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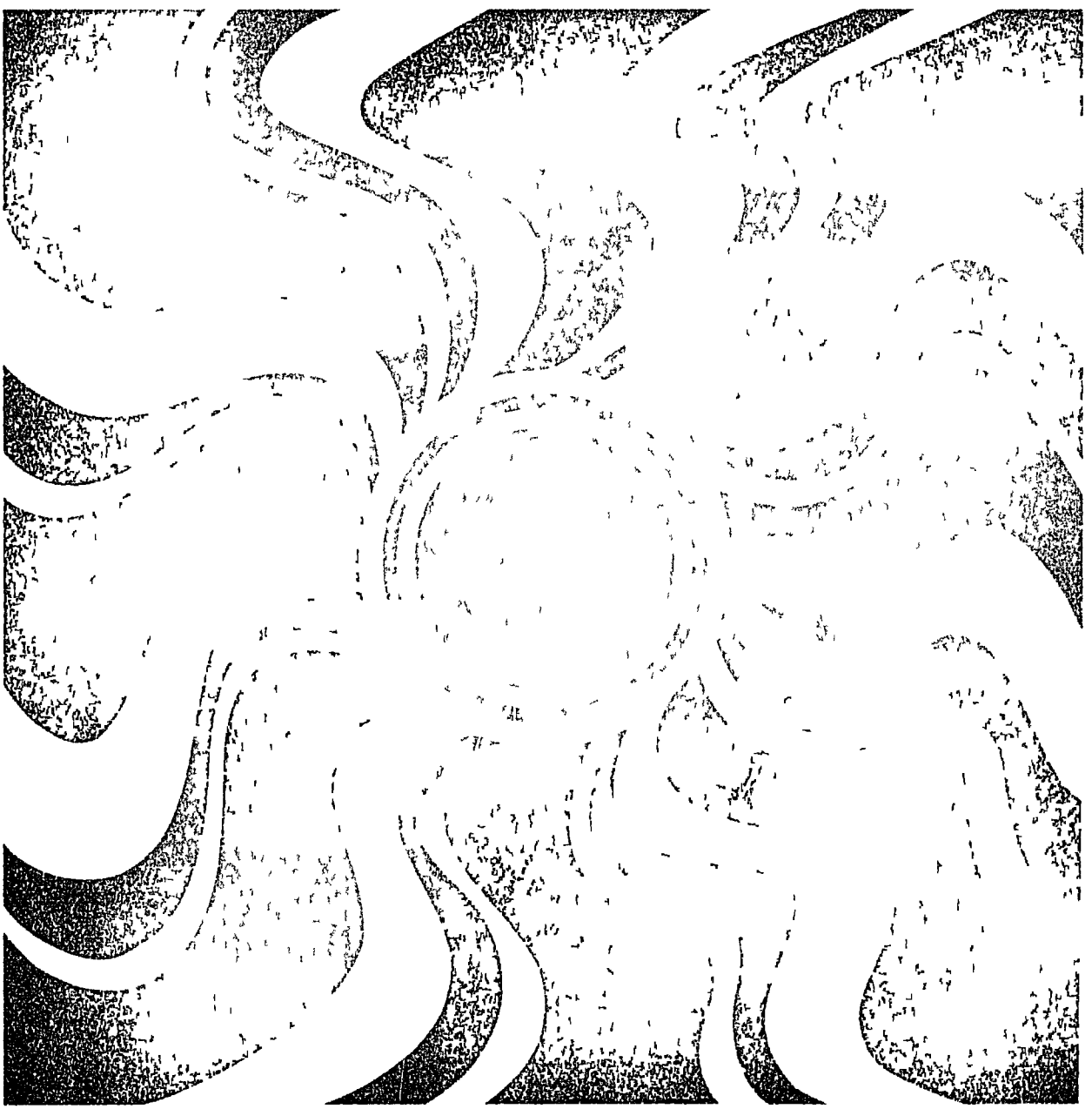

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By the

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FOREWORD

Nutrition of Rice is the second in a series of bibliographies being prepared on basic food crops *Nutrition of Maize* was published in mid 1971 and *Nutrition of Wheat* is under preparation The bibliographies are being prepared at the request and with the financial support of the Agency for International Development A basic goal is to make available to AID technicians and those trained under AID sponsored programs the most recent literature published on these food crops, particularly in regions where library facilities are limited or absent

Nutrition of Rice contains many of the most important articles written on the subject in the past 5 years The short abstract included with each title should enable the researcher to decide whether the article is relevant to his interests All references in this bibliography were selected from primary or secondary sources in the Technical Library of the NFDC The complete text of most articles is on file in the NFDC Technical Library

The bibliography itself is arranged into sections according to geographic regions suggested by the *Worldmark Encyclopedia of Nations* 3rd ed (Harper & Row, New York, 1967) Within sections, abstracts are arranged alphabetically by country in which the work was done or, if unknown, the country in which the work was published

Nutrition of Rice would not have been possible without the cooperation and assistance of many individuals and organizations Several institutions were particularly helpful in furnishing information and in permitting use of abstracts from their publications They and their identifying notations are

1 The Commonwealth Agricultural Bureaux (Publishers of *Soils & Fertilizers*, shown as SF, and *Field Crop Abstracts*, shown as FCA)
2 Chemical Abstracts Service (shown as CA)
3 Royal Tropical Institute, Amsterdam (shown as Trop Abst)
4 Dissertation Abstracts International (shown as Diss Abstr)

Other abstracts were taken from TVA's *Fertilizer Abstracts* (shown as FA)

Most of the title entries (without abstracts) were taken from the International Rice Research Institute's (Los Banos, Philippines) *Bibliography on Rice Research* and supplements Also, special appreciation is in order to AID for the financial support that helped insure the success of this project

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AFRICA

GHANA

1 Halm, A T 1969 *The Effect of Soil Submergence Duration on Rice Grown in a Forest Zone Sandy Loam* Ghana J Agr Sci 2 25 9 (Eng) (Soil Res Inst , Kumasi)

The soil was submerged for periods of 10 30 days Duration of submergence markedly affected yields of two varieties of upland and lowland rice and had a significant effect on the NPK contents of tissues, submergence for 20 and 30 days produced the highest stem weight, grain yield, and NPK content in the upland variety (Mendii) and lowland variety (C 21), respectively (SF 32 4017)

2 Halm A T 1967 *Effect of Water Regime on the Growth and Chemical Composition of Two Rice Varieties* Trop Agr 44(1) 33 7 (Eng)

In Ghana plants of the upland rice variety Saka and of the swamp variety D 52 37 were grown in pots filled with a clay loam soil from a rice field Water regimes compared were soil held at field capacity, saturated and submerged to a depth of 8 cm Aerial parts of the plants were harvested at panicle emergence In both varieties, dry matter production decreased in the order submerged–saturated–dry, the difference between the two first treatments was small P contents decreased and N and K contents increased in the same order Consequently N and K uptake was but little affected by the water regime, whereas P uptake was significantly lower under dry conditions than under saturated or submerged conditions (Trop Abstr 22 661)

MADAGASCAR

3 Celton, J Velly, J 1966 *Influence of Fertilizing the Nursery and the Rice Field on the Paddy Yield of the Rice Field* Agron Trop 21(10) 1111 117 (Fr)

Experiments conducted near Tananarive, Madagascar, in 2 successive years showed that NPK fertilizing of rice nurseries resulted in vigorous seedlings with a dry weight considerably higher than that of plants from nonfertilized seed beds Fertilizing of the nursery, however, influenced neither the number of fertile tillers nor the yield of the crop which are both determined by the fertility of the field Fertilizing the field with NPK gave significant increase of both tillering and yield (Trop Abstr 22 889)

4 Chabrolin, R 1967 *Use of Fertilizers in Rice Fields of Madagascar* Agron Trop 22(4) 387 405 (Fr)

The fertility of most rice soils in Madagascar is rather low Though fertilizers are expensive, a series of trials have shown that their application can be remunerative Recommendations issued for each region so far are based on moderate doses Research is now directed towards the realization of the full potential of the soils through the application of more massive doses This requires a basal dressing with P, if necessary combined with Ca and/or Mg, and in some cases of minor nutrient elements, and annual applications of N and K Nutrient requirements for such a program have been calculated, and methods are discussed of assessing the profitability of fertilizer applications at various price levels of the product (Trop Abstr 22 1993)

5 Roche P , Dufournet R Rabetzano A 1964 *Problems Relating to the Use of Mineral Fertilizers on the Highlands of Madagascar Province of Tananarive* Agron Trop 19 285 317 (Fr) (Inst Rech Agron Trop)

The rates recommended per ha for rice are 30 kg N, 50 kg P_2O_5, and 45 kg K_2O annually for organic hydromorphic soils or gley peats and 30 kg N, 62 5 kg P_2O_5, 30 kg K_2O, for the first year on hydromorphic alluvial soils (spotted soils), with 25 kg P_2O_5 instead of 62 5 kg the following years (SF 27 3790)

6 Velly, J 1969 *Effect of Various Depths of Placement of Nitrogen on the Uptake of Nitrogen and Phosphorus by Rice, Studied by the Use of the Isotopes N^{15} and P^{32}* Agron Trop 24(10) 901 5 (Fr)

In Madagascar the effect of placement at different depths of ammonium sulfate on the uptake of N and P by irrigated rice was studied Superphosphate was applied on the surface at transplanting The trial indicated that wherever possible ammonium sulfate can be applied best at a depth of at least 5 cm, and possibly 10 cm Uptake of P was not affected by placement of ammonium sulfate, however, deep placement of N appears to give the best P absorption (Trop Abstr 25 2357)

7 Velly, J 1967 *Influence of Placement of Nitrogen and Phosphorus in a Rice Field on Their Absorption, Studied with the Aid of the ^{15}N and ^{32}P Isotopes* Agron Trop 22(4) 364 76 (Fr)

Plots of flooded rice in Madagascar at transplanting received 60 kg K_2O 60 kg P_2O_5, and 60 kg N/ha, the N and P fertilizers being applied in various ways Labeled N and P fertilizers were used on part of each plot An analysis of growth factors yields, and uptake of N and P from the fertilizers indicated that incorporation of fertilizers into the top 5 cm of the soil was more effective than surface application, and that application to the rows was more effective than broadcasting Mixing the fertilizers before their application increased uptake of P from P fertilizer reduced uptake of N from N fertilizer and had but little effect on grain yield (Trop Abstr 22 1995)

8 Velly, J 1969 *Prospects of Improvements in Intensive Rice Culture in Madagascar* Agron Trop 24(8) 670 72 (Fr)

For most of the rice fields of this area 200 400 kg of P_2O_5/ha was sufficient to eliminate the serious prevalent P deficiency K deficiencies were much less serious and frequent than P deficiencies Once the P and K deficiencies were corrected, it was possible to take advantage of high applications of N (chiefly when using high responsive varieties from Taiwan) and obtain yields of 6000 8000 kg/ha It was concluded that, with a good initial application of P, and in a few cases, K, a subsequent annual dressing of about 120 150 kg N, 60 80 kg of P_2O_5, and 90 120 kg of K_2O/ha, would

make possible consistent high yields of rice in the Plateau area of Madagascar In the main rice growing areas of Madagascar, on very different types of soils (ranging from peat to sandy soils) and from about 4000 ft to sea level the only deficiency was P, which could be cured by 200 300 kg of P_2O_5/ha In all places very good yields (6000 7000 lb/acre) were obtained Several experiments involving two crops of rice a year, and sometimes three, were undertaken, which indicate that multiple cropping may be feasible in some areas

9 Velly, J 1970 *Use of Potash Fertilizers in Rice Fields* Agron Trop 25(1) 13 27 (Fr) (Inst Rech Agron Trop, Univ Paris)

Trials were carried out from 1961 to 1968 to show what happens in the rice fields in Madagascar with different types of fertilizing and the following various types of soils mahitsy, hydromorphic soils temporarily completely waterlogged (spotted humic soils) ambatobe spotted clay hydromorphic alluvium (characteristic of the rice fields on the High Plateau) ivoloina mineral hydromorphic deep gley soil The first experiments with low NPK rates showed good response to potash but when the rates of N and P_2O_5 were high the K response was low or nonexistent N and P allow a better use of the inorganic or organic reserves of K in the soil until the K content of the straw was <1% only then was a yield decrease found (after 2 or 3 years) It does not appear possible to practice potash basal dressing in rice fields (in contrast to P_2O_5) The potash reserves of soils can be exhausted very rapidly so it is necessary to manage to make up rapidly wholly or partly for the removal of potash from the plant in taking into account the amount lost by leaching and provided annually by the soil Rice straw manuring makes up for the removed element to a great extent But where the straw is removed a good crop currently depletes as much as 150 200 kg K_2O/ha (CA 73 97965m)

10 Velly J Latrille E 1967 *Effect of Time of Application and Nitrogen Rate on the Efficiency of Nitrogen and Phosphorus in Rice Fields* Agron Trop 22 351 63 (Fr) (Inst Rech Agron)

On the hydromorphic soil containing 4 62% organic C, 0 463% total N, and 29 6 ppm available P_2O_5 (Bray No 2) in the 0 20 cm layer N increased tillering and ear number in rice plants and not significantly decreased ear weight and thousand grain weight Yields of grain and straw increased with increasing amounts of N, irrespective of time of application, 1 kg N applied (up to 120 kg) producing 16 04 kg dry matter Split N applications affected N but not P nutrition Highest N uptake occurred when N was given in a single application 2 weeks before ear formation (SF 30 3811)

MAURITIUS

11 Chaudhry, M S 1969 *Rice Cultivation* Rev Agr Sucr Ile Maurice 48(1) 27 38 (Fr)

The following basic aspects of future rice production in Mauritius are discussed (1) climatic conditions and kind of soil, (2) variety selection, and (3) system of rice growing, dealing with the various problems of both transplanted and direct sown crops Water management, manuring, and fertilizing, plant protection against various diseases and pests, and harvesting are treated as well (Trop Abstr 25 1317)

MOZAMBIQUE

12 Silva, R 1968 *The Use of Fertilizers in Growing Rice in Mozambique* Gaz Agr, 20(229) 162 63 (Port)

The lack of response of fertilizer applications to the local varieties in Mozambique led formerly to the conclusion that the rice fields were supplied sufficiently with plant nutrients from irrigation water However imported varieties such as Bluebonnet Rexoro, and Belle Patna responded positively to N and P fertilizers applied under the furrow Bluebonnet treated with a 84 126 0 fertilizer compound yielded 1006 kg/ha more than the untreated plots showing the use of fertilizers to be a profitable practice In view of the tendency for lodging and the long vegetative cycle of the local varieties, the new erect varieties with a shorter vegetative cycle will be preferred under the system of mechanized irrigated rice growing, which has been introduced with success (Trop Abstr 24 791)

NIGERIA

13 Bredero, T J 1966 *Fertilizer Responses in Swamp Rice (Oryza sativa" L) in Northern Nigeria* Exp Agr 2 33 43 (Eng) (Rice Res Sta Badeggi via Minna)

Irrigated rice on alluvial soils showed small increases with medium dressings of P and large responses to heavy dressings of N Responses to N showed considerable variations between soil types due to different cation exchange capacities, resulting in NH_4 leaching from the root zone and between years, due to different physiological timings of the topdressings Recovery of N was about 18% on clay "basin" soils, and averaged only 9% on sandy 'levee soils Recovery of P varied from good (14%) at medium levels of N to moderate (9%) at moderately high levels of N on basin soils, P recovery on levee soils was poor The utilization of recovered N (75 lb paddy/lb N) and P (42 lb paddy/lb P_2O_5) was very good for N and fair for P (SF 29 2095)

14 Lnyi B A C 1968 *Comparative Studies of Upland and Swamp Rice Varieties (Oryza sativa) I II Effect of Varying Supply of Manganese on Growth and Yield* J Agr Sci 71(1) 15 17 (Eng) (Univ Nigeria Nsukka)

Upland rice (Agbede) and swamp rice (BG 79) varieties grown on flooded soil and on soil maintained at 80% and 100% moisture saturation were sprayed with solutions containing 0 (M 0) 10 (M 1), and 20 (M 2) ppm of Mn The M 2 treatment depressed total dry weight and dry weight of leaf laminae, stems leaf sheaths, and root of both varieties grown on soil maintained at either 80% or 100% moisture saturation The M 1 treatment increased the ear weight of Agbede grown on soil maintained at either 80% or 100% moisture saturation while the M 2 treatment increased the ear weight of plants grown on saturated soil In flooded soil both the M 1 and M 2 treatment increased ear dry weight of BG 79 The ear weight of Agbede plants receiving M 0 and M 1 treatment decreased with increasing soil moisture while that of BG 79 increased It

is considered that Mn supply limits yield of Agbede grain grown on flooded soil (FA 1 1507)

15 Enyi, B A C 1967 *The Effect of Nitrogen and Phosphorus on Nutrient Uptake in Two Varieties of Rice* Nigerian J Sci 1(2) 185 203 (Eng)

Rice cv (a) Tinkinga and (b) Black Faddy were grown in polythene lined excavations (4 2 x 4 2 m) filled with local soil and kept flooded to a depth of 5 cm, the soil was dressed with 100 or 300 lb ammonium sulfate/acre with 80 or 240 lb superphosphate/acre The contents of K, Ca, Mn, Zn, and Mo were higher in plants of (a) than of (b), but the reverse was observed for N, Cu and B The higher level of N increased the accumulation of N, Ca, Na, B, and Mo in the plants, and the higher level of P increased the accumulation of P, K, Ca, Na, Mg, B, Cu, Mn, Zn, and Mo (FA 2 554)

16 Enyi, B A C 1966 *The Effect of Nursery and Field Fertilization on the Growth and Yield of Rice Variety BG 79* Ghana J Sci 6(1 2) 41 51 (Eng)

The effect of NPK fertilizing in the nursery and in the field on the growth and yield of the rice variety BG 79, when transplanted at an age of 30 or 60 days, was studied in Nigeria Fertilizing in the nursery and in the field, and early transplanting, had a favorable effect on tillering (number of shoots formed), growth (height and total dry matter production), and yield of ear and grain The favorable effect of nursery fertilizing on grain yield was mainly due to an increase in dry weight per shoot, and much less to an increase in shoots formed, while it only manifested itself when the rice was also fertilized in the field and was transplanted early The possible mechanisms of the yield increases brought about by these treatments are discussed (Trop Abstr 22 1786)

17 Enyi, B A C 1965 *Effect of Soil Moisture, Nitrogen, and Phosphorus Supply on Nutrient Concentration and Accumulation in an Upland Rice Plant* Curr Sci 34(8) 249 51 (Eng)

In East Nigeria rice plants of the upland variety Agbede were grown in pots filled with a poor sandy clay soil to which different amounts of N and P fertilizers had been added, half of the pots in each fertilizer treatment were flooded Mean dry weights per mature plant were 197 g in the nonflooded pots and 85 g in the flooded pots Flooding, and increases in the doses of N and P fertilizers, increased the levels of almost all nutrients in the plants, but on account of the reduction in plant weight caused by flooding the total amount per plant of each nutrient was higher in the nonflooded pots Flooding reduced the uptake of Mg and Mn more than that of the other nutrients, this suggests that adverse effects on the yield of upland rice fields caused by flooding may be due to Mn and Mg deficiency (Trop Abstr 20 1959)

18 Enyi, B A C 1964 *Effect of Varying Phosphorus and Water Supply on Growth and Yield of an Upland Rice Variety ("Oryza sativa ' I)* Trop Agr 41 47 53 (Eng) (Univ Nigeria, Nsukka)

On sandy clay soil with pH brought to 6 0 by liming, waterlogging in pot experiments had no effect on tillering but increasing P supply increased tiller number Increasing the P supply increased total leaf number at tillering and at the early reproductive phase Waterlogged plants had greater grain weight and grain weight as percentage of straw weight than dry soil plants Increasing the P supply increased the grain weight and the grain to straw weight ratio (SF 27 1788)

19 Enyi, B A C 1964 *Note on the Effect of Fertilizers and Soil Cover on Submerged Pregerminated Rice Seeds* Emp J Exp Agr 32 92 6 (Eng) (Univ Nigeria Nsukka)

In pot tests establishment viability dry weight, and tillering of plants were adversely affected by covering the seed with ¼ in of soil The effect of soil cover was less when no fertilizer or only KCl was applied than when $(NH_4)_2SO_4$ and super were applied Super had a favorable effect on early tillering and the effect was enhanced by N (SF 27 1785)

20 Enyi, B A C 1964 *Note on the Effect of Levels of Potassium and Nitrogen Supply on the Growth of an Upland Rice Variety* Emp J Exp Agr 32(127) 228 30 (Eng)

Results are presented of a pot experiment with an upland rice variety conducted at Nsukka in Nigeria in which the effects of two levels of potassium sulfate and three levels of ammonium sulfate were compared The higher level of K application was found to depress the plant height at harvest but to hasten ear emergence Higher levels of N resulted in the formation of more tillers and increased yields of grain and straw It was concluded that K application is not essential (Trop Abstr 20 30)

21 Enyi, B A C 1964 *Note on the Effect of Split Application of Ammonium Sulfate on the Growth and Yield of Rice* Emp J Exp Agr 32 175 78 (Eng) (Univ Nigeria, Nsukka)

Plants, of swamp rice variety BG 79, receiving $(NH_4)_2SO_4$ in three doses, at planting, in the mid vegetative stage and during the early reproductive stage had more panicle bearing shoots, greater straw and grain dry weight, greater straw/root ratio, and lower root dry weight than those grown with the same total amount of $(NH_4)_2SO_4$ given in two doses or one Applied early in the reproductive stage $(NH_4)_2SO_4$ increased the height of the plant and hastened ear emergence Applied at the mid vegetative stage $(NH_4)_2SO_4$ delayed the maturation of the plant (SF 27 3098)

22 Enyi, B A C 1966 *Nutrient Composition of Upland and Swamp Rice Varieties* Ghana J Sci 6(3 4) 87 91 (Eng) (Univ Nigeria, Nsukka)

In a pot trial the effects of N and P levels on the content of various nutrients were studied in (a) swamp rice cv BG 79 grown in flooded soil and (b) upland cv Agbede grown in soil at 80% of field moisture capacity In (a) high N rates increased the contents and total amounts of N, P K, Ca, Mg, Cu, Zn, and Mo in mature rice plants more than did low N rates, high rates of P increased contents of P, Ca, Cu, Zn and Mo In (b) high N rates increased the contents of N and Na, but decreased those of K, P Mg Mn, Cu B, and Mo more than did low rates of N Total amounts of these nutrients per plant were, however increased High rates of fertilizer P increased the contents of P, Na and Ca, and Zn more than did low rates of P In another trial the swamp cv BG 79 was grown in pots with (a) flooded soil, and (b) in soil at 80% of soil moisture capacity Contents of N and Na in (a) were higher than in (b),

whereas the reverse was observed for K, Mn, Cu, and Zn (FCA 23 329)

23 Enyi, B A C 1965 *Soil Moisture as a Factor Influencing the Degree of Response of an Upland Rice Plant to Increasing Supply of Nitrogen and Phosphorus* J Agr Sci 64 15 18 (Eng) (Univ Nigeria, Nsukka)

In rice grown on sandy clay (adjusted to pH 6) in pots kept in the open, shoot and leaf number, leaf area, dry weight of grain, and root growth were greater under dry than flooded conditions irrespective of the N and P supply The increase in shoot number and various yield components with increasing N supply from 1 5 to 4 5 g $(NH_4)_2SO_4$/11 kg soil, was greater under dry than flooded conditions The lower efficiency of N under flooded condition may be associated with a greater N absorption in dry soil, reduction of NO_3, and loss of gaseous N in flooded soil, and/or impaired N absorption due to lack of aeration under flooding (SF 28 2754)

24 Waterworth, J V 1967 *Floating Rice NPK Fertilizer Trial, 1965* Nigeria Midwest Reg Min Agr Natur Resources Exp Rep 91, 3 pp (Eng)

In contrast to the 1964 fertilizer trial, no yield increase resulted from the application of NPK to floating rice (variety Mahiong) in 1965 Earlier planting and flooding apparently affected the results

REPUBLIC OF SOUTH AFRICA

25 Wolf, E, Visser J H, LeRoux, F H 1969 *Fertilization of Rice in the Eastern Transvaal Lowveld* Fert Soc S Afr J 2 6 9 (Eng)

Rice of the indica type has been grown under irrigation in the Transvaal Lowveld It has been found with P nutrition kept at a constant level, that high N and high K levels produce significantly higher yields than lower levels of N and K Three split applications of N are superior to two or a single application at planting

SENEGAL

26 Couey, M, Bloc, D, Ehemba, T 1968 *Intensification of Rice Production at Richard Toll (2nd Study)* Agron Trop 23(10) 1049 53 (Fr)

The results of trials in 1967 68 showed that for growing two crops of rice at Richard Toll Senegal by the transplanting method, the best varieties were D 9 9 grown in the rainy season, followed by Taichung Native 1 in the dry season, with direct sowing the best cv were Paugern followed by Taichung Native 1 or D 52/37 N should be applied at 150 200 kg/ha at tillering in the dry season (FCA 22 1885)

SIERRA LEONE

27 Anon 1966 *Rice Fertilizer Trials in Sierra Leone* Ann Rep of the W Afr Rice Res Sta 1964 65 39 42 (Eng)

In Sierra Leone, four fertilizer trials with upland rice showed a good response to 125 kg sulfate of ammonia (SA) per ha, though the soils were poor in P the crop did not respond to 125 kg superphosphate (SP) per ha probably because sufficient P was obtained from burned fallow vegetation No differences in yield were observed as the result of various times of SA application On riverain plain soils responses were obtained to SP and to lime, not to SA or K_2SO_4, no significant interactions were observed Responses to P decreased when SP was applied more than 4 weeks after sowing A trial on new mangrove land subject to tidal flooding during the whole year showed a high response to 187 kg SP/ha, whereas yields were depressed by 187 kg SA/ha either alone or with SP On similar land subject to flooding during the dry season only, yields were very low, they were depressed by SA, not affected by SP, considerably improved by SA + SP (Trop Abstr 22 662)

28 Carpenter, A J 1968 *Rice Growing in Sierra Leone* Agri Digest, No 15 34 44 (Eng)

Rice farming in Sierra Leone occurs under several conditions upland, coastal mangrove swamps, deep and shallow flooded grasslands and inland swamps The boli soils used for upland rice and the inland swamps respond to P fertilizers Normal superphosphate commonly is used but basic slag would be cheaper and would provide Ca which is needed also Few consistently profitable responses to N have been shown This seems to be due to difficulty in applying fertilizer so that N will be absorbed by the plant rather than oxidized to gaseous N or leached away in the heavy rains and flood water Development of improved varieties requires that more fertilizer research be conducted (FA 2 724)

29 Das Gupta, D K 1969 *The Response of Rice Varieties to Applied Nitrogen Under Swamp Cultivation in Sierra Leone I Wet Season* Trop Agr 46 311 23 (Eng) (Njala Univ Coll)

In a field experiment with two contrasting swamp rice varieties, N fertilizers increased dry matter, leaf area indices, number of tillers, number of panicle bearing tillers, grain yield and crop growth rate, and plant weight after panicle emergence Yield response to N and total N content differed with variety Depending on the maturation period and rate of uptake and recovery of N, it was advised that the fertilizer should be added in two or three split dressings depending on variety (SF 33 1539)

30 Enyi, B A C 1969 *Effect of Varying Supply of Nitrogen and Phosphorus on Growth and Nutrient Uptake in Upland and Swampy Rice Varieties Under 'Dry' Soil Conditions* Indian J Agr Sci 39 180 95 (Eng) (Njala Univ Coll)

Growth and yield of upland rice (Agbede variety) increased with increasing application of $(NH_4)_2SO_4$, whereas P had little or no effect, growth of swamp rice (BG 79 variety) increased with increasing application of $CaH_4(PO_4)_2H_2O$, but increasing N increased the growth and yield only of plants that received high levels of P

UNITED ARAB REPUBLIC

31 Abdel Hak, T, Ashour, W A, Ayad, M R, Fahmy, I, Risk, K I 1966 *Influence of Nitrogen, Phosphorus, and Potash Fertilizers on the Incidence of Rice Blast in U A R*

Tech Bull Cereal Diseases, Res Div 11 17 43 52 (Eng)

Some of the major factors affecting the development of rice blast under field conditions are the climatic situation, soil moisture, and soil fertility A study on the relationship between N, P, and potash supply and rice blast disease, conducted in Egypt, showed that high doses of ammonium sulfate significantly increased the percentage of both foliar and neck infection, superphosphate had no apparent influence on the percentage of infection, while potassium sulfate seemed to decrease blast infection Different levels of P and K combined with N increased the infection significantly (Trop Abstr 23 1389)

32 El Nawawy, A S, Ibrahim, A N, Aboul Fadl, M 1968 *Nitrogen Fixation by Calothrix Species, as Influenced by Certain Sodium Salts and Nitrogen Compounds* Acta Agron (Budapest) 17(3-4) 323 27 (Eng) (Alazhar Univ, Cairo)

The effect of NaCl, Na_2S, $(NH_4)_2SO_4$, KNO_3, and asparagine on N fixation by *Calothrix* species (a blue green alga associated with rice cultivation) was studied N fixation was inhibited at $\geq$3393 5 ppm NaCl, 795 ppm Na_2S (no growth occurred at 1 $\geq$3180 ppm Na_2S), and at both concentrations (21 and 105 ppm) of each of the N compou ds, but presence of organic N in the filtrate was not determined Under field conditions the surface dwelling alga may avoid the inhibiting salt concentrations The soil could be inoculated at transplanting and only half the N fertilizer added then, and the remainder in 3-4 weeks to avoid injury to the alga (CA 69 66513a)

33 Abdel Samie, M, Eid, M T, El Damaty, H, Hamdi, H 1968 *Use of A Value (Soil Phosphorus Supply) Concept for Determining Relative Efficiencies of Some Phosphate Fertilizers* J Soil Sci U A R 8(2) 73 86 (Eng) (Plant Nutr Sect Min Agr)

Superphosphate was superior to basic slag and rock phosphate as a nutrient for rice grown on sandy and clayey soils of the U A R Rice plants could obtain P from $CaHPO_4$ and basic slag Rock phosphate had very little effect on rice production (CA 70 114259s)

34 Hamadi, H, El Damaty, A H, El Baradi, T A 1964 *Ammonium Sulfate Fertilizer Placement for Rice* Ann Agr Sci 6 101 5 (Eng)

The rice yield resulting from $(NH_4)_2SO_4$ broadcast and disked into the soil before transplanting was greater than the yield from $(NH_4)_2SO_4$ applied on the soil surface 15 days after transplanting There were no significant yield differences due to the residual effect of different forms and amounts of P fertilizer (SF 29 4337)

35 Nada, I A, Moursi, M A, Abd El Gawad, A A 1967 *Nitrogen Metabolism in Rice Plants III Effect of Nitrogen on the Nitrogen Metabolism in the Different Parts of Rice Plants* Ann Agr Sci 9(2) 273 87 (Eng) (Ain Shams Univ, Cairo)

The total N % in low and high blades and in the high and low parts of stems + sheaths, and the absolute amount of N in the blades increased with the increase in N supply to plants The carbohydrates associated with N in the tissues of the plant decreased with increase in N supply There exists a positive correlation between the amide N % in both the high and low blades and the amount of N applied to plants (CA 70 76834r)

36 Taha, S M, Zayed, M N, Zohdy, L 1968 *Bacteriological and Chemical Studies in Rice Straw Compost III Effect of Ammoniacal Nitrogen* Zentralbl Bakteriol, Parasitenk, Infektionskr, Hyg, Abt II 122(5) 500 9 (Ger) (Soil Microbiol Unit, Nat Res Centre Dokki, Cairo)

The proper amounts of ammonia N to add in composting rice straw were determined Straw in glass jars was incubated with 0 35%, 0 7%, and 1 0% N for 1 120 days at 30 60° The important specific groups of bacteria were determined and their numbers related to oven dry weight The highest rate of multiplication of mesophilic and thermophilic bacteria and of actinomycetes occurred at the 0 7% concentration of N On the contrary, cellulose decomposers N fixers, and fungi were unaffected by the level of N Speed of decomposition measured by loss of C and increased percentage of ash, was most rapid at the 0 7% level The highest rate of decomposition took place, in all composts, during the high temperature stage in the early days of composting Although no great change occurred in the actual amounts of N, the percentage of total N increased, there was a possibility of N fixation Despite the above, 0 3% ammonia N was recommended from the economic point of view (CA 70 36705t)

NORTH AMERICA

COSTA RICA

37 Brown, F B 1969 *Upland Rice in Latin America* Int Rice Comm Newsl 18(1) 1 5 (Eng)

Soil nutrients are lost faster under upland conditions than under flooded conditions In Costa Rica the addition of 75 kg/ha N has increased yields by 45% The effect of N is equally striking elsewhere in Latin America

38 Cordero, A 1967 *Late Application of Nitrogen on Rice of the Variety S M L Tapuripa (S M L 140/5)* Central American Cooperative Program for the Improvement of Food Crops, 13th Meeting, San Jose, Costa Rica, Feb 28 Mar 4, 1967, 74 5 (Sp)

N was applied at the rate of 50 kg/ha at 40, 55 85, and 100 days after seeding Best results were obtained with application 55 days after sowing No benefit resulted from application at 100 days

39 Cordero, A 1967 *Response of Rice to Ammonium*

Sulfate in Four Differently Soluble Carriers Central American Cooperative Program for the Improvement of Food Crops, 13th Meeting, San Jose, Costa Rica, Feb 28 Mar 4, 1967, 68 74 (Sp)

Ammonium sulfate was coated with three different emulsions of asphalt and paraffin, such that leaching time for 75% of the N was 300, 1500, and 3500 hours A basal dressing of 80 kg/ha P was applied before seeding N was applied 6 days after seeding Yield increased linearly with rate of N independent of source, except with commercial $(NH_4)_2SO_4$, where amounts over 78 9 kg/ha diminished yield because of increased fungus disease There were no significant differences in moisture in grain or protein content of grain

DOMINICAN REPUBLIC

40 Shu, Y P 1965 *The Effect of Nitrogen and Phosphorus on Rice Production in Dominican Republic* J Agr Assn China No 51 47 60 (Chin) (Chi Natn Taiwan Univ)

A split plot experiment with 15 NP treatments and 5 cv was carried out in the Dominican Republic in 1964 Chianung 242 gave the best response and the highest yield, 46 5%-56 5% above the control cv Tono Brea Yield responses of the other cv were Bluebonnet 50 4 1%-23 0%, Palmyra, 7 4%-23 4%, Fidelia 15%, Redmedjah (replacing Fidelia in the second crop), 6 6% (FCA 20 987)

MEXICO

41 Anon 1968 *Fertilization of Rice in the Fuerte Valley* Circular CIAS No 25, 15 pp (Sp) (Instituto Nacional de Investigaciones Agricolas, S A G, Centro de Investigaciones Agricolas de Sinola)

Highest yields, 4 9 5 tons/ha, resulted from urea or ammonium sulfate applied 40 kg/ha at seeding and 40 kg/ha when the plants were 40 days and 70 days old There was a positive response to superphosphate only on soils deficient in P

42 Jarero Z, M, Ortega T, E 1968 *Rice Fertilization in the Rio Fuerte Valley* Agr Tec Mex 2(8) 370 73 (Sp)

Fertilization of rice in the Rio Fuerte valley of Sinaloa, Mexico, was more effective if carried out over a period of 70 days, rather than at seeding, or in a 40 day period Best results (5 tons/ha yield) were given by application of 40 kg P/ha at seeding, 80 kg N/ha after 40 days, and 40 kg N/ha after 70 days NH_3 was superior to NO_3 as a source of N (CA 72 54199b)

TRINIDAD

43 Ahmad, H, Whiteman, P T S 1969 *Comparison of Sulfate of Ammonia and Slow Release Nitrogen Fertilizers for Rice in Trinidad* Agron J 61 730 34 (Eng) (W Indies Univ, St Augustine)

On a River Estate loam of pH 5 0 (CLC and exchangeable Ca, Mg, and K–9, 4 1 1 2, and 0 05 meq/100 g, respectively) two slow release pelleted N fertilizers (EAP 3033 and EAP 3032) were compared with $(NH_4)_2SO_4$ as N sources for rice (variety 'Bluebelle") All N treatments were applied at rates of 70 kg/ha at transplanting EAP 3033 produced yield response of 2920 kg/ha, EAP 3032 produced one of 2060 kg/ha, and $(NH_4)_2SO_4$ 1195 kg/ha Plants treated with $(NH_4)_2SO_4$ had absorbed all of their N when they had accumulated only 50% of their final dry weight, at the same stage plants treated with slow release materials had absorbed only half their final N content (SF 33 1542)

44 Ahmad, N 1967 *Seasonal Changes and Availability of Phosphorus in Swamprice Soils of North Trinidad* Trop Agr 44(1) 21 32 (Eng)

Fluctuations in the contents of various forms of inorganic P in the top 15 cm layer of four rice soils in the Caroni basin of Trinidad were studied during a whole yearly cycle of flooded and dry conditions The two older soils investigated had less than 3% organic matter, two young soils contained over 5% organic matter Iron phosphates constituted over 50% of all inorganic P compounds in all soils Contents of Al phosphate, alkali soluble Fe phosphate and occluded Fe and Al phosphates showed sharp maxima at various times after submergence had started, the fluctuations increased with the organic matter contents of the soils Among four extraction methods tested, Olsen's method gave the best estimate of available P as expressed by levels of P uptake by the rice plants (Trop Abstr 22 655)

UNITED STATES

45 Anon 1968 *How to Make the Most of Nitrogen in Paddy* World Farming 10(2) 12 13 (Eng)

Experiments conducted in Louisiana showed that the highest rice yields were obtained when N was applied in ammonium form and placed in the soil before sowing Ammonium sulfate (AS), urea, resin coated AS, resin coated urea, placed 7 6 10 2 cm deep in the soil before sowing produced 5600 5470, 5580, and 5510 kg/ha, whereas the unfertilized control gave 3510 kg/ha The same fertilizers topdressed produced 5050, 5150, 5055, and 5200 kg/ha, respectively (Trop Abstr 24 2448)

46 Anon 1969 *Timing and Method of Fertilizer Application Equally Important as Quantity Used* Rice J 72(1) 14, 16 (Eng)

Experiments showed that sunlight determines the optimum amount of N for rice production At least a portion of N should be applied near sowing date, with the remainder applied prior to the reproductive stage, 55 60 days before harvesting To determine the optimum fertilizer amount, data of soil tests are needed in first instance, together with information on date of sowing, past cropping systems, length of rotation, yield potential, previous fertilizer applications, and observations during the growing season Bluebelle sown late March should be fertilized at a rate exceeding 50% the amount recommended by the soil test, and when sown in June the rate should be less than 50% of the recommended amount (Trop Abstr 24 2201)

47 Banerjee, S K 1965 *The Yield Response of Rice in*

Relation to Applied Phosphorus Fertilizer and Soil Test Values of Three Different Soil Types in Texas Diss Abstr 26(1) 13 (Eng) (Texas A & M Univ, College Station)

Three soil types (Beaumont clay, Bernard clay loam, and Lufkin fine sandy loam), varying in pH and clay content and each having very low extractable P, were selected for the study and rice varieties Century Patna 231 and Belle Patna were used No significant effect of the increase in rate of fertilizer application could be observed on the yield of grain and straw Additional application of 40 lb of P 1 week prior to seeding also failed to show any significant effect on grain and straw yield of rice A lack of response of grain and straw yield to the different rates of application of fertilizers, as shown by the analysis of variance, further suggested the study of the minor elements like Zn and Mn, submerged condition of the soil and weather factors such as temperature, humidity, and rainfall (CA 63 15494f)

48 Broadbent, F E, Mikkelsen, D S 1968 *Influence of Placement on Uptake of Tagged Nitrogen by Rice* Agron J 60(6) 674 77 (Eng) (Univ California, Davis)

The placement of two ^{15}N tagged fertilizer sources applied to lowland rice was studied to determine the effects on yield components, fertilizer N uptake, and the residual N present after cropping Tiller number and bearing tillers were increased by fertilization, but the source and placement had no effect Grain yield was increased by N fertilization with ammonium sulfate and urea but was not affected by source Broadcast applications gave lower yields than other treatments while the highest yields were obtained with half the N placed in the soil and the balance topdressed Fertilizer N in the Y leaf and total plant uptake showed the superiority of banding with variations in total N uptake varying from 25% to 47% Ammonium sulfate provided a larger increment of N to grain production than urea and also showed a lower magnitude of N loss from the soil plant system (FA 2 227)

49 Cherian, E C, Paulsen, G M, Murphy, L S 1968 *Nutrient Uptake by Lowland Rice Under Flooded and Nonflooded Soil Conditions* Agron J 60(5) 554 57 (Eng) (Kansas Agr Exp Sta, Manhattan)

Lowland rice (*Oryzea sativa* L) produced more foliage and usually adsorbed more P and Mn from flooded soil than from nonflooded soil Flooding, however, decreased the contents of Ca and Mg, and frequently the contents of K and Zn, in rice foliage The responses of Fe and Cu contents of rice foliage to flooding varied P fertilization increased the growth of rice and caused similar levels of P to accumulate in the foliage under flooded and nonflooded conditions Superphosphate and liquid ammonium polyphosphate were more effective sources than solid ammonium polyphosphate under flooded conditions, but there was little difference among sources under nonflooded conditions The highest P rate (100 ppm) produced most rice growth under flooded conditions while, under nonflooded conditions, the medium P rate (50 ppm) was as effective Mn fertilizer increased the Mn content of rice foliage only when applied at extremely high rates (50 ppm) and there was little difference between Mn contents of flooded and nonflooded plants at the higher Mn rates Neither Mn nor Fe fertilizers affected rice growth (FA 1 1652)

50 Curtis, O D, Hill, L C, Caffey, H R, Patrick, W H, Jr, Peterson, F J, Wilson, E 1967 *Fertilizer Recommendations for Rice, Application Rates, Sources, Timing Methods* Rice J 70(3) 32 3 (Eng)

N is the most deficient nutrient element in soils planted to rice For most Louisiana soils, 50 100 lb of N/acre is recommended P and K fertilizers are generally not needed on most alluvial soils, but on Prairie and Flatwood soils, 25 50 lb of phosphate and 0 50 lb of potash/acre are recommended Yields from preplant or at seeding fertilizer applications have averaged 350 lb of dry rice/acre more than for topdress applications

51 Engler, R M, Peterson, F J 1967 *The Effects of Additions of Zinc and Limestone on the Vegetative Production of Rice Grown on Crowley Silt Loam Soil* La Agr Exp Sta Rep Proj Dept Agron pp 216 18

Preliminary field investigations with rice grown on soils with pH values approaching neutrality and that have been water leveled indicate that Zn may be a limiting micronutrient for sustained high yields The limestone treatments were (1) no limestone, (2) 2 tons/acre, and (3) 4 tons/acre and mixed with the soil 4 in deep by disking Zn was applied at a rate equivalent to 0 852 lb/acre as Zn chelate (14 2% metallic Zn), or no Zn was applied Differences in yield were not statistically significant

52 Espada, W G 1968 *Changes of Inorganic Fractions of Phosphorus with Equilibration Time in Flooded and Moist Soils and the Resulting Phosphorus Availability to Nato Rice Seedlings* Diss Abstr B 29(5) 1542 543 (Eng) (Ohio State Univ, Columbus)

Tests were conducted to determine the uptake of P from phosphate rock (acidulated to different degrees) by rice seedlings under flooded or moist incubated conditions on three soils Tests were of 8 weeks duration Generally greater uptake was obtained with plants fertilized with partially acidulated rock, the 10% producing effects comparable to higher percent of acidulation Applied phosphate was tied up mostly as Al P in Wooster loam soil and as Fe P in Ripley silt loam and Arkansas paddy soils P from rock phosphate remained largely as Ca P while the soluble monocalcium phosphate in 100% acidulation was immediately tied up chiefly as Al P and Fe P leaving an insignificant amount of phosphate as Ca P even after 16 weeks of incubation Fe P predominated in the untreated soils Although there were differences with the various phosphates added the average percentage distributions of inorganic P fractions were little different, whether flooded or moist incubated The distribution of the total inorganic fractions showed Fe P to predominate in all soils at the end of 16 weeks Fe P formed at the expense of both Ca P and Al P To some extent Al P formed at the expense of Ca P with prolonged period of incubation More Al P formed under moist conditions and more Fe P formed under flooded conditions in Wooster silt loam and Arkansas paddy soils These changes in phosphate fractions were not evident in Ripley soils Both H_3PO_4 and phosphate particles reflected the equilibrium status of incubated soils The H_3PO_4 potentials were significantly lower under moist than under flooded conditions (FA 2 379)

53 Evatt, N S 1968 *Effect of Varying the Time of Early Single Nitrogen Applications on Rice* Rice J 71(3) 10, 12 (Eng) (Texas A & M Univ, Beaumont)

Ammonium sulfate was applied for rice on heavy clay soils 2 weeks prior to seeding, at seeding, and 2 weeks after emergence Rice grain yields increased with amount of N applied from 40 to 120 lb/acre and were usually higher for post emergence application (FA 1 726)

54 Evatt, N S 1969 *Nitrogen Recommendations for Texas Rice Productions* Rice J 72(4) 40 (Eng)

The general fertilizer rate recommendations for the six major rice soil types in the Texas Gulf Coast Prairie are as follows Beaumont clay, 80 40 0 Lake Charles clay, 80-40 0, Bernard clay loam, 80 40 0, Katy fine sandy loam, 60 40 20, Hockley fine sandy loam 60 40 0, Edna fine sandy loam, 60 40 0 At least a portion of the N should be applied as near to seeding is possible All of the N should be applied prior to the reproductive stage of growth Placement on dry soils has given approximately 10% higher yields than on wet soils and 15% 20% higher yield than when applied to flooded soils

55 Evatt N S 1969 *Rice Fertilizer Studies* Rice J 72(7) 64 5 (Eng)

Liquid ammonium polyphosphate (10 34 0) applied at seeding and as a topdressing with a uniform 40 lb of phosphoric acid (P_2O_5) and N rates of 40 80, or 120 lb adjusted with appropriate quantities of ammonium sulfate produced equal amounts of Bluebelle rice when compared with like amounts of N and P from ammonium sulfate and superphosphate In 1968 no differences in rice yields were obtained from four urea ammonium phosphates (29 29 0 25 35 0 33 20 0 and 34 17 0) two nitric phosphates (20 20 0 and 26 13 0) ammonium polyphosphate, solid (15 60 0), suspension (12 40 0) and clear liquid (11 37 0) A slight yield increase resulted from applying part of the N at jointing No advantage resulted from split application of P

56 Evatt, N S 1970 *Rice Fertilizer Studies* Rice J 73(7) 58 9 (Eng)

Rice seeded early produced the highest yield, however, excessive grain sterility was apparent throughout the season—from the middle of July through October in the Texas Gulf Coast area No conclusive relations between grain sterility and fertilizer management variables in the experiments were found

57 Evatt, N S 1968 *Rice Pasture Station Reports on Texas Research Studies Rice Fertilizer Studies* Rice J 71(7) 32 6 (Eng)

Urea ammonium phosphate fertilizers gave rice yields equal to those from recommended fertilizer sources Nitric phosphates produced significantly smaller yields Results are also given for the responses of Nato Saturn, and Dawn rice varieties to N fertilizer the response of Belle Patna variety to split applications of N and responses to time of N application row width and Zn and Fe (SI 32 742)

58 Faulkner M D 1970 *Soil and Water Management* Rice J 73(6) 6 (Eng)

Experiments were conducted involving fertilizer application methods for water planted rice and for drill planted rice The treatment "two way with drill" was with a fertilizer drill mounted on a two way disk plow The fertilizer was placed at approximately 4 in deep at plow depth The drilled in treatment resulted in the highest yields and were statistically significant at the 5% level In the drill seeded experiment, various rates of fertilizer were applied, both mixed and separate from the seed, in order to determine the effects of mixing fertilizer with the seed No statistical differences in yields occurred in the drilled portion of the experiment

59 Hall, V L, Sims, J L, Johnston, T H 1968 *Timing of Nitrogen Fertilization of Rice II Culm Elongation as a Guide to Optimum Timing of Applications Near Midseason* Agron J 60(5) 450 53 (Eng) (Arkansas Agr Exp Sta Fayetteville)

Field studies were conducted with Vegold' 'Nato,' and 'Bluebonnet 50 rice (*Oryza sativa* L) in 1963 1964 and 1965 to determine the optimum time near midseason to apply N fertilizer for greatest yield Internode elongation was used as a guide to estimate proper morphological stage of development for the optimum time to apply N During the 3 years of study all 3 varieties had grain yield increases of over 1120 kg/ha that could be attributed to applying midseason N at the proper time during panicle initiation Topdressing N at midseason was found to be most effective when 50% of the plants had elongating internodes equal to or in excess of 12 8 mm for Vegold, 39 7 mm for Nato, and 32 1 mm for Bluebonnet 50 (Part I Abstr 74) (FA 1 1638)

60 Holly, H Z 1967 *Midseason Nitrogen Applications* Rice J 70(8) 10 11 (Eng)

Application of N fertilizer to rice in Arkansas is increasingly being timed in accordance with the morphological development of the crop in particular with the average length of the first internode of the main stalk Farmers are advised to apply one third of the total amount of N fertilizer 15 days after emergence, the second one third at a certain stage of internode elongation, and the third dose 10 days later Recent studies have indicated that the optimum stage at which the second application is to be made is different for each variety For the time being it is advised to apply the second dose of N to varieties such as Bluebonnet 50 Nato Century Patna 231, etc, when the mean internode length is about 38 mm long, whereas other varieties such as Belle Patna, Bluebelle, etc, should receive it when the internode length is only 19 mm long (Trop Abstr 22 2440)

61 Jennings R W 1968 *The Techniques of Rice Fertilization* Agr Nitrogen News 18(1) 16 (Eng)

Best utilization of applied N and highest yields of rice in Louisiana were obtained where NH_4^+ forms of N (ammonium sulfate urea, anhydrous NH_3 and aqua NH_3) were applied several inches deep before seeding and flooding Topdressing and shallow placement at time of seeding were both inferior to deep placement (FA 1 446 SF 28 2863)

62 Keogh, J L Maples, R, Wells, J P 1968 *Effects of Limestone on Rice and Soybeans that Follow Pasture on a Crowley Silt Loam* Arkansas Agr Exp Sta, Bull No 733, 14 pp (Eng) (Univ of Arkansas, Fayetteville)

Rice and soybeans were grown in rotation on a soil which

had been kept as pasture for >30 years previously Areas received one treatment of limestone at 0, 1, 2, 4, or 8 tons/acre in January 1961, and crop responses were determined during 1961 67 The average yearly crop of soybeans was 36 8, 38 8, 38 5, 38 4, and 38 5 bu/acre with the 0, 1, 2, 4, and 8 tons/acre rates, respectively The average yearly crop of rice was 126 9, 128 6, 130 8, 131 3, and 129 3 bu/acre with the 0, 1, 2, 4, and 8 tons/acre rates, respectively Significant decreases in rice crops were obtained with 8 ton/acre rate in 1964 and with the 1 ton/acre rate in The soil pH was 5 5 6 5 before the start of treatment The increase in pH after limestone was generally greatest about 6 months after treatment and the increase was greater at the greater application rates, but the average pH in any one area did not exceed 7 0 Neighboring fields having soil pH >7 0 probably receive large quantities of lime in their irrigation water The level of incubatable N was decreased by application of limestone but was greater following soybeans than following rice Limestone applications caused a reduction in the level of exchangeable Na, but increased levels of exchangeable Ca and Mg (CA 71 122986n)

63 Kirithivip, R Sims, J L 1970 *Influence of Nitrogen on Rice Culm Elongation Near Midseason* Agron J 62 120 21 (Eng) (Univ Kentucky, Lexington)

In glasshouse experiments $(NH_4)_2SO_4$ was applied at four levels to "Nova 66" rice (*Oryza sativa* L) grown on a Grenada silt loam, and elongating internodes were measured at four dates near midseason The length of the first elongating internode was greater for plants treated with 84 and 168 kg N/ha than it was for plants treated with 0 or 252 kg N (SF 33 4087)

64 Patrick W H Jr, Mahapatra, I C 1968 *Transformation and Availability to Rice of Nitrogen and Phosphorus in Waterlogged Soils* Advan Agron 20 323 59 (Eng) (Louisiana State Univ, Baton Rouge)

Waterlogging causes changes in the properties of soils which affect the nutrition of lowland rice Advantage can be taken of the reducing conditions of waterlogged soils to increase the utilization of N fertilizer NH_4^+ sources of N are the best and are applied several inches deep in the soil before flooding so that there will be little danger of the N being oxidized to NO_3 (in which form it is easily lost from the soil) Although NO_3, Mn^{3+}, Fe^{3+} and SO_4^{2} are stable in well aerated soils, they become unstable when the O supply is cut off Nitrate N is subject to loss through denitrification as a result of the ability of facultative microbes to substitute NO_3 for O Mn^{2+} and Fe^{2+} are produced from oxidized compounds of these elements under waterlogged conditions If reduction is intense enough, SO_4^{2} is reduced to S^{2} Denitrification is probably the major mechanism by which N is lost from waterlogged soils Usually, lowland rice does not need or respond to additions of PO_4^{3} fertilizer In cases in which phosphate is needed, it can be applied to the rice crop or to crops grown in rotation with rice with about equal results (CA 72 89266y)

65 Patrick W H Jr, Peterson F J Seaholm, J E, Faulkner, M D, Miears, R J 1967 *Placement of Nitrogen Fertilizers for Rice* La Agr Exp Sta Bull 619, 19 pp (Eng)

On silt loam soil, utilization of applied N was better and yields of lowland ri were higher with $(NH_4)_2SO_4$, urea, anhydrous NH_3, or aqua NH_3 than with $NaNO_3$ Deep placement of NH_4 fertilizers (6 and 10 in) at the time of seeding was better than 2 in placement For $NaNO_3$ at 40 lb/acre N, shallow placement was better than deep placement, at the 100 lb rate, placement depth had little effect (SF 31 1417)

66 Patrick, W H, Peterson, F J, Turner, F T 1968 *Nitrification Inhibitors for Lowland Rice* Soil Sci 105(2) 103 5 (Eng) (Louisiana State Univ, Baton Rouge)

Laboratory and field experiments were conducted in which the effectiveness of 2 chloro 6 (trichloromethyl) pyridine and 2 amino 4 chloro 6 methyl pyrimidine in inhibiting nitrification of ammonium N and increasing the yield of lowland rice was evaluated 2 chloro 6 (trichloromethyl) pyridine was very effective in preventing the conversion of ammonium to nitrate in the laboratory, but was of limited effectiveness in increasing N utilization and rice yields under field conditions 2 amino 4 chloro 6 methyl pyrimidine did not materially inhibit nitrification under laboratory conditions and did not increase rice yields in the field (FA 1 731)

67 Peterson, F J 1968 *L S U Rice Station Research Rice Fertilization* Rice J 71(7) 53 (Eng)

With each delay in application of P fertilizer up to 4 weeks, rice yield was reduced drastically Rice responded to as much as 150 lb/acre of N and 50 lb/acre of P_2O_5, response to K_2O was erratic (FA 1 1360)

68 Peterson, F J, Patrick, W H, Jr, Faulkner, M D 1969 *Placement of Fertilizer for Rice* Rice J 72(7) 32-4, 76 (Eng)

The comparison of two methods of placement of phosphate, on a Crowley silt loam soil, for rice preplant 3-4 in deep and topdressing at various times after seeding was carried out There was no marked response to phosphate, consequently there was little difference between the methods of application

69 Place, G A 1969 *Relation of Iron, Manganese, and Bicarbonate to Chlorosis of Rice Grown in Calcareous Soil* Arkansas Agr Exp Sta, Rep Ser No 175, 21 pp (Eng) (Univ Arkansas, Fayetteville)

One field experiment and three greenhouse experiments (two with soil and one with nutrient culture) were conducted to study chlorosis of rice growing in a soil that had become alkaline from use of calcareous irrigation water Fe bearing and acidifying compounds prevented chlorosis in calcareous soils by temporarily reducing the soil pH In a field study $Fe_2(SO_4)_3$ applied to supply 0, 200, or 400 kg of Fe/acre not only corrected chlorosis but also increased grain yields $Fe_2(SO_4)_3$ will not always prevent or correct chlorosis, however because the chlorosis is not always caused by a calcareous soil condition It would not help chlorosis in alkali (Na) conditions Increasing the concentration of HCO_3 in nutrient culture decreased the Fe concentration in the culture and in the rice plant tops Consequently dry matter production decreased and the plants developed chlorotic symptoms similar to those of plants growing in the field Results from the other greenhouse studies showed that

$Fe_2(SO_4)_3$, H_2SO_4, and gypsum decreased HCO_3 in the soil solution but did not decrease water soluble Mn Ferric citrate did not reduce HCO_3, but did increase water soluble Mn The plants in soil treated with ferric citrate produced less dry matter and absorbed more Fe and Mn than the $Fe_2(SO_4)_3$ treated plants Two mechanisms are probably responsible for causing chlorosis and finally necrosis of rice seedlings 48 72 hours after submergence (1) the concentration of HCO_3 is increased and interferes with Fe utilization, (2) the Fe/Mn ratio is critical under soil conditions In alkaline soils, the availability of both elements is low When an alkaline soil is submerged, Mn availability is increased through the reductive process sooner than Fe availability, inducing Mn toxicity or Fe deficiency (CA 73 13589f)

70 Place G A, Sims, J L, Hall, V L 1970 *Effects of Nitrogen and Phosphorus Fertilization on Growth Yield and Cooking Characteristics of Rice* Agron J 62 239-43 (Eng) (Univ Arkansas, Fayetteville)

The experiments involved application of 0 56 kg/ha P and 0 136 kg N (in the greenhouse) or 0 90 kg P and 90 180 kg N (in field trials) is superphosphate and $(NH_4)_2SO_4$ Increased P tended to cause lodging and to decrease grain yield and 1000 grain weight, but had no adverse effect on the cooking characteristics of rice, the latter was variously affected by increased N Incorporation of P into the soil increased straw weight more than broadcasting did Increasing N increased the number and total weight of panicles, weight of straw, and plant height, whereas increasing P decreased plant height but improved other variables (SF 33 40/9)

71 Sedberry J E Peterson, F J, Wilson, F E, Engler, R M 1969 *The Effect of Certain Micronutrients, Sulfur, and Phosphorus on the Yield of Rice* Rice J 72(7) 77 8 (Eng)

Zn and S applied singly and in combination with Fe and Cu had the greatest effect on increasing the yields of rice The application of Cu resulted in a decrease in yield, both with and without P The data suggest that P applications may be responsible for the fixation or immobilization of certain micro and secondary nutrient elements, and that response to added P may be governed in part by the addition of S, Zn, Fe, and Cu

72 Sharma, K C Krantz, B A, Brown, A L Quick, J 1968 *Interactions of Zn and P with Soil Temperatures in Rice* Agron J 60(6) 652 55 (Eng) (Univ California, Davis)

Rice (*Oryza sativa*) was used as a test crop in greenhouse to study the interactions of Zn and P with soil temperatures in a Corning clay loam soil A decrease in soil temperature from 30° to 22 5° C and to 15° C gave a progressive decrease in dry weight The response to Zn decreased with increasing soil temperatures At 15° C, Zn application increased Zn concentration in the roots, but there was practically no translocation of Zn to the tops Furthermore at the lowest temperature the Zn concentration in tops of plants grown with added Zn was even lower than the Zn concentration of plants without added Zn at 22 and 30° C Application of P reduced the Zn concentration in tops and there was no effect on Zn concentration in roots Application of Zn had no significant effect on P concentrations of rice plants (FA 2 279)

73 Sims J L, Blackmon B G 1967 *Predicting Nitrogen Availability to Rice II Assessing Available Nitrogen in Silt Loams with Different Previous Year Crop History* Soil Sci Soc Amer Proc 31(5) 676 80 (Eng) (Arkansas Agr Exp Sta, Stuttgart)

Soil test methods that measure ammonium N in silt loams before and after incubation under waterlogged conditions were evaluated as predictors of N availability to Nato rice (*Oryza sativa*) grown in the greenhouse Eighteen soils for each of five previous year crop histories were utilized All soils were from crop rotations containing rice Coefficients of determination (r^2) for the regression of N uptake by rice on ammonium after 6 days incubation of soil with different crop histories were in the order of cotton (*Gossypium hirsutum*) < rice<lespedeza (*Lespedeza striata*) < soybean (*Glycine max*) < reservoir (irrigation water storage or fish production), and ranged 0 12 0 77 Exchangeable Ca was inversely related to N uptake and accounted for significant percents of variation in uptake on all soils except those from reservoirs Exchangeable Ca was not related to ammonium N production during incubation For all previous year crop histories ammonium N in soil after 6 days incubation was a better single predictor of N uptake by rice than soil organic matter values Initial ammonium N content of reservoir soils was about 5 fold greater than in soils of other crop histories The amount in these silt loam soils from reservoirs (55 kg N/ha) was about half that found in previous studies for reservoir soils of clay texture Multiple regression analyses indicated that including initial ammonium N together with ammonium N production during incubation improved the prediction of N uptake over ammonium N production values alone Including exchangeable Ca together with initial ammonium N and ammonium N production values improved the prediction on all soils except those from reservoirs (CA 68 21244b)

74 Sims, J L, Hall, V L, Johnston, T H 1967 *Timing of N Fertilization of Rice I Effect of Applications Near Midseason on Varietal Performance* Agron J 59 63 6 (Eng) (Arkansas Agr Exp Sta, Stuttgart)

Yields of rice grain were inversely related to plant height and lodging, and generally increased with increasing delay of time of N application up to 50, 67 and 79 days from emergence for Vegold (I), Nato (II), and Bluebonnet 50 (III) varieties, respectively N applied earlier than 45, 55, and 65 days to I, II, and III, respectively, stimulated vegetative growth and resulted in taller plants, greater lodging, and lower grain yields Significant rate x time and year x time interactions occurred Rates of N had little or no effect on grain yield and plant height at treatment dates which gave maximum grain yields, but high rates applied early tended to depress grain yields and increase plant height and lodging (Part II Abstr 59) (SF 30 3029)

75 Sims, J L, Hall, V L, Johnston, T H, Blackmon, B G 1967 *Effect of Rates and Timing of Midseason Nitrogen Applications on Performance of Short Season Rice Varieties, 1964 1965* Arkansas Agr Exp Sta, Rep Ser No 154, 24 pp (Eng) (Fayetteville)

Drill sown rice received 40 lb N/acre at 10 15 days after seedling emergence plus 40, 80, or 120 lb N at 43 67 days after emergence Highest grain yields (>6000 lb/acre) were obtained by topdressing at 61 67 days and by applying the

lowest rate of N Grain yields were inversely proportional to plant height, degree of lodging, and time to maturity In general, cv Saturn and Nova showed the greatest response to time of application, cv Nova 66 and Nato were intermediate in response, and cv Dawn showed the least response (FCA 20 2364)

76 Sims, J L, Johnston, T H, Henry, S E 1965 *Effect of Rates and Timing of Nitrogen Fertilization on Performance of Rice Varieties 1957 1962* Arkansas Agr Exp Sta, Rep Ser No 142, 45 pp (Eng)

Eight rice varieties were tested, urea was applied at 75, 120 and 165 lb/acre N In 1958, maximum yield with minimum plant height and lodging followed application of 40 lb N at seeding, 40 lb at first flood and 40 lb at second flood In 1959, 80 lb N at first flood with 40 lb at second flood was generally the best treatment but two varieties produced more grain under the heaviest N treatment In 1960, applying 40 lb N at first flood, 40 lb at second flood, and 40 lb at the booster stage gave grain yields almost as high as those from heavier N treatments and resulted in shorter straw and less lodging (SF 29 626)

77 Sims, J L, Place, G A 1968 *Growth and Nutrient Uptake of Rice at Different Growth Stages and Nitrogen Levels* Agron J 60(6) 692 96 (Eng) (Arkansas Agr Exp Sta, Fayetteville)

Dry matter synthesis and uptake of N, P, and K in field sown rice (*Oryza sativa* L) growing in Crowley silt loam soil was measured at weekly intervals throughout the growing season K as KCl and N as anhydrous ammonia were applied preplant at rates of 56 of K and 0, 123, and 157 kg/ha of N 'Vegold', 'Nato', and 'Bluebonnet 50' varieties (cultivars), classed as very short season, short season, and midseason in maturity, were used Approximately half of the total uptake of N and K and two thirds of the P uptake occurred after dates previously established as optimum for midseason topdress N applications, for example, 50, 67, and 79 days after seedling emergence for Vegold, Nato, and Bluebonnet 50 espectively About two thirds of the dry matter production also occurred after these dates Consequently, the requirements for nutrient elements by the rice plant are great during the reproductive stages of growth These data partially explain why topdress N applications at midseason (jointing stage) are more efficient than topdress applications near seeding for increasing grain yields Uptake of N, P and K at dates of maximum nutrient accumulation (near soft dough stage) reveal a greater uptake by Nato than Vegold or Bluebonnet 50 As an average of all varieties at N levels producing maximum grain yields, 232 48, and 171 kg/ha, respectively of N, P, and K were taken up At N levels producing maximum yields, about 25 kg of additional grain were produced for each kg of N applied Losses of N and K from the plant occurred during a growth stage between the tillering and jointing stages for each variety Additionally N and K content at maturity v much lower than 1-4 weeks prior to maturity (soft dough stage) These facts should be considered when selecting sampling dates for measuring nutrient uptake or when uptake data are used as bases for fertilizer rate recommendations (FA 2 228)

78 Sims, J L, Wells, J P, Tackett, D L 1967 *Predicting Nitrogen Availability to Rice I Comparison of Methods for Determining Available Nitrogen to Rice from Field and Reservoir Soils* Soil Sci Soc Amer Proc 31(5) 672 75 (Eng) (Arkansas Agr Exp Sta, Stuttgart)

Organic matter or available N in soil before or after incubation under waterlogged conditions each was used to predict soil N availability to Nato rice (*Oryza sativa*) plants in a greenhouse experiment The 42 silt loams had much lower organic matter and available N contents than the 19 clays (or reservoir soils) used in the study Solution + extractable ammonium N after 6 days incubation accounted for 91% of the variation in yield on the 19 clay (or reservoir) soils, but accounted for only 18% on the 42 silt loams Initial ammonium N, initial nitrate N, ammonium N production during 6 days incubation and ammonium N production during 6 12 days incubation, as independent variables in a multiple linear regression, were used to predict grain yield Little was gained by including nitrate N or 6 12 day ammonium N production Of the independent variables included, ammonium N production during 0 6 days incubation alone accounted for the greatest percent of yield variation, but including initial ammonium N together with 6 day ammonium N production (also initial ammonium N + that produced during 6 days) improved the prediction Organic matter or methods which measure total N in soil alone were poor predictors of N availability to rice Organic matter accounted for 41% of the variation in yield on clay soils and <1% on silt loams, whereas total N accounted for 56 and <1% of the yield variation on the clays and silt loams, respectively (CA 68 21243a)

79 Stansel, J W, Bollich, C N, Thysell, J R, Hall, V L 1965 *The Influence of Light Intensity and Nitrogen Fertility on Rice Yields Components of Yield* Rice J 68(4) 34 5, 49 (Eng)

Trials with rice, showed that reduction of the light intensity by means of plastic screens reduced the number of panicles per m^2 the number of full florets per panicle, and the mean kernel weight N increased the number of full florets per panicle only in full daylight and increased the mean kernel weight at light intensities 100%, 70%, and 40% of full daylight Reduction of the light intensity to 40% had no effect when applied from seedling emergence to tillering, reduced tillering when applied from tillering to panicle differentiation, and reduced the number of full florets per panicle when applied either from panicle differentiation to heading or from heading to maturity The practical conclusion was that cloudy weather will reduce the yields as well as N fertilizer utilization especially if occurring during the later stages of crop growth (Trop Abstr 20 1963)

80 Templeton, G E, Wells, B R, Johnston T H 1970 *N Fertilizer Applications Closely Related to Blast at Nodes and Resultant Lodging of Rice* Rice J 73(7) 71 (Eng)

Vegetative growth and plant height increased and incidence of nodal blast and accompanying lodging tended to increase as N rate was increased from 0 to 120 lb/acre in increments of 30 lb/acre However, appreciably less lodging and nodal blast were present when a three way split (1 1 1) application was used rather than a two way split (1 2 0) The highest yielding treatment (30 30 0) showed only 14% lodging very little nodal blast and produced 1240 lb/acre more rough rice and

about 900 lb/acre more head rice than the 40 80 0 treatment These data strongly emphasize the need for proper scheduling of N fertilizer applications to avoid excessive vegetative growth of the rice and a highly favorable environment for development of blast and other diseases

81 Terman G L, Allen, S E 1970 *Fertilizer and Soil P Uptake by Paddy Rice, as Affected by Soil P Level, Source, and Date of Application* J Agr Sci 75 547 52 (Eng)

A greenhouse pot experiment was conducted with paddy rice (*Oryza sativa* L variety Nato') grown on Mountview silt loam at its initial low P level and on this soil receiving preplant unlabeled P applications (medium and high soil P levels) Labelled granular CSP (concentrated superphosphate) alone, a 2/1 mixture of CSP and DCP (dicalcium phosphate) and a 1/2 CSP DCP mixture were evaluated Dry matter yields and tillering increased markedly with amount of applied P on the low P soil and slightly on the medium P soil there was no response on the high P soil Response decreased with decrease in water solubility of the applied P at the low and medium soil P levels Total uptake of P by rice showed similar trends, except that uptake increased significantly with amount of P applied at the medium soil P level Percentages of plant P from the labeled fertilizer and uptake of fertilizer P increased in all situations with amount of applied P decreased with decrease in water solubility of the applied P, and decreased with increase in soil P level Uptake of soil P increased markedly with increase in soil P level Soil labeling was much less satisfactory than fertilizer labeling for evaluating the effectiveness of P in different fertilizers A solution of labeled CSP was applied in a second experiment at time of transplanting and 3 or 6 weeks later On the low P soil yields P uptake, and tillering increased with rate of applied P but decreased with later date of application On the medium P soil, yields, tillering and uptake of P by the grain were rather similar among treatments Uptake of P in the foliage and mature straw however increased with later date of application These results indicate that late applied P is readily absorbed by rice but is not effective for increasing yields

82 Terman G L Allen, S L Engelstad, O P 1970 *Response by Paddy Rice to Rates and Sources of Applied Phosphorus* Agron J 62(3) 390 94 (Eng)

In pot experiments marked yield response by rice (variety "Nato) was obtained to applied P, but maximum yields were obtained at much lower rates of applied P than is true for most upland crops Response to applied P decreased with liming of the soil and with increasing levels of acid soluble soil P Granular water soluble P sources were most effective for increasing tillering and yields granular dicalcium phosphate was ineffective The P in S coated concentrated superphosphate was not available to a first crop of rice but after degradation of the coating became available for a second crop The P in Fe phosphates was more available than that in Al phosphates in the flooded soil These phosphates were more available as fines than as granules and in colloidal form than as fine crystals

83 Vlamis, J, Williams, D L 1964 *Iron and Manganese Relations in Rice and Barley* Plant Soil 20 221 31 (Eng) (Univ California, Berkeley)

Optimum growth of both plants in culture solution occurred when Mn concentration was 0 1 and 0 2 ppm, below this level of Mn yields dropped rapidly for both species, at higher Mn concentrations barley yield fell, but rice yield was not significantly reduced till Mn concentration reached 5 ppm (the highest used) Severe Mn toxicity symptoms appeared on old barley leaves but symptoms on rice were slight Mn contents of barley and rice leaves reached 1200 and 7000 ppm respectively and of barley and rice roots 8000 and 5000 ppm, respectively In the lower range of Mn concentration, Fe content of both plants fell with increasing Mn but this appeared to be a dilution effect With stronger Mn concentrations, tissue Fe leveled off Rice leaves had about twice the level of Fe found in barley leaves Rice roots contained substantial amounts of Fe, most was visible on the surface, probably as oxide The results are discussed in relation to the possible role of Mn in accounting for the poorer growth of rice in drained than in submerged soils (SF 27 2960)

84 Wallihan E F Garber M J 1968 *Effect of Iron Nutrition on Root Top Ratio* Agron J 60(1) 41 2 (Eng) (California Agr Exp Sta, Riverside)

In a glasshouse experiment rice plants were grown in solution culture at three levels of Fe Plant growth and Fe concentration in the leaves increased and the root/top ratio decreased with increase in applied Fe (concentration not given) (FCA 21 1783)

85 Wells, B R 1968 *Arkansas Rice Research Timing Midseason Nitrogen Applications to Rice in Arkansas* Rice J 71(7) 40 42 (Eng)

Data consistently show that increased yields along with decreased plant height and percentage lodging are associated with delaying a portion of the fertilizer N until after internode elongation begins Early season growth is assured by early application of a part of the N (FA 1 1339)

86 Wells B R 1970 *Progress Report of Fertility Studies in Rice* Rice J 73(7) 69 (Eng)

Studies on problem soils included additions of elemental S, preplant N and Zn to calcareous soils S at the rate of 1000 lb/acre increased grain yields by approximately 1600 lb/acre Preplant N as $(NH_4)_2SO_4$ was applied at rates of 0, 50 100 and 200 lb/acre just ahead of seeding Additional N at the rate of 108 lb/acre was applied in a three way split during the growing season The 100 lb/acre resulted in a significant grain yield increase and 200 lb/acre gave a further increase in grain yield $ZnSO_4$ was applied at three locations and compared with Zn chelate at a fourth $ZnSO_4$ significantly increased grain yields at only two of the sites and Zn chelate increased yields where it was tested Plots fertilized with S coated urea consistently yielded as high or higher than those fertilized with either urea or $(NH_4)_2SO_4$

87 Wells, B R 1969 *Timing, Rate, and Source of Nitrogen for Rice* Rice J 72(7) 88 9 (Eng)

Tests conducted at the Southeast Branch Experiment Station, Rohwer Arkansas, in 1968 with Starbonnet rice showed a yield increase of approximately 600 lb/acre as a result of delaying the midseason N application from 67 to 74 days after seedling emergence Yield responses to N rates up to

120 lb/acre were observed in this test Those plots fertilized with the S coated urea consistently out yielded plots fertilized with urea in 1967 and with either urea or ammonium sulfate in 1968 These yield increases were particularly striking at N rates of 80 90 lb/acre Plant height was not controlled by use of the S coated urea, however Slight but significant increases in the protein content of the grain were observed from ¼ lb/acre rate of simazine applied at flowering, provided the midseason N source was nitrate

88 Wells, B R , Sims, J L 1968 *Sources of Nitrogen for Use on Rice* Arkansas Farm Res 17(2) 5 (Eng) (Arkansas Agr Exp Sta ,Stuttgart)

A comparison of the effectiveness of a 32% N solution with urea as a source of N for rice was made Tests were conducted over a 3 year period using Bluebonnet 50 rice Rates of 60 90, and 120 lb/acre of N were applied in split applications to unflooded soil Half of the N was applied 15 days after seedling emergence just before initial flooding of the rice The remaining N was applied 70 days after seedling emergence All plots were flooded immediately after application of N Application of the N solution resulted in rather serious burning of the rice foliage The use of urea resulted in taller plants and higher grain yields in all 3 years The lower yields and reduced vegetative growth with N solutions may have been caused by damage to the rice with the N solution (FA 1 1179)

89 Westfall, D G 1969 *The Efficiency of Applied Nitrogen on Rice Producing Soils* Rice J 72(7) 66 7 (Eng)

At normal rates of fertilization used by producers (80 120 lb N/acre), the efficiency was from 33% to 34% for urea and ammonium sulfate N in the soil can be lost by denitrification, volatilization of immonia from surface applied materials and leaching but in rice soils most is lost through denitrification This can be avoided in part by deep placement of the N below the oxidized surface layer of soil by applying fertilizer to dry soil and placing the N deeper in the soil with the flood water, or by mechanical incorporation in the soil The latter is not practical when topdress applications are made to existing crops of rice, but it is more important to apply the N when the rice plant needs it than to make applications that may produce a greater N efficiency but lower yields

90 Westfall, D G 1970 *The Nitrogen Uptake and Efficiency of Rice* Rice J 73(7) 59 60 (Eng) (Texas A & M Univ Agr Res Exten Center, Beaumont)

Bluebelle variety rice growing on a Beaumont clay was fertilized with 60 140 lb/acre of N as ^{15}N enriched ammonium sulfate Time of application was a three way split of 40% preplant 40% at tillering and 20% at panicle differentiation or 60% preplant and 40% at tillering N efficiency varied from 61 8% at the 60 lb/acre rate to 49 2% at the 160 lb/acre rate but there were no significant differences among the 60 140 lb/acre rates Carryover N, is measured by ^{15}N in the soil was negligible and no ^{15}N was found below the 18 in depth Denitrification appeared to be the major cause of N loss (FA 3 1649)

91 Westfall, D G , Anderson, W B , Hodges, R J 1969 *Micronutrients and Rice Production* Rice J 72(7) 67 8 (Eng)

Micronutrients may have a beneficial effect on the yield of rice where chlorotic seedling condition occurs Under these conditions it appears that Zn and Fe are definitely beneficial The data are too limited to make a recommendation as to exact rates and/or ratios of these materials to use to produce maximum returns

92 Wilson E 1965 *Tillering of Rice as Affected by Time of Nitrogen Application* Rice J 68(7) 24, 26 (Eng)

In Louisiana an experiment was conducted to determine, (1) the effect of the time of N fertilizing on date of tiller development, and (2) the relationship of date of tiller development to number of tillers per plant, number of panicle producing tillers, and yield In all three varieties used Belle Patna, Nato, and Bluebonnet N applied at sowing induced early tiller development, increased tiller productivity, and number of panicles at maturity Application 4 weeks after sowing delayed tiller inception but increased the number of tillers per plant, potential panicles, panicle weight grains per panicle and 1000 grain weight N applied at sowing produced the highest yield of Belle Patna In the other varieties no significant yield increase was obtained by early applications of N (Trop Abstr 20 2619)

93 Wilson, E 1969 *Timing Midseason Nitrogen at Developmental Stages of the Rice Plant* Rice J 72(7) 31 2 (Eng)

Maximum yields were obtained from (1) 120 lb of N applied at seeding and (2) a split N topdressing, one half preflood and one half first joint

SOUTH AMERICA

ARGENTINA

94 Merzari, A H , Broeshart, H 1968 *The Utilization by Rice of Nitrogen from Ammonium Fertilizers as Affected by Fertilizer Placement and Microbiological Activity* Isotope Studies on the Nitrogen Chain, pp 79 87, IALA, Vienna, Austria (Comision National de Energia Atomica, Buenos Aires)

N balance studies with three different rice soils, using ^{15}N labeled NH_4 fertilizer showed that gaseous losses of N from the fertilizer can be as high as 60% The losses are related to the pH and the redox potential of the soils The placing of $(^{15}NH_4)_2SO_4$, $NH_4{}^{15}NO_3$, $^{15}NH_4NO_3$, and ^{15}N labeled urea at 5 cm depth resulted in a higher utilization of the NH_4 from the fertilizers than placement on the surface, is indicated by the results of a greenhouse experiment with five different rice soils Apparently the reduced conditions at 5 cm depth prevent the microbiological oxidation of NH_4 to NO_3 and subsequent

reduction to NO_2 and gaseous N oxides In the top few mm of the soil where, even under submerged conditions, a high redox potential is maintained, the nitrification denitrification processes can continue normally and may result in an appreciable loss of gaseous N from the applied fertilizer To demonstrate the role of microorganisms in relation to N losses, a greenhouse experiment was conducted under sterile conditions The soils were sterilized with gamma rays (2 5 Mrad) and, in some treatments, then inoculated with various organisms (*Pseudomonas aeruginosa Nitrosomonas europea, Nitrosomonas agilis* and total flora of the soil) $(^{15}NH_4)_2SO_4$, with an atom excess of 1 2% ^{15}N, was applied on the surface and at 5 cm depth In the absence of microorganisms, the utilization of NH_4 from the fertilizer applied on the surface was higher, or identical to the utilization of NH_4 applied at 5 cm depth Even in the presence of organisms the redox potential of the soil remained high, even at a depth of 10 cm Inoculations of the sterile soil with the original microbiological flora, with nitrifying or denitrifying bacteria, failed to restore the normal microbiological conditions for the duration of the experiment as suggested by the high redox potential and the absence of a placement effect of NH_4 fertilizer on the utilization of fertilizer N by the rice plants (FA 2 882)

BRAZIL

95 deMello, F A F, Haag, H P, Malavolta, E 1966 *Phosphorus Elimination by Rice Seeds and Roots (Oryza sativa variety Batatais)* An Esc Super Agr "Luiz Queiroz," Univ Sao Paulo 23 137 43 (Port) (Esc Super Agr Luiz Queiroz, Piracicaba)

Rice seeds were incubated with ^{32}P for 12 hours, washed, and then germinated in flasks containing silica or silica added to three varieties of soil The plants were grown for 18 days After growth, plants, soil, and silica were treated with a mixture of HNO_3 and $HClO_4$ and the radioactivity was measured A high percentage of ^{32}P was found in soil and silica suggesting elimination of phosphate by rice seeds and/or plants (CA 68 57435d)

96 Gargantini, H, Blanco, H G 1965 *Absorption of Nutrients by Rice Crops* Bragantia 24(38) 515 28 (Port) (Inst Agron Campinas Sao Paulo)

Rice plants were grown in a glasshouse and sampled at 10 day intervals It was calculated that for a yield of 4300 kg of grain in the husk and 39,350 kg of straw and roots/ha, the quantities of nutrients absorbed were 115 kg N, 18 5 kg P, 142 kg K, 35 kg Ca, and 36 kg Mg At 110 days from germination, all the N and K had been absorbed The absorption of P, Ca, and Mg was continuous throughout the growth period (FCA 20 254)

97 Oliveira, D, Montojos J C, Igue, T 1964 *Fertilizing Unirrigated Rice I Study of the Effect of Nitrogen, Phosphorus, and Potassium on the Characteristics of an Early Variety of Unirrigated Rice* Bragantia 23 73 81 (Port)

In a factorial experiment on podzolized soils, N had a marked effect on the vegetative development of rice plants It increased weight of aerial parts and number of panicles, decreased specific weight, and had no significant effect on yield or number of grains per panicle P increased number of panicles, number of grains per panicle, specific weight, and yield, 60 kg/ha P_2O_5 being the optimum rate K had no significant effect (SF 29 616)

98 Oliveira, D, Montojos, J C, Igue, T, Miranda, H, Freitas, M L 1965 *Preliminary Studies on Fertilization of Upland Rice 2 "Cultivar Pratao"* Bragantia 24(33) 437-46 (Port)

Five fertilizer experiments using upland rice, variety "Pratao", were conducted in Sao Paulo N only affected the production in one place, in which the plant residues of corn were incorporated in the soil Under 0 08 e mg PO_4^{3}/100 g of soil, P affected the production The use of 60 kg/ha of P_2O_5 was sufficient for the higher yields The use of K was efficient in only one place No beneficial effect was noted with the use of micronutrients

99 Penny, J M 1966 *Fertilization Trials Fertilizers in Soil and in Covered Bed* Lav Arroz 20(227) 28 9 (Port)

In experiments with various rates and combinations of N (as urea), P (as triple superphosphate), and K (as KCl) applied to Selecao 388 rice, best results were obtained with NP at 178 and 89 kg/ha respectively

100 Primavesi, A M, Primavesi, A 1970 *Variety Determined Fertilizer Effect on Rice and Soybeans* Agrochimica 24(4) 321 26 (Ger) (Inst Bodenk Bodenbiol Pflanzenernaehr Pflanzenbau, Bundes Univ, Santa Maria)

The rice cultivars Agulha and 404 were tested for response to four fertilizations all of which received 900 kg dolomite and 60 kg P_2O_5/ha, (1) no other fertilization, (2) 1 g $CuSO_4$/kg seed and 3 kg $CuSO_4$/ha (3) same as 2 with 20 kg FTE/kg seed, and (4) 20 g FTE/kg seed and 3 kg $CuSO_4$/ha on the soil The yields of the different varieties showed significantly different responses to the fertilizations, some known to be suited to poor soils gave better yields without fertilization Recommendations for fertilization should accordingly be not only for specific soils but for specific varieties of the crop (CA 73 97953f)

101 Schmidt, N C, Gargantini, H 1966 *Application of Nitrogen as Topdressing to a Rice Crop* Bragantia 25(5) 57 63 (Port)

A NPK fertilizer trial with flooded rice on a clayey valley soil, conducted in the State of Sao Paulo, showed responses to N only With 40 kg N/ha application of the whole amount at sowing and split applications of 8 kg/ha at sowing plus 32 kg/ha after 30, 40, or 50 days resulted in grain yields 130%, 176%, 148%, and 156% of that without N, respectively When 20% of the N was applied at sowing and 80% after 40 days, grains and straw yields increased with total doses of N of up to at least 80 kg/ha (Trop Abstr 23 31)

102 Vasconcelos, D, Almeida, L M 1966 *Application of Fertilizers to Rice in the Northeast* Pesquisa Agropec Brasileira 1 353 56 (Port)

Results are presented of 14 factorial fertilizer trials with the same dryland rice variety, conducted in the coastal belt of northeastern Brazil Superphosphate at rates of 60 and 120 kg P_2O_5eha was applied at sowing, 60 and 120 kg N/ha as

ammonium sulfate and 60 and 120 kg K_2O/ha as KCl were distributed in two topdressings 30 and 60 days after sowing Responses to N were obtained in all trials responses to P in one trial only, responses to K were absent The Mitscherlich response equation derived from the combined results of the 13 trials showing a response to N only indicated that the economically optimum dosage of N would be about 125 kg/ha (Trop Abstr 22 1787)

103 Vasconcelos, D M, Almeida, L M 1966 *Chemical Fertilization of Rice in Northeastern Brazil* Bol Tec Inst Pesqu Exp Agropecuar Norte No 4, 353 56 (Port) (IPEANE, Recife)

Rice cultures were grown over 5 years in different locations in the state of Pernambuco, using N, P, and K at levels of 0, 60, and 120 kg/ha each [using $(NH_4)_2SO_4$, simple superphosphate containing 20% P_2O_5, and KCl] in 14 factorial experiments P was applied at the time of planting, the others after 30 and 60 days of growth Variance analysis of the yield (tons/ha) of rice showed that the effect of N was highly significant, and the effects of P and K were not The effect of N is expressed by the Mitscherlich equation y(tons rice/ha) = $2\,4282[1\ 10^{0\,8817\,(x\,+0\,4333)}]$ the value of x being kg N/ha applied Optimum yield resulted with 124 kg N/ha One set of data, obtained in the swamp area of Pium Valley, Rio Grande do Norte, gave irregular results because of a P deficiency (CA 70 67223p)

BRITISH GUIANA

104 Cate, R B, Sukhai, A P 1964 *A Study of Aluminum in Rice Soils* Soil Sci 98(2) 85 93 (Eng)

Studies on the effect of Al on the growth of rice in British Guiana showed that (1) if nutrient cations are absent, 1 2 ppm water soluble Al will inhibit root growth More ppm prevent root growth altogether and produce a brown mottling of the leaves, (2) with less than 1800 ppm soluble neutral salts in the soil, water soluble Al ions may be expected only if more than 60% of the salt displaceable cations consists of Al, (3) under the reducing conditions in flooded rice fields, exchangeable Al is replaced by exchangeable ferrous Fe Therefore, by early and continuous flooding and the removal of excess salts by leaching, rice may be grown on soils rich in exchangeable Al, provided they are fertile enough, (4) leaching with sea water may improve acid soils by removing exchangeable Al through displacement and by raising the nutrient status (Trop Abstr 20 519)

CHILE

105 Pisano, V C 1968 *Rice Growing in Chile* Agri Digest 14 24 7 (Eng)

From 1948 and 1967 rice production decreased from 89,400 tons to 67,000 tons, and yields from 3370 kg/ha to 2300 kg/ha Rice varieties presently used in Chile have some less favorable properties they are not very resistant to lodging, they have a great height ranging from 1 5 to 1 7 m, and they have a long growing period extending over 150 days Traditional fertilization with N and P showed no yield increase Recent experiments appear to indicate that this unfavorable effect can be corrected by a K supply Investigations are carried out to obtain new varieties better adapted to Chilean conditions (Trop Abstr 24 1719)

COLOMBIA

106 Cuellar, D E, Henao, J M, Perdomo M A 1969 *Evaluation of Chemical Methods for Determining Available Phosphorus in Rice Soils* Bogota D E Colombia Instituto de Asunto Nucleares, 44 pp (Sp)

P is one of the most difficult elements to determine in soils in terms of available plant nutrients Six commonly used methods were studied in order to determine their suitability in assessing available P Soil samples were taken at random from rice growing regions in the Departments of Tolima Huila, and Meta The P extraction methods utilized in this research were Bray I, Bray II, North Carolina, Olsen, Bingham, and Truog The evaluation of methods was made by using the radioactive isotope P^{32} and the concept of the "A" value for available P This value, which gives the best measure of the quantities of available P in the soil, was found A highly significant correlation was found for Olsen, Truog, and Bray II methods and a significant correlation for the North Carolina method Therefore, in accordance with experimental results and the correlation coefficient, the order of accuracy for the chemical methods studied was as follows (1) Olsen, (2) Truog, (3) Bray II, (4) North Carolina, (5) Bray I, (6) Bingham

107 Galiano S 1967 *Effect of Nitrogen Fertilizing on the Absorption of Potassium by Rice According to Foliar Analysis* Tecnologia 8(40) 9 19 (Sp)

Leaf analysis showed a close relationship between the percent of N and of K in the plant, suggesting that N increases K uptake For this reason, heavy applications of N may result in K deficiency in K poor soils

108 Morales, G M, Roscero, M J 1968 *Soil Analysis and Rice Fertilizing* Agr Trop 24(7) 404 6 (Sp)

For soils with a pH lower than 5 5 the fertilizer recommendation is 500 kg/ha Thomas slag before seeding, 250 kg/ha 10 20 20 before or at seeding, and 200 kg/ha urea 30-45 days after seeding, for soils which test low in P and K On soils which test high in P and K, 100 kg/ha of a 15 15 15 grade fertilizer should be substituted for 10 20 20 On soils with pH over 5 5, lime may be omitted, 300 kg/ha 10 20 20 should be applied before or at seeding with 200 kg/ha urea added 30 45 days later

109 Ovalle M, I A J 1969 *Recommendations for Rice Cultivation* Arroz (Colombia) 18(190) 14, 18 20 (Sp)

The recommendations presented for rice cultivation in Colombia include soil cultivation spacing, irrigation weed, pest, and disease control, and fertilizer application To prevent damage from *Piricularia oryzae Cercospora oryzae* and *Helminthosporium oryzae* as much as possible, it is recommended to burn infected harvest residues, to avoid using seed from infected crops, to use seed from resistant or early maturing varieties to treat seed with organo mercury fungicides, to apply K fertilizer at sowing time, and to avoid

excessive N application, and to practice crop rotation (Trop Abstr 25 1302)

110 Perdomo, M A, Lopez, J I 1969 *Effect of Lime on the Absorption of P 32 from Fertilizer in Rice Culture* Bogota, D E Colombia Instituto de Asuntos Nucleares, 27 pp (Sp)

Highest yields were obtained from Thomas slag applied at ½ 1½ tons/ha Superphosphate, without lime, did not increase yields over control

PANAMA

111 Espinoza, E, Alvarez, L F, Concepcion, M 1965 *Effect of Nitrogen on the Yield of Rice Varieties of Different Characteristics* Central American Cooperative Program for the Improvement of Food Crops, 11th Meeting Panama, March 16 19, 1965, pp 128 33 (Sp)

The Japanese variety Nilo 2 and Taiman Iku 487 showed greater ability to use high rates of N than the American varieties Bluebonnet 50, Zenith, and Century Patna 231 Because they are less susceptible to lodging short stemmed varieties in general can use more N effectively than can taller varieties Nilo 2 showed increased yield response to up to 500 lb/ha N Optimum rates for Taiman Iku 487 were from 300 375 lb/ha N

PERU

112 Carmen, M L 1968 *Yield of Rice as Affected by Fertilizer Rates Soil and Meteorological Factors* Diss Abstr B 29(4) 1236 (Eng) (Iowa State Univ, Ames)

Response of rice to N, P, and K under different soil and weather conditions was determined from 38 experiments carried out in Peru under flooded conditions during 1964 1965, and 1966 A double cube composite design with one additional check plot/replication was used in all experiments The response of rice was determined by analysis of variance and multiple regression analysis Regression models, including soil and temperature variates, were fitted to the yield data Response to applied N was greater at low soil N, high soil P, and high pH The response to P was greater at low level of soil N and P, respectively Response to applied K was not significant NP, NK, and PK interactions in general were nonsignificant The increase in one additional °C over the mean minimum temperature appears to have a greater positive effect on yield early in the growing season, at heading time, and at the end of the growing season Maximum temperature had a similar effect with the difference that the increase of one additional °C over the mean had positive effect on yield only at the beginning and end of the growing season (FA 2 283)

113 Contreras, M P 1968 *Good Fertilizers in Rice Cultivation* Arroz (Peru) 2(11) 27 8 (Sp)

SURINAM

114 Ahmad, N 1969 *Growing Rice in Three Caribbean Countries* Caribbean Farming 1(4) 6 7 (Eng)

Rice growing in Surinam, Guyana (both exporters of rice), and Trinidad (an importer of rice) are discussed from the viewpoints of varieties best suited, water control, diseases and pests, use of fertilizers and storage, processing and marketing No specific recommendations are made

115 Raktoe, B L, Federer W T 1965 *Statistical Analysis of Fertilizer Response for Rice Yields in Nickerie Surinam–I* Surinaamse Landbouw 13(5) 218 21 (Neth)

Ten simple (non replicated) fertilizer trials with rice were laid down on farmers' fields in the rice district of northwestern Surinam in 1957, the treatments were no fertilizer, 150 kg ammonium sulfate/ha, 250 kg renophosphate/ha, and both fertilizers together The mean paddy yields were 3 80, 4 14, 4 16, and 4 17 tons/ha, respectively, a statistical analysis of the combined results showed that increases over the yield of plots without fertilizer are significant Evidently only N or P fertilizer needs to be applied, for the moment application of 150 kg ammonium sulfate/ha is the more profitable measure (Trop Abstr 21 791)

ASIA

AUSTRALIA

116 Allen, G H 1969 *Rice, Queensland's New Industry* Qd Agr J 95(6) 358 65 (Eng)

During 1967 68 a small rice industry was established in the Burdekin River region of Queensland, Australia Experiments with rice in this region started in 1951 Varieties were tested in the wet and dry season Bluebonnet was selected for initial commercial production during the wet and dry season It responded well to fertilizer, possessed a regular and suitable growth pattern, showed less lodging than other varieties, and produced a milled rice favored by the commercial market Commercial production of Bluebonnet varied between 5 and 6 9 tons/ha Studies with different rates of N showed that yields increased with higher rates of N up to 90 kg/ha, but indicated that 90 kg/ha may be adequate One new variety, SML, produced 6 5 tons/ha at 90 kg/ha and did not respond to higher applications of N Studies are continued to test other recognized varieties, such as Belle Patna, IR 5, and IR 8 (Trop Abstr 25 569)

117 Boerema, E B 1966 *New Fertilizers for Rice* Agr Gaz N S W 77 96 7 (Eng) (Kimberley Res Sta Kununurra, W Australia)

Both anhydrous and aqua NH_3 are good N sources for rice but their application is cumbersome, an extra operation being unavoidable (SF 29 3564)

118 Boerema, E B 1970 *Nitrogen for Rice in New South Wales* Agr Gaz N S W 81(2) 72 6 (Eng)

Plowing of a legume pasture is possibly the best way of supplying N to the soil for the rice crop However, due to the denitrification process under waterlogged conditions much of the N may be lost again N losses can be reduced by late plowing or sod seeding, early flooding, allowing only for a short period between fertilizer application and irrigation, and aerial sowing Anhydrous ammonia has been found to be released over a much longer period than ammonium sulfate Ammonium sulfate has the disadvantage of high losses during irrigations Urea in contact with seed may result in a poor seedling emergence Promising results have been obtained with isobutyl diurea, a new fertilizer containing 32% N Chemicals that inhibit the nitrification in dry soils have given very good results in trials (Trop Abstr 25 2070)

119 Boerema, E B 1965 *Response of Rice to Nitrogen and Phosphorus* Agr Gaz N S W 76(8) 461 65 (Eng)

Twelve factorial N x P fertilizer trials were conducted in 1961 62 and 1962 63 on new rice farms in two irrigation districts of New South Wales The soils were various types of clays and clay loams, varieties planted were Calrose and Caloro, the most extensively used varieties in the area The weather was normal in both seasons average commercial rice yields in the region amounted to 6 7 tons/ha Though significant responses to N fertilizer were obtained in 11 trials, they were usually not large yields increased with ammonium sulfate dosages up to 450 kg/ha on the poorer soils whereas on the richer soils maximum yields were attained with 225 kg fertilizer/ha Responses to P fertilizer were significant in only two trials, in one of these where the land had previously been under pasture, superphosphate at a rate of 225 kg/ha depressed the yield It is concluded that the new farms require only N fertilizer (Trop Abstr 21 294)

120 Boerema, E B McDonald J D 1965 *Fertilizer Requirements of Rice on the Murrumbidgee Irrigation Area of New South Wales The Importance of the Rice Pasture Rotation* Exp Agr 1 11 21 (Eng) (Agr Res Sta, Yanko N S W

N was the most important, and usually the only nutrient necessary for high rice yields in the South Western Riverina Inclusion of a legume pasture phase in the rotation was a very effective means of improving the N status of the soil, but small additions of artificial fertilizer at sowing might be needed for maximum yields Addition of P was rarely necessary except on a few isolated virgin soils where pastures were included in the rotation, ample PO_4 for the rice crop was usually present as a residue from pasture topdressing K and trace elements did not improve rice yields in this area (SF 28 2751)

121 Kleinig, C R, Nobel, J C 1969 *Competition Between Rice and Barnyard Grass (Echinochloa) 2 The Response to Nitrogen Phosphorus, and Sulfur in Pots* Aust J Exp Agr Anim Husb 9(36) 105 12 (Eng)

The results are presented of four glasshouse experiments conducted at Deniliquin, New South Wales, investigating the competition between the *Japonica* rice variety Early Caloro and *Echinochloa* spp grown on Riverina clay A study of the response to N, P, and S showed that tillering of *Echinochloa* spp was favored as level of nutrient supply increased *Echinochloa* spp severely depressed tillering and yield of rice Delayed application of N did not result in any increase in rice yield when competing with *Echinochloa* spp In the absence of *Echinochloa* competition, tillering, and grain yield of rice responded to N and P, but there was no significant yield response to S (Trop Abstr 24 2200)

122 Kleinig, C R, Nobel J C 1967 *The Influence of Flowering Time Nitrogen Supply, and Plant Density on Rice Yield in the Southern Riverina of New South Wales* Aust J Exp Agr Anim Husb 7(28) 465 71 (Eng)

In two field experiments in New South Wales time of flowering was closely related to grain yield of three *japonica* rice varieties Later sowing and increasing N supply delayed flowering For any sowing time and N level Early Caloro flowered first followed by Calrose and then Caloro II Heavy seedling density also delayed the onset of anthesis in Caloro II at each level of N applied Total spikelet production and total dry matter yield increased with increasing N supply The percentage of grain filled spikelets was a major determinant of yield, values ranged from 3% to 83% and percentage decreased as flowering was delayed There was no clear relation between temperature during flowering and low yields (Trop Abstr 23 703)

123 Strickland, R W 1968 *The Effect of Drainage on Physiological Disorders of Rice Grown on the Sub Coastal Plains of the Adelaide River, N T* Aust J Exp Agr Anim Husb 8(31) 212 22 (Eng) (CSIRO, Div Land Res, Darwin)

Rice grown under continuous flooding on the heavy clay soils of the sub coastal plains of the Adelaide River, N T, suffers from leaf chlorosis, premature leaf senescence, root rot, lodging and low yields The effect of periodic drainage on the observed symptoms, of level of plant N, and carbohydrate fractions Fe, Mn, and P, and on soil Eh, pH, Fe, Mn, and N was investigated for two varieties under two drainage regimes, compared with continuously flooded rice Draining the rice twice between the start of flooding and ear initiation prevented severe soil reduction and the onset of the symptoms Yellowing and premature leaf senescence, which started 4 weeks after flooding were associated with ferrous Fe toxicity in the plants, and it is highly probable that sulfide toxicity from about the time of ear initiation onwards also contributed to root rot, lodging, and low yields (FCA 22 247)

124 Strickland, R W 1969 *Fluctuations in Available Mineral Nitrogen in a Flooded Rice Soil on the Sub Coastal Plains of the Adelaide River N T* Aust J Exp Agr Anim Husb 9(40) 532 40 (Eng)

In the Northern Territory, soil from the 0 7 5 cm and 7 5 30 cm layers of N fertilized and unfertilized cropped and fallow plots was sampled at 2 weekly intervals during growth of rice The soil was extracted with sodium acetate acetic acid (pH 4 8) Nitrite N levels fell from 0 4 ppm before flooding to less than 0 1 ppm after flooding Ammonium N reached peak mean levels of 64 and 62 kg/ha in the surface 30 cm of the soil in fertilized and unfertilized plots, respectively 8 weeks after flooding Nitrate N in the surface 30 cm of soil reached peak levels of 45 and 11 kg/ha 2 weeks before flooding and 31 and 28 kg/ha 8 weeks after flooding in fertilized and unfertilized plots, respectively (Trop Abstr 25 1552)

BRITISH SOLOMON ISLANDS

125 *Department of Agriculture, British Solomon Islands Rice Reports* Honiara, v p (Eng)

Semi annual reports on rice crops and fertilizer experiments

BURMA

126 Thant, M, Khin, A 1968 *Relative Efficiency of Phosphatic Fertilizers on Paddy* Union Burma J Life Sci 1 1 3 (Eng)

Triammonium phosphate was 33% and bone meal 19% more efficient than superphosphate for rice cultivation on soil rich in N Farmyard manure and rock phosphate were less efficient than superphosphate, but much cheaper

127 Thant M, Win K 1968 *Determination of Available Phosphorus in Paddy Growing Soils of Burma* Union Burma J Life Sci 1(1) 4 11 (Eng) (Agr Res Inst, Gyogon)

Available P was determined in 124 Burmese paddy soil samples comparing results using Fried and Dean s *A* value method and five soil extraction methods The *A* value method was modified to give consistent results with paddy, including harvest of plants after 6 weeks to eliminate interference from P in the seeds, and application of the radioactive fertilizer in holes at 2 cm intervals in the soil followed by stirring, to insure even application Rates of 40 and 80 lb $^{32}P_2O_5$/acre give identical results so 40 lb/acre was used The pH of soil samples was 4 9 Extractants were (1) 0 03*N* NH_4F + 0 025*N* HCl as the extractant in the ratio of 1 7 soil extractant (2) 0 03*N* NH_4F + 0 1*N* HCl ratio of 1 7 (3) 0 002*N* H_2SO_4 buffered with $(NH_4)_2SO_4$ to pH 3, ratio of 1 20, (4) 0 5*N* $NaHCO_3$, ratio of 1 20, and (5) 0 03*N* NH_4F + 0 03*N* H_2SO_4, ratio of 1 7 Method (4) gave results comparable to the *A* value method on all the soil samples With soil samples from some experiments conducted in 1964 on the effect of urea on paddy, 13 samples were found which had the same pH, amount of organic matter, and exchangeable K If method (4) was used to determine available P on these samples, a correspondence significant to the 1% level was found between P and the yields recorded for these samples in 1964, further indicating that this method of determining the available P is efficient for paddy soils (CA 70 95768p)

128 Thant, V M 1968 *Forms of Phosphate and Their Distribution Throughout the Soil Profiles Under Rice in Burma* Pochvovedenie No 10, 73 81 (Russ) (Univ Druzhby Nar im Lumumby, Moscow, USSR)

The results are reported of a comparative profile study of the forms of phosphate in three types of soil under rice The method of Chang and Jackson was used for fractionation of the phosphates In modifications, shaking time with 0 1*N* NaOH for extraction of Fe phosphates and occluded Al Fe phosphates was reduced from 17 to 4 hours with subsequent digestion lasting 17 hours In the colorimetric determination of total P the interference of Fe^{3+} was eliminated by reduction with a few drops of 2 5% $SnCl_2$ in 10% HCl The soils have a total P concentration of 15 0 164 mg P_2O_5/100 g The content of organic P is 1 33 26 3 mg P_2O_5/100 g The ratio of CaP/(AlP + FeP) is highest in compact soils and lowest in paleo alluvial ones with a laterite horizon Among the occluded phosphates the reduced solution formations predominate in all three soils (CA 70 46438x)

129 Thant, V M 1968 *Use of Phosphorus 32 for the Determination of Available Phosphorus in the Rice Soils of Burma* Agrokhimiya No 9, 70 5 (Russ) (Univ Druzhby Nar im Lumumby, Moscow, USSR)

A good correlation was found between the yield of rice and the amount of available P in the soil P containing fertilizers were usually fixed in the arable stratum In order to achieve reliable results, the green matter of rice should be harvested within 6 weeks after planting rice seedlings (CA 70 10664d)

130 Win K 1968 *Placement of Phosphate Fertilizer in Rice Cultivation* Vie Milieu Ser C 1(2) 109 13 (Eng)

Two phosphate fertilizer placement experiments on rice using P^{32} were conducted in Gyogon and Mandalay under the IAEA program to determine the best method of fertilizer application in rice cultivation The results indicate the highest amount of fertilizer P was taken up by rice plants when the fertilizer was applied broadcast and hoed in afterwards It is important to hoe in the fertilizer when water in the field cannot be completely drained out Rice plants took up less fertilizer P when it was placed at 10 cm and 20 cm depths in localized points

131 Win K, Kyi, T, Hmun, T 1969 *Changes of pH in Gyogon Paddy Soils Under Waterlogged Condition* Union Burma J Life Sci 2(1) 11 15 (Eng) (Agr Res Inst, Rangoon)

Changes of pH value occur when a soil is kept under waterlogged conditions A study of the pH values of rice paddy soil was made for 3 consecutive years, showing a steady rise of pH from 4 26 4 98 to 5 45 6 26 The pH values increased with duration of submergence and reached peak values after 120 days, they declined again on nonsubmergence It is believed that the reduction of Fe(III) to Fe(II) is greatly responsible for the increase of pH by 1 8 units in Gyogon paddy soil during submergence This indicates that a pH value of 1 8 units should be added to the observed pH value when pH determination is conducted for rice growing acid soil having low organic matter content This value can then be used to calculate the amount of lime needed to lime soil to raise soil pH (CA 73 3044k)

CAMBODIA

132 Yasuo, M 1966 *Water Supply, Soil and Soil Productivity in Cambodia* The Center for Southeast Asian Studies, Kyoto Univ Symposium Series, No 3, 93 105 (Eng)

Rice yields in Cambodia were found on an average to increase by 91 kg/ha for every 100 mm increase in annual rainfall, they also increase with the amount of irrigation water available and, consequently, with the degree of reduction of the soil Though the irrigation water generally is poor in nutrients, most rice fields appear to need only N fertilizer whereas dryland crops require NPK fertilizers Two thirds of the 2 3 million ha of rice fields are on sandy alluvial soils, most

of the remainder on clayey alluvial soils, a small area is found on valley floor soils, while floating rice is grown on periodically inundated soils of the Mekong Valley Chemical and mineralogical analyses and pot trials indicated that the most fertile types are the inundated alluvial soils, and the red and black residual plateau soils which are used for dryland crops (Trop Abstr 22 1324)

CEYLON

133 Al Abbas, A H, Siriwardene, P P G L, Weerasekara, D A, Nagarajah, S 1967 *Isotopic Exchange and Availability Studies of Inorganic Soil Phosphorus Fractions on Some Rice Soils of Ceylon* Isotop Plant Nutr, Physiol, Proc Symp Vienna, 1966, 13 25 (Eng) (Int At Energy Agency, Vienna)

Eight rice soils of varying pH (4 4 8 4) and free Fe content were selected for this study Fractionation of soil P compounds, ^{32}P equilibration studies, *A* values isotopically exchangeable P (*L* values) of soils and their inorganic P fractions were determined Two methods of determining available P, namely the Olsen $NaHCO_3$ and the Al Abbas and Barber NaOH $Na_2C_2O_4$, were also tried on these soils The Fe P fraction was the dominant inorganic P fraction in all soils up to a pH of 6 7 This was followed by the Ca P fraction which, however, dominated above this pH The Al P fraction was the least dominant fraction All soils were equilibrated with carrier free ^{32}P for 96 hours to determine isotopic exchange properties of the soil inorganic fractions The total remaining activities and specific activities ranked in the following order Total activity, Fe P > Al P > Ca P Specific activity, Al P > Fe P > Ca P *A* values of the soils and *E* values of the Al P and Fe P followed similar trends showing good correlation NaOH $Na_2C_2O_4$ extracted correlated highly with *A* values, and *E* values of Al P and Fe P fractions (CA 67 116196f)

134 Kathirgamathaiyah, S, Thenabadu, M W, Al Abbas, A H 1968 *Utilization of Nitrogen and Phosphorus by Rice as Affected by Form and Time of Application of Fertilizer Nitrogen Using N^{15} and P^{32}* Trop Agricst 124 1 13 (Eng) (Cent Agr Res Inst, Peradeniya)

Late N application as $(NH_4)_2SO_4$ or urea increased plant height more than early application Irrespective of source, N broadcast 2 weeks before primordial initiation was used more efficiently than when applied at planting Efficiency of N absorption was in the order urea > $(NH_4)_2SO_4$ > NH_4NO_2 > $NaNO_3$ Efficiency of P usage from superphosphate was highest when urea was given 2 weeks before primordial initiation Increased uptake of N and P in the presence of urea was not reflected in significant grain yield increases (SF 33 4841)

135 Nagarajah, S, Al Abbas, A H 1965 *Co-ordinated Contract Program on the Application of Isotopes and Radiation in Rice Cultivation in Ceylon* Trop Agricst 121(1 2) 1 23 (Eng)

Field experiments with lowland rice, conducted at two places in Ceylon in 1964 65, showed that at both locations 60 kg N/ha applied in a single dose 2 weeks before flower primordial initiation (about 4½ weeks after transplanting) resulted in the highest uptake of fertilizer N by the rice plants There was little advantage in splitting the N into several applications An effect of the timing of N on the uptake of fertilizer P_2O_5 was observed in one trial It is concluded that as far as fertilizer uptake is concerned the most efficient time of N application is half way between transplanting and 2 weeks before primordial initiation (16 days after transplanting) at one location, and 2 weeks before primordial initiation (30 days after transplanting) at the other location (Trop Abstr 22 893)

136 Nagarajah, S, Al Abbas, A H 1965 *Nitrogen and Phosphorus Fertilizer Placement Studies on Rice Using N^{15} and P^{32}* Trop Agricst 121(3-4) 89 103 (publ 1967) (Eng)

In a fertilizer trial with rice conducted in Ceylon, 60 kg N/ha as ammonium sulfate and 60 kg P_2O_5/ha as superphosphate were applied in rows either on the surface or at a depth of 5 cm Subplots received radioactive fertilizer Utilization of fertilizer N was higher when the fertilizer was placed at a depth of 5 cm than when it was applied on the surface Placement of P fertilizer or mixing of the two fertilizers before application had no appreciable effect on N utilization However, grain yields did not show significant differences between placements (FA 1 1052, Trop Abstr 23 497)

137 Ota, Y 1968 *Effect of Different Forms of Nitrogen on the Growth and Yield of Indica Rice* Nettai Nogyo 11(4) 137-42 (Jap)

Urea gave significantly higher yields than $(NH_4)_2SO_4$ in acid lateritic paddy field in Ceylon N application to acid lateritic soil of low cation exchange capacity resulted in little increase in the yield of rice due to the root rot caused by the presence of sulfides in the soil Acid lateritic soils of high cation exchange capacity gave a good response

138 Panabokke, C R 1963 *Fertilizer Recommendations for Rice* Trop Agricst 119(3 4) 167 69 (Eng)

The recent results of a rice soil fertility survey and other observations resulted in new recommendations for manuring rice in Ceylon The rice soils are characterized by (1) an inverse relationship between rainfall and soil pH, (2) a P penury in most rice soils, except in those of the flood plains in the dry zone, and (3) an inverse relationship between exchangeable K and both leaching intensity and parent material, the latter effect being marked in particular in the dry zone Improved varieties in the dry zone require 250 kg ammonium sulfate/ha/season For acid sandy soils 56 112 kg urea/ha/season in three applications is recommended the rate depending on the N status of the soil Almost all soils require a basal dressing of 38 76 kg saphos phosphate depending on the P status of the soil Depending on the K status of the soil, K dosages may vary from 28 to 84 kg KCl/ha/season (Trop Abstr 20 2615)

139 Rodrigo, D M 1967 *Prediction of the Economically Optimal Phosphorus Fertilizer Needs of Rice* Trop Agricst 123(3 4) 125 52 (Eng)

Trials were conducted with different varieties of rice grown on various types of soils in different parts of Ceylon in cultivators' fields with dressings of P ranging from 0 to 120 lb

P_2O_5/acre over basal dressings of N and K At harvest the grain yields corresponding to the different P_2O_5 applications were recorded Curves were then fitted to these values using equations of the form $y = a+bx+cx_2$, different soils giving different values for a, b, and c y represented the yield of grain in bu/acre and x the quantity of fertilizer P_2O_5 applied/acre By regression equations and correlations it was found possible to predict the economically optimal quantity of P fertilizer to be applied and the yield response to be expected by determining the soil value for available P as given by the $NaHCO_3$ method of Olsen

140 Takijima Y Gunawardena, S D I E 1969 *Nutrient Deficiency and Physiological Disease of Lowland Rice in Ceylon I Relationships Between Nutritional Status of Soil and Rice Growth* Soil Sci Plant Nutr 15(6) 259 66 (Eng)

P deficiency was found the most frequent symptom in rice plants followed by K and SiO_2 deficiencies and bronzing disease P content in straw was highly correlated with available P in the soil The critical amount of available P causing severe deficiency was less than 1 mg P_2O_5/100 g of soil Ceylon rice varieties Indica had lower SiO_2 content than Japanese rice varieties SiO_2 content in straw in its deficiency level appeared to be below 8%

141 Takijima Y Gunawardena S D I E, Wijeratne, H M S Kanaganayagam, M, Seneviratne, J 1969 *Nutrient Deficiency and Physiological Disease of Lowland Rice in Ceylon II Phosphate Fertilizer Use for Phosphorus Deficiency of the Rice Plants* Soil Sci Plant Nutr 15(6) 267 73 (Eng)

Sufficient level of phosphate application was estimated to be 168 kg/ha P_2O_5 depending on the degree of P deficiency of the soil Increased application of phosphate fertilizers is recommended in view of the high absorption of phosphate by the soils

142 Thenabadu, M W 1966 *Chemistry of Rice Soils and the Principles of Fertilizer Use* Trop Agricst 122(3-4) 101 7 (publ 1967) (Eng)

Properties of flooded rice soils and consequences for fertilizer applications are outlined Submergence increases the pH and electric conductivity of the soil, lowers the redox potential, and results in O_2 deficiency and in formation of CO_2 and CH_4 by anaerobic decomposition of organic matter Except in the oxidizing top layer N is present in the ammoniacal form which is not prone to denitrification, ammonium sulfate is a better fertilizer than nitrates except where the SO_4 ion would be reduced to sulfides, urea should be used on these soils Rock phosphate and bone meal can be used on acid soils, superphosphate on near neutral soils K is readily available but easily leached out Increased solubility of Si may be beneficial, increased solubility of Fe and Mn may cause toxicity (Trop Abstr 23 1795)

143 Thenabadu, W, Jayaratna, J A 1966 *The Potassium Supplying Power of Bathalagoda Rice Soils* Trop Agricst 122(3 4) 159 66 (publ 1967) (Eng)

Flooded rice at Bathalogoda, responds well to N and P but not to K fertilizers though the soils contain only 0 03 0 18 meq/100 g exchangeable K Analyses of the irrigation water showed that this would be able to supply 35 50 kg of K/ha/crop A pot trial with two rice varieties was conducted during two seasons, using a sandy clay loam soil containing 0 06% total K of which 10% was exchangeable K, and a loamy sand soil containing 0 02% total K of which 17 5% was exchangeable K No yield differences were observed between pots flooded with irrigation water, deionized water, or water containing 5 mg K/l This indicates that lack of response to K on these soils is not due to supply of K by the irrigation water but should be ascribed to supply from soil minerals (Trop Abstr 23 1798)

144 Thenabadu, M W, Wickremasinghe K, Perera, T B 1968 *Experiments with Granular Compound Fertilizers on Rice in the Wet Zone of Ceylon* Trop Agricst 124 103 21 (Eng) (Cent Agr Res Inst, Peradeniya)

Sunfoska A, Sunfoska B, and compound fertilizers based respectively on $(NH_4)_2HPO_4$, isobutylidene diurea, and NH_4Cl were compared with ordinary fertilizers in field trials at 19 sites The compound fertilizers generally gave better results than simple fertilizers but there were no definite trends in the performances of the individual fertilizers (SF 33 2387)

145 Weeraratna, C S 1969 *Absorption of Manganese by Rice Under Flooded and Unflooded Conditions* Plant Soil 30(1) 121 25 (Eng) (Univ Ceylon, Peradeniya)

The rate of Mn absorption by 1 week old rice seedlings grown in a greenhouse in pots containing lowland or upland soil which was either flooded to 1 in or kept at 80% maximum waterholding capacity showed a progressive increase, and was particularly high during the 3rd 4th week and the 9th 10th week Rice grown in lowland soil under flooded conditions showed higher Mn absorption and dry matter accumulation than under unflooded conditions, while the reverse was true of rice grown in upland soil The lower Mn absorption and lower yield of rice grown in flooded soil may be partly due to a high soluble Fe content which interferes with Mn absorption (CA 70 95848q)

CHINA

146 Hsu, H 1966 *The Effect of Nitrogenous Seed Fertilization on Rice* T'u Jang T ung Pao No 2, 51 2 (Chin) (Ch'ang Ch'ih Cereals Res Lab, Shansi)

Application of 0 44 kg N/acre 10 20 days after germination is the most effective treatment for rice growth This small amount of applied N to the developing seed promotes root development, with both the root number and root weight in the treated plant being greater than those of untreated rice plants, this results in a higher grain yield for N treated rice (CA 67 53100x)

147 Kuo, C F 1965 *Change in Activity of Terminal Oxidases in the Roots of Rice Seedlings Under Oxygen Deficient Condition* Acta Bot Sin 13(3) 265 77 (Chin)

Air was replaced by N_2 in sealed bottles in which 3 and 7 day old rice seedlings (cv Yinfang) were growing The maximum activity of polyphenol oxidase in the root tip occurred on the fourth day of germination, when O_2 supply was restricted, this activity decreased sharply The activity of

cytochrome oxidase increased steadily to a constant value after 10 days, under O_2 deficiency this activity was reduced but still increased with growth, and this enzyme was thought to play an important part in the tolerance of rice to submergence (FCA 20 1002)

148 Ting, C 1966 *The Effect of Phosphate Fertilizer on Rice Seedling Beds of Kiangk'ou Region* T'u Jang T'ung Pao No 2, 52 4 (Chin) (T'anggen Agr Res Inst , Kueichen)

Phosphate fertilizer stimulated rice seedling growth, with both aerial and subterranean plant parts of the fertilized rice seedlings exhibiting growth superior to the controls The better quality of treated plants was maintained after the seedlings were transplanted (CA 67 53140k)

149 Yu Chiang Agricultural Extension Station 1966 *A Preliminary Report on the Experiment of Fertilizing Rice by Dipping Seedlings into a Soil Paste Containing Calcium Magnesium Phosphate and Ammonium Sulfate* T'n Jang Hsueh Pao 14 94 5 (Chin) (SF 29 3551)

HONG KONG

150 Siak, P L , Lau, S C 1968 *Nitrogen Response of Exotic Rice Varieties in Hong Kong* Agr Sci Hong Kong 1 1 12 (Eng)

On a poorly drained soil of pH 5 9 all varieties (one local and nine introduced from the International Rice Research Institute) responded to up to 120 lb/acre N as $(NH_4)_2SO_4$ The higher N levels increased the incidence of empty panicles caused by neck rot and stem borers (SF 32 3199)

INDIA

151 Abraham, T P , Jha, M P 1968 *Statistical Analysis and Results of a Series of Experiments to Estimate the Residual Effect of Phosphate* Indian J Agr Sci 38(4) 605 19 (Eng)

Long term experiments with superphosphate application, among others on continuously grown rice in India, showed considerable direct and residual responses The direct response of rice varied from 280 to 620 kg/ha dependent on the level of application The first residual response to 22 4 or 44 8 kg P_2O_5/ha was equivalent to direct applications of 7 or 16 kg P_2O_5/ha, respectively The second residual response was relatively lower The cumulative response from annually applied fertilizer was significantly higher than the direct response but was less than the sum of the direct and residual responses Fertilizer dressings applied once in 3 years were more advantageous than those applied every year (Trop Abstr 24 1257)

152 Abraham, T P , Jha, M P , Prasad, R 1969 *Studies on Time of Application of Nitrogen to Rice ("Oryza sativa" L)* Indian J Agr Sci 39 1088 97 (Eng) (Inst Agr Res Statistics, New Delhi)

In field experiments with transplanted paddy the treatments consisted of all combinations of seven times of application of two N sources–$(NH_4)_2SO_4$ and urea There was no significant interaction between the time of application and the two sources The differences in response to different application times were only significant in a few cases Split application was superior to single on long duration varieties grown on heavy soil (SF 33 4088)

153 Abraham, T P , Raheja, S K 1967 *An Analysis of Growth of Production of Rice and Wheat in India* Indian J Agr Econ 22(3) 1 15 (Eng)

From 1951 52 to 1964 65, rice production in 13 Indian states with 97% of the Indian rice area increased by 12 6 million tons A mathematical analysis indicated that 7% of this increase was due to increases in the nonirrigated area, 16% to increases in the irrigated area, 77% to increased fertilizer use, the production increased by about 825 kg/additional nonirrigated ha, by about 1650 kg/additional irrigated ha and by 25 tons for every extra ton of fertilizer used Corresponding figures for wheat in seven states with 94% of the total area were 30%, 35% and 35%, 825 kg 2500 kg and 17 tons, respectively Yields per ha of both crops increased mainly because of increased fertilizer use However, other factors which may have contributed to the increases such as the introduction of improved varieties were neglected in the analysis (Trop Abstr 23 697)

154 Ahmed, M K 1966 *The Effect of Various Forms of Nitrogen on Rice Yields and Their Relative Efficiency* Indian Agr 10(2) 144 6 (Eng)

N fertilizer as $(NH_4)_2SO_4$, $(NH_4)_2SO_4NO_3$, $CaNH_4NO_3$, and urea, were applied in a single application and $CaNH_4NO_3$ also in a split application Split application gave statistically significant results only during the rainy season The yield was proportional to the ammoniacal form of N applied

155 Arora, S K 1969 *Blue Green Algae A Source of Nitrogen and Organic Matter in Paddy Fields* Riso 18(1) 63 6 (It)

From a review on N fixation of blue green algae in rice fields in India, the author concludes that rice yields can be increased more by blue green algae, than by applying artificial fertilizers, provided the rice fields are inoculated at least 1 month before transplanting The application of basic slag is recommended for the supply of Ca, P, and trace elements (Trop Abstr 24 2202)

156 Arora, S K 1969 *The Role of Algae on the Availability of Phosphorus in Paddy Fields* Riso 18(2) 135 38 (It)

In India, rice soil was inoculated in laboratory trials with the algae *Anabaena naviculoides, Tolypothrix tenius* and *Chlorella vulgaris* The availability of P increased with the growth of algae, due to excretion of organic acids in the medium It was concluded that algae play an important role in the fertility of paddy fields by fixing atmospheric N, adding organic matter, and increasing the availability of nutrients (Trop Abstr 25 559)

157 Bajaj, J C , Gulati, M L , Tamhane R V 1967 *Correlation Studies of Soil Tests for Available Nitrogen with Nitrogen Uptake and Responses of Paddy and Wheat* J Indian Soc Soil Sci 15(1) 29 33 (Eng)

Pot trials with rice and wheat were conducted in India on 11 different soils (pH = 5 2 7 1) to test eight methods of

determining available soil N For rice, all methods showed significant correlations with yield and N uptake Oxidation by alkaline $KMnO_4$ showed the highest correlation with yield (r = +0 0856) and uptake (r = +0 989), immediately followed by determination of mineralizable N by standard incubation for 30, 15, 60, and 45 days, respectively Lower correlations were found for hydrolyzable N and organic C percentages In general correlations with N uptake were higher than those with yield For wheat, only $KMnO_4$ appeared of interest Prediction values showed the superiority of $KMnO_4$ (Trop Abstr 23 24)

158 Bala Narsaiah, G , Suryanarayana Rao, R 1968 *Studies on the Effect of Time of Nitrogen Application on the Yield of Paddy* Indian J Agron 12 416 21 (Eng) (Andhra Pradesh Agr Univ , Rajendranagar)

The effects of $(NH_4)_2SO_4$ at 22 4 67 2 kg/ha N on grain yields of manured paddy (12 tons/ha dung 2 weeks before transplanting 44 8 kg P_2O_5 applied during the last puddling) on a sandy clay loam (pH 7 7) were not significant, but an application of 44 8 kg was optimal for the short duration variety H R 19 split application of N (one half at planting and one half 2 weeks before flowering) was significantly better than any other treatment (SF 30 4506)

159 Balasubramaniam, B , Kalyanikutty, T , Srinivasan, V , Palaniswamy, K M Purushothaman, G 1967 *Calcium Ammonium Nitrate A Fertilizer to Paddy* Madras Agr J 54(3) 127 30 (Eng) (Paddy Breeding Sta , Coimbatore)

Experiments are conducted to assess the comparative efficacy of Ca ammonium nitrate with $(NH_4)_2SO_4$ and urea as fertilizers in the paddy fields No significant difference in yields among the different fertilizers is observed (CA 67 72903c)

160 Ballal D K Joshi R P 1968 *Effect of Nitrogenous Fertilizers on the Quality of Paddy Grain and Straw* Nagpur Agr Coll Mag 40(2 2) 67 9 (Eng)

A pot experiment was conducted to study the effect of $CaNH_4NO_3$ on composition of paddy in comparison with $(NH_4)_2SO_4$ and urea Half the N was applied at transplanting and the remaining half at the tillering stage After harvesting, the grain and straw were throughly dried and weighed separately to determine the N P, K, and Ca contents $CaNH_4NO_3$ had the greatest effect on the nutrient content of both the grain and straw The quality is affected more by higher rates of fertilizer application than lower rates

161 Bandyopadhya A K , Adhikari, M 1968 *Effect of Fertilizers on the Availability of Trace Element in Rice Soils* Riso 17(4) 265 70 (Eng)

High doses of N and P ($N_{100\ 8}P_{22\ 4}$ $N_{134\ 4}P_{44\ 8}$) decreased soil pH and increased the availability of Zn and Mn Availability of Cu was not affected by high rates of fertilization Ammonium sulfate was slightly more effective than urea or calcium nitrate in increasing Zn availability Heavy application of phosphates increased exchangeable and water soluble Mn in soils but the effectiveness of different phosphate sources varied with different soils

162 Bandyopadhya, A K , Adhikari, M 1968 *Trace Element Relations in Rice Soils I Alluvial Soils of West Bengal* Soil Sci 105(4) 244-47 (Eng) (Univ Coll Sci Tech , Calcutta)

The status of Zn, Cu, and Mn and their interrelations in some alluvial soils of West Bengal were investigated Total and extractable (exchangeable) Zn ranged from 30 8 to 76 8 and from 0 51 to 6 2 ppm, respectively Total and extractable (exchangeable) Cu ranged from 18 6 to 36 4 and from 0 25 to 0 53 ppm, respectively Total, exchangeable, reducible, and water soluble Mn varied from 240 to 350 from 23 0 to 30 4, from 30 5 to 105 1, and from 0 10 to 0 32 ppm, respectively The yield of rice from these soils is not likely to be increased by applying these elements The average values of total Zn, Cu, and Mn were about 26 , 70 , and 10 fold, respectively, the average values of the corresponding exchangeable elements Positive correlations were found between total and extractable Zn, total and extractable Mn, total and reducible Mn, and total and water soluble Mn but not between total and extractable Cu A negative correlation was found between pH and extractable Zn, pH and exchangeable Mn, and pH and water soluble Mn but not between pH and extractable Cu or between pH and reducible Mn An increase in soil pH results in a decrease of availability of Zn and Mn by converting them to unavailable forms A positive correlation was found between the amount of organic matter and extractable Zn and between the amount of organic matter and reducible Mn but no correlation was found between the level of organic matter and the extractable Cu, extractable Mn, and water soluble Mn levels No correlation was found between the silt plus clay content and either the Zn, Cu or Mn levels which is opposite to that found previously in Punjab soils (CA 68 94910a)

163 Banerjee, P K , Sinha H 1966 *Nitrogen Manganese Interrelationships in Soil and Plant* Ranchi Univ J Agr Res 1 33 7 (Eng) (Ranchi Agr Coll , Kanke)

In pot experiments with paddy and wheat grown on acid sandy loam (pH 5 5), $(NH_4)_2SO_4$ was superior to $NaNO_3$ (at 100 lb N/2 million lb soil), and both applied in conjunction with 50 lb $MnSO_4$ increased the availability of soil Mn Liming reduced soluble and exchangeable Mn in soil and Mn uptake by plants (SF 31 4360)

164 Barche, N B , Singh, R , Rajaendra Singh, K 1968 *Response of Upland Paddy to Fertilizer Application* Fertilizer News 13(7) 44 (Eng)

Application of N either alone or in combination with P_2O_5 resulted in significant increases in grain yield Maximum yield of 2991 79 kg/ha was obtained by application of 44 8 kg N and 44 8 kg P_2O_5/ha followed by the treatment 44 8 kg N alone, the difference in yield between these two treatments was not significant Application of N beyond 44 8 kg did not increase yield

165 Basu Ray Chaudhuri, N C 1968 *Response of Paddy to Fertiliser Application* Fertilizer News 13(2) 29 31 (Eng)

Test results showed a marked and consistent increase in grain yield per plot in Taichung 65, as the fertilizer applications were increased from 0 to 140 kg N/ha Similar trend of higher yields was also obtained in Taichung Native 1 up to 112 kg level, but in *Churnakati*, yield decreased gradually above 28 kg N The degree of response to nitrogenous fertilizers in high yielding varieties is dependent on tillering

166 Bhattacharya, A K 1969 *Changes of Ammonium Sulfate in Waterlogged Rice Soils* J Indian Soc Soil Sci 17(4) 411 15 (Eng) (Visva Bharati, Santiniketan)

Waterlogged soil samples were collected from 0 15 cm depths from rice fields, and $(NH_4)_2SO_4$ was added (30 ppm N) Rice seedlings were added to the soil samples, which were maintained in a greenhouse for 30 days Plants were analyzed for total N and HF HCl soluble NH_4^+N Recovery as NH_4^+N was 56% 106% of added N Exchangeable NH_4^+ was determined by the KCl extraction method A portion of added N entered into an exchangeable complex, a portion was fixed within crystal lattices, and another portion in some soils underwent a transformation whose chemical nature was not understood All these NH_4^+ forms were available to the plants However, fixed native NH_4^+ was only available to a limited extent (CA 73 108792f)

167 Bhattacharyya, D P, Sircar, S M 1966 *Studies on the Physiology of the Rice Plant XVII Nutrient Deficiency Symptoms and Metabolism of Leaves at Different Stages of Maturity* Indian J Agr Sci 36(2) 47 66 (Eng)

At Calcutta, India, the rice variety Bhismanik was grown in sand culture at deficiency levels of N, P K, or Ca P deficiency resulted in reduction of protein N in early leaves, total and protein N accumulation in later leaves, accumulation of sugar, higher total acidity, and reduced respiration rates K deficiency was characterized by a lower protein content and high soluble N content and by an increased respiration rate N deficiency resulted in sugar accumulation and in a high respiration rate at tillering, indicating that reduction in growth is not due to an effect on carbohydrate metabolism Ca deficiency did not significantly affect N and carbohydrate metabolism (Trop Abstr 22 1335)

168 Bhumbla, D R, Rana, D S 1965 *Effect of the Time of Application of Fertilizers on the Yield and Chemical Composition of Rice* J Res Punjab Agr Univ 2 84-91 (Eng) (Punjab Agr Univ, Hissar)

Applying Ca ammonium nitrate at maximum tillering was better for growth and yield than application at transplanting, boot stage, or ear emergence N utilization was 20 8% and 77 7% when applied at puddling and maximum tillering Applying P at maximum tillering tended to give higher yields than application at transplanting The former treatment gave higher P content of the grain but P content of the straw was greater in the latter K had no effect on yields (SF 30 3023)

169 Borthakur, H P Mazumder N N 1968 *Effect of Lime on Nitrogen Availability in Paddy Soil* J Indian Soc Soil Sci 16(2) 143 47 (Eng)

In experiments conducted in Assam, liming of highly acid rice field soils (pH 4 5 5 5), mainly consisting of silty loam or silty clay loam, resulted in an increased N content (both mineral and total) of the soils under low moisture conditions However, under waterlogged conditions the total N content of the soils was decreased while mineral N content was not significantly affected Under both moisture levels, N uptake by rice seedlings was significantly increased by liming, while under waterlogged conditions the N uptake was correlated with the mineral N content of the soil (Trop Abstr 24 536)

170 Chadha, T R 1967 *Paddy ADT 27 Package Approach Gives Optimum Return* Fertilizer News 12(3) 20 2 (Eng)

The success of the high yielding varieties is primarily dependent on the use of all the recommended package of practices that are considered necessary to obtain optimum results These include proper spacing between plants proper intercultural operations, the application of timely and adequate quantities of irrigation water and of balanced fertilizers pesticides and insecticides, etc ADT 27 not only gives substantially higher yields than the local varieties with the adoption of the complete package of practices, but also responds well to a higher level of potash (equivalent to that of N applied) To achieve desired yields and economic returns, it is very essential that the required minimum inputs are assured and made available to the farmers at the correct time and at the right places

171 Chandrasekaran, M, Raj D 1969 *Influence of Modes of Fertilizer Application on Nutrient Uptake and Yield of Paddy Grain and Straw* Madras Agr J 56 767 71 (Eng) (Agr Coll Res Inst, Coimbatore)

In pot experiments on clay and sandy loam, a single application of 60 lb N, 40 lb P_2O_5, and 30 lb K_2O/acre as $(NH_4)_2SO_4$, single super, and K_2SO_4 at planting gave higher grain and straw yields than double or triple split applications (SF 33 4080)

172 Chakravorty, A K, Mukherjee P N Lahiri, A 1966 *Effect of Coal Fertilizers on Paddy and Wheat Yield* Indian J Agron 11(2) 193 97 (Eng) (Cent Fuel Res Inst, Dhanbad)

Coal fertilizer was prepared by passing a mixture of air and NH_3 through heated coal particles at 325° for 4 6 hours, yielding a 12%-20% N fertilizer which had many of the characteristics of soil humus About 65% of the N was in cyclic compounds not immediately available to the plant For effect on paddy, 30 or 60 lb N/acre was applied, while for wheat, 20 or 40 lb total N/acre was applied $(NH_4)_2SO_4$ and oil cake (5 5% N) were used for comparative purposes, and 40 lb P_2O_5 (in superphosphate) + 20 lb K_2O in KCl/acre were applied at sowing $(NH_4)_2SO_4$ gave higher yields for the first 2 years, but from the third year on, the N enriched coal gave higher yields, probably due to leaching of N from other fertilizers and the residual N from the coal fertilizer becoming available (CA 67 21133u)

173 Chatterjee, S C 1969 *Availability and Uptake of Phosphorus by Rice and Barley from Phosphate Fertilizers in the Red Soil of Sindri* Technology 6(1) 24 30 (Eng) (Fert Corp India Ltd, Sindri)

P availability and uptake by Sindri red soil, treated with water soluble, citrate soluble and citrate insoluble P fertilizer was studied Aman paddy under waterlogged condition was grown in pots and it was found that NH_4^+ phosphate gave higher yield and uptake, followed by nitrophosphate triple superphosphate, superphosphate, and least by rock phosphate In case of barley grown on the same soil nitrophosphate gives better results as a residual effect followed by superphosphate and triple superphosphate and the least by NH_4^+ phosphate Citrate soluble phosphate gave better results on higher doses of application and supplied phosphates to plants for a longer period, possibly due to the increase in available phosphate at

higher doses of application and also release of the P_2O_5 slowly (CA 72 42358q)

174 Chaudhry, M S 1965 *Form, Method, and Time of Application of Nitrogenous Fertilizers to Rice* Oryza 2(1) 175 76 (Eng)

Field experiments have been conducted at the Central Rice Research Institute to find means of increasing the efficiency of $(NH_4)_2SO_4$, $CaNH_4NO_3$, and urea by rational application Subsurface, split applications are the best with the last dose being given at the boot stage

175 Choubey, S D, Nema, V P, Shrivastava, A K, Bakshi, S 1967 *Effect of Different Forms, Levels, Time, and Methods of Applications of Nitrogenous Fertilizers on the Growth and Yield of Paddy* JNKVV Res J 1(2) 158 62 (Eng)

Studies on the effect of different forms, levels, and time of application of nitrogenous fertilizers were undertaken under the soil and climatic conditions of Jabalpur Three years' studies indicated that for early variety, the entire quantity of N can be profitably applied at the time of planting, but split application will be more advantageous in the case of medium to late varieties Subsurface application of nitrogenous fertilizers was found to be superior to surface method

176 Choudhury, S P, Pal, L M, Roy, D R 1969 *Response of IRRI Paddy Varieties to N in Tripura* Fertilizer News 14(9) 37 9 (Eng)

Application of N at rates of 45, 90, and 135 kg/ha affected the yield significantly and the response to fertilizer was linear There was no significant difference among the varieties (Taichung Native 1, IR 8, and Kaoshiung 68) in respect to grain yield Taichung Native 1 gave the highest yield of 3793 35 kg/ha Interaction effect was not found to be significant Yield components, such as the number of effective tillers, number of fertile grains per panicle, and length of panicle, had a positive relationship with N levels in Taichung Native 1 and IR 8

177 Chowdhury, B, Dhua, S P 1967 *Studies on the Relative Efficiencies of Nitrophosphates and Other Nitrogenous and Phosphatic Fertilizer Combinations* Technology 4(4) 126 33 (Eng)

In a trial with irrigated rice (Patnai 23), conducted in Bihar State (India), rock phosphate and superphosphate each combined with $(NH_4)_2SO_4$, urea or ammonium phosphate nitrate, and carbonitric and sulfonitric nitrophosphate were applied at dosages equivalent to 56 and 112 kg N and P_2O_5/ha The upper level gave taller plants a higher initial rate of growth and tillering, more effective tillers, and a higher yield of grain and straw over the low level and control Soluble P increased the number of effective tillers by some 80%, the grain yield by some 40%, and straw production by more than 100% over those obtained with rock phosphate and in the controls, it also tended to promote early death of tillers The source of N had little effect (Trop Abstr 23 2241)

178 Daniel, K V 1970 *Nitrogen Requirements of Semi Dry Rice in Trivandrum, Kerala* Indian J Agr Sci 40(3) 288 90 (Eng)

An experiment was carried out to study the response of semi dry rice to graded dose of ammonium sulfate, applied as basal and topdressing Ammonium sulfate was added at the rates of 33 6 and 67 2 N/ha, alone and in combination with farmyard manure to supply 16 8 and 33 6 kg N/ha The grain yield increased significantly for every higher dose of N applied up to 50 4 kg N/ha Increased yield was obtained by topdressing the fertilizers at all levels of N tried A dose of 50 4 N as ammonium sulfate with or without farmyard manure can be topdressed on the 30th day after sowing with definite increase in grain yield

179 Das, P, Vig, A C, Bhumbla, D R 1968 *Effect of Chlorocholine Chloride on the Growth Characteristics, Lodging, and Yield of Rice* J Res, Punjab Agr Univ 5(1) 33 9 (Eng) (Punjab Agr Univ, Punjab)

Chlorocholine chloride (*I*) was applied as a spray at 4 lb/acre to rice Three different levels of fertilizer N (calcium ammonium nitrate at 40, 80, and 120 lb N/acre) were also applied *I* reduced the length of basal node, and increased the diameter of the second node significantly A dose of 4 lb *I* gave yield responses equal to 40 lb of N fertilizer However, a combination of 4 lb *I* and 40 lb N/acre gave a 39% increase in the yield of rice over the fertilizer alone (CA 70 2648m)

180 Das, B, Vig, A C, Gupta, V K 1968 *CCC Improves the Yield of Rice* Farm J (Calcutta) 9(7) 19 21 (Eng)

The high potential of the short statured varieties of rice is due to the fact that they can withstand high doses of fertilizers without lodging Cycocel (CCC) is a recently developed growth retardant which has been used to reduce the stem length, allowing the plants to withstand higher doses (20%-30%) more N than customary

181 Das, K C, Misra, A, Pandey, J 1970 *Effect of Split Application of Potash on Rice* Fertiliser News 15(8) 49 51 (Eng)

A field trial in the lateritic sandy soil of Bhudaneswar was conducted in *kharif* 1969, to study how the utilization of potash was influenced by split and customary basal application at two levels of K_2O (100 and 200 kg/ha) in conjunction with two levels of N (100 and 150 kg/ha) on dwarf Indica rice IR 8 Results indicated that split application of potash was significantly superior to its application only as basal dose, the forme giving a significant 8% higher grain yield over the latter The interaction between levels of N and levels of K_2O indicated that utilization of N could be impeded when potash was limiting and vice versa The interaction between levels of potash and method of application was not significant

182 De, R Mohta, N K, Sharma, S K 1967 *Fertilizer Fed Through Leaves Raises Paddy Yields* Indian Farming 17(3) 17 (Eng)

The highest efficacy of grain production per kg of N applied was noted in the treatment where 40 kg of N was applied to the soil and 40 kg of N applied through foliage The net economic return per rupee invested in fertilizer was also the highest under this treatment

183 Dhua, S P 1965 *Efficiency of Various Forms of Phosphate in Crop Plant Nutrition II Response of Aman Paddy in Field Trials* Technology 2(2) 82 6 (Eng) (Fert Corp India Ltd, Sindri)

Multiphosphate, fused Ca Mg phosphate, calcined phosphate, and superphosphate, were evaluated at 25, 50, and 100 lb/acre on Patnai 23 rice in the soil of Aman paddy The soil contained 27 95% clay, 21 22% silt, and 45 95% sand, its chemical analysis indicated 1 211% organic C, 0 154% total N, 0 185% total P_2O_5, 0 941% total K_2O, pH 8 4, base exchange capacity 24 151 meq/100 g, exchangeable K 0 361, exchangeable Na 1 176 The Japanese procedure of seed selection and seedbed preparation was used Multiphosphate, 100 lb/acre, was superior to the other fertilizers in grain and straw yields in an average of eight replicates (CA 64 13345h)

184 Dhua, S P Chowdhury, B 1966 *The Relative Efficiencies of Nitrophosphate and Other Nitrogenous and Phosphate Fertilizer Combinations I Response of Aman Paddy in Field Trials* Technology 3(2) 78 86 (Eng) (Fert Corp India Ltd, Sindri)

The effects of nitrophosphate, ammonium phosphate sulfate, superphosphate ammonium sulfate, superphosphate ammonium nitrate, superphosphate, and ammonium sulfate were examined on the growth and development of the Patnai 23 variety of rice grown under puddled conditions Comparative experiments were made on the plant heights, number of tillers formed, yields of rice straw and grain, and uptake of N and phosphate by the rice plants under the action of the above fertilizers at the 50 and 100 lb levels of N + P_2O_5/acre There is little difference in the various fertilizers used (CA 67 21170d)

185 Dhua, S P, Roy, A K, Chakravorty, K R 1964 *Efficiency of Various Forms of Phosphate in Crop Plant Nutrition I Response of 'Aus' Paddy in Pot Cultures* Technology 1(3) 12 18 (Eng) (Fert Corp India, Sindri)

The effect of base fertilizing with three thermal phosphates (defluorinated calcined phosphate, fused calcium magnesium phosphate, and multiphosphate, the latter prepared by adding liquid phosphate before calcination) and super on paddy are compared Plants given multiphosphate showed the most rapid growth best utilization of applied P and highest uptake of N and K (SF 28 2760)

186 Dhua, S R 1964 *Agronomical Significance of Carbon Nutrition II & III Studies on the Efficiency of Various Forms of Ammoniacal Nitrogen, Responses of "Aus" Paddy in Pot Culture and in Field Trials* Technology 1(4) 36 52 (Eng) (Fert Corp India, Sindri)

In pot experiments with NH_4HCO_3, $(NH_4)_2CO_3$, $(NH_4)_2SO_4$, and NH_3 on neutral loam, NH_4HCO_3 was the most effective source for promoting vegetative and reproductive growth under dry conditions Under waterlogged conditions $(NH_4)_2CO_3$ was best The yield of rice tops was significantly higher under dry than under waterlogged conditions, the opposite was true of roots Waterlogged plants took up significantly larger amounts of P than corresponding dry plants Waterlogged rice roots had 40% less C than corresponding dry roots In field experiments, plants receiving $(NH_4)_2CO_3$ and NH_4HCO_3 showed more rapid growth and higher grain and straw yields than those given the other N compounds (SF 28 4016)

187 Dhua, S P, Roy, S 1968 *Response of Aman Paddy and Potato to Soil and Foliar Applications of Various Nitrogenous Fertilizers* Technology 5(2) 124 26 (Eng) (Fert Corp India Ltd, Sindri)

Foliar application proved superior to soil applications as regards straw yields of paddy, though no such difference was discernible with tuber yields of potato Among the fertilizers used, NH_4HCO_3 proved superior in encouraging straw yield of paddy though no significant difference could be obtained for tuber yields of potato The response of paddy to various levels of application was manifested by an increased straw yield and a decreased grain yield with increasing levels of N Potato responded with increasing tuber yields with soil application, while a reverse trend was observed for foliar application (CA 70 46492k)

188 Datta, N P, Kalbande, A R 1967 *Correlation of Response in Paddy with Soil Test Potassium in Different Indian Soils* J Indian Soc Soil Sci 15(1) 1 6 (Eng)

In a pot trial with rice grown in soils from different regions in India, relations were examined of 10 different methods to determine soil K, yield, and K uptake Plants received no nutrients, N + P, or NP + K at three different levels In soils with a pH over 6 5, containing free lime, in which illite was the dominant clay mineral, the yield response was significantly correlated with K extracted by 1*N* H_2SO_4 for 30 minutes Extraction by 1*N* NH_4 acetate of soils containing less than 20% clay was superior for the evaluation of exchangeable and water soluble K, if less than 0 2 meq K/100 g soil is present, whereas 6% ammonia solution + 7% acetic acid was better when the soil contained more K No correlation was found between methods of extraction and K uptake at the tillering stage (Trop Abstr 23 25)

189 Datta, N P, Shinde, J E 1965 *Yield and Nutrition of Rice Under Upland and Waterlogged Conditions –Effect of Nitrogen, Phosphorus and Silica* J Indian Soc Soil Sci 13(1) 53 60 (Eng)

Studies conducted at New Delhi showed that N and P benefited the dry matter yield of rice more under waterlogged than under upland conditions Si increased the yield irrespective of the conditions of growth N under waterlogged conditions did not influence the total uptake and contents of either N or P No significant interaction occurred between N and conditions of growth as regards percent fertilizer P uptake, utilization, and P availability P increased under waterlogged conditions both percent utilization of added P and P availability but the crop met its major demand from the soil Si did not influence percent fertilizer P uptake and P availability but under waterlogged conditions decreased utilization of applied P and total N uptake The Si content increased under both but more markedly under the upland conditions (Trop Abstr 21 289)

190 Datta N P, Venkateswarlu J 1968 *Uptake of Fertilizer Phosphorus and Nitrogen from Different Methods of Application by Lowland Rice Growing on Major Indian Soils* Trans 9th Int Congr Soil Sci 4 9 18 (Eng) (Agr Res Inst, New Delhi)

There was no significant difference in availability and utilization of P fertilizer as superphosphate applied at the

surface or at 5 cm depth NH_4NO_3 increased P availability when the fertilizers were mixed N was best applied at 5 cm depth (SF 32 3194)

191 Datta, S 1968 *Effects of Split Application of Potash on Yield of Paddy* Potash News Letter 3(12) 3 pp (Eng)

The magnitude of response to split application of K_2O as against single application varied from 158 kg in Alleppey district to 276 kg in Palghat district The average response for all districts obtained from 35 demonstrations amounted to 194 kg/acre or an increase in yield of 9%

192 Deshpande M R, Kunkalkar, O G, Rangaroa, D S 1966 *Cumulative Response of Paddy to Nitrogen and Phosphoric Acid in North Konkan Area of Maharashtra State* Poona Agr Coll Mag 56(3-4) 29 35 (Eng)

Five different fertilizer experiments on paddy were conducted (1) three levels of N, P_2O_5, and K_2O, (2) three levels of N P_2O_5 and farmyard manure, (3) three levels of N, P_2O_5 and three forms of N, (4) three levels of N, P_2O_5, and three mid late strains of paddy, and (5) three levels of N, P_2O_5, and three late strains of paddy were carried out during two seasons of 1954 and 1955 In grain yields straw yields height of plants and number of tillers, the response of paddy to N was significant at both the levels of 20 and 40 lb/acre There was no effect of phosphoric acid fertilizer on the crop of paddy

193 Dikshit N N, Sahai B Gupta, J C Singh, K P N 1967 *Breeding Rice Varieties Responsive to Nitrogen Fertilization in Uttar Pradesh I Screening Different Strains for Potential at Two Levels of Fertility* Madras Agr J 54(9) 489 91 (Eng)

The response of 18 rice strains, differing in maturity, to 45 kg and 90 kg N/ha was investigated in small field trials Early and medium strains produced more tillers at the higher than the lower N level the difference was more pronounced in medium strains All tillers bore ears in early strains but not all in mid season ones The difference in the number of tillers in late season strains at the higher N level was not marked The duration of mid season strains tended to be shorter at the lower than at the higher N level, but early and late season strains showed variable response to N Early strains at the higher fertility level gave the highest grain yields 63 74 6 kg/ha, followed by 56 5 65 6 kg/ha for mid season strains and 53 9 59 1 kg/ha for late ones (FA 1 1471)

194 Enyi, B A C 1965 *Analysis of Growth and Yield of Upland and Swamp Rice Varieties Under Nigerian Conditions* Indian J Agr Sci 35(3) 216 33 (Eng)

An experiment to study the growth and yield of Agbede upland rice and of the BG 79 and Black Paddy swamp rice varieties was conducted in Nigeria The three rice varieties behaved differently in their growth habits BG 79 outyielded Agbede and Black Paddy by 66% and 101%, respectively N significantly increased the grain yield the ear length the total dry weight and the leaf area in all the varieties Split N application for Black Paddy was suggested, applications to be made at the time of sowing the mid vegetative stage 9 10 weeks after sowing, and a week after ear emergence For Agbede and BG 79 only two split N applications are suggested, viz at the time of sowing and at the time of ear emergence (FA 21 1015)

195 Finfrock, D C, Donahue, R L 1965 *The Efficiency of Various Nitrogenous Fertilizers for Paddy* Chem Age India 16(10) 851 54 (Eng) (Ford Found New Delhi)

Studies show that only NH_4^+ or urea fertilizer should be used on paddy Per unit weight of N, NH_4NO_3, and $Ca(NO_3)_2\ 4H_2O$ are as effective as urea or NH_4^+ fertilizer on all upland crops on most soils, but are not efficient when used as a basal dressing on paddy For most efficient use, fertilizers for paddy should be placed 2 4 in deep in the soil, and applied either all at preplanting or part at preplanting and part as topdressing before the floral parts start to grow, normally 25 30 days before ear emergence (CA 64 4215)

196 Gopalakrishnan, M D 1968 *Productivity and Profitability of ADT 27 in Thanjavur District* Indian J Agr Econ 23(4) 65 9 (Eng)

In Thanjavur district (India), a field survey was conducted to study the economics of growing the introduced rice variety ADT 27 This variety is nonlodging, has a high fertilizer response and is less susceptible to pests than the local varieties It was found that the introduction of the high yielding strain, ADT 27, has raised the agricultural production on a massive scale, most of the farmers have switched over to this variety as they get better economic returns from their farms as a whole (Trop Abstr 24 1493)

197 Grewal J S, Randhawa N S, Bhumbla, D R 1969 *Effect of Micronutrients on Yield of Rice and Maize* J Res, Punjab Agr Univ 6(1) 38 45 (Eng) (Punjab Agr Univ, Ludhiana)

Spray application of $ZnSO_4$ increased the yield of rice and maize in all soils containing $\leqq$ 0 68 ppm available Zn Responses of rice and maize to $FeSO_4$ application were significant in Ludhiana soil only (which contained 11 8 ppm exchangeable Fe) $MnSO_4$ application increased the yield of rice in Rohtak and Karnal soils which contained 1 5 and 3 1 ppm exchangeable Mn, respectively Responses to the application of B Cu, Mo and Mg were inconsistent and not significant (CA 73 13609n)

198 Husain, M M 1967 *Rice Yield as Influenced by Fertilizer Level and Spacing* Indian J Sci Ind 1(3) 127 31 (Eng)

A trial conducted at Hyderabad India, during two successive seasons compared (1) an *indica* x *japonica* rice variety with an *indica* variety, (2) spacings of 15 x 10, 15 x 15, and 15 x 20 cm, (3) fertilizer dosages of 34 kg N + 17 kg P_2O_5 and 67 kg N + 34 kg P_2O_5 in combination with 12 5 tons farmyard manure/ha In the December April season, grain and straw yields were significantly higher with the higher fertilizer dosage, the *indica* variety yielded much more grain but less straw than the hybrid, grain yields increased with denser planting, interactions were not significant In the June November season, only the hybrid profited from the higher fertilizer dosage, the difference in yield between the varieties was smaller than in the previous season, close spacing increased the grain yield of the hybrid only (Trop Abstr 23 1379)

199 Israel, P, Prakasa Rao, P S 1968 *Influence of Potash on Gall Fly Incidence in Rice* Oryza 4(1) 85 6 (Eng) (Cent Rice Res Inst, Cuttack)

In pot experiments, rice seedlings were given 0 25 ppm of K as K_2O in studies on the influence of K on gall fly (*Pachydiplosis oryzae*) incidence For every unit ppm increase in K level, gall fly incidence increased by 0 2/03% (FCA 22 1896)

200 Jain, G L, Singh, R M 1967 *Effect of Iron and Zinc on Nutrient Uptake by Paddy* Labdev Part B 5(2) 156 57 (Eng) (Univ Udaipur Rajasthan)

Soil application of Zn at 2 53 kg/ha or foliar spray with Fe at 2 23 kg/ha significantly increased uptake of N and Ca by rice plants P uptake was markedly increased by foliar spray with Zn alone or in combination with Fe (FCA 23 331)

201 Jain, N K Singh, V Singh, R V, Nath, U 1969 *Response of Rice ('Oryza sativa" L) Varieties to Different Levels of Fertility and Spacing* Indian J Agr Sci 39 893 97 (Eng) (Indian Explosives Ltd, Kanpur)

Different varieties of rice (China 4, IR 8, Taichung 65, Taichung Native 1) were compared at three spacings (15 x 10, 15 x 15 and 15 x 20 cm) and at six levels of fertilizing with 40 200 kg/ha N (or no treatment) balanced with half the amounts of P_2O_5 and K_2O Maximum yields were produced by the *indica* varieties (with 160 80 80), whereas the *ponlai* type was intermediate between the dwarf and tall *indicas* (SF 33 3192)

202 Jayaraman, M Swaminathan, K Nariakulandai, A 1968 *Time of Application of Nitrogen to Paddy in the Old Canvery Delta* Madras Agr J 55 243-47 (Eng) (Model Agron Experiments, Aduthurai)

Experiments with 40 lb/acre N showed that there was little difference between $(NH_4)_2SO_4$ and urea A single application of N before planting or at tillering benefited the *kharif* rather than the *rabi* crop split application one half before planting and the other one half at tillering was the best for long duration paddy N applied a week before flowering did not increase yields in a short term variety, and response of the latter to split applications was lower than that of a long duration crop (SF 30 4508)

203 Jayasekera, E H W, Ariyanayagam, R P 1964 *Efficiency of Urea and Sulfate of Ammonia as a Source of Nitrogen for Rice in the Sandy Soils of the Batticaloa District* Trop Agricst 118 103 8 (Eng) (Dep Agr Exp Sta, Karadiyan Aru Batticaloa)

On sandy soils of pH 5 5 6 low in Fe average yield increases were 33 7% with $(NH_4)_2SO_4$ and 73 4% with urea Root drainage occurs with $(NH_4)_2SO_4$ (SF 28 2029)

204 Kalam, M A Thampi, P S, George, C M 1966 *Direct and Cumulative Effects of Nitrogen, Phosphorus and Potassium on Rice* Agr Res J Kerala 4 11 16 (Eng) (Agr Coll, Vellayani)

Increasing dressings of up to 60 lb/acre N significantly increased grain yields, yield increase from 30 60 lb P_2O_5 was much lower, and response to K_2O was not significant There was not significant difference between response to fertilizer applied in a single season and the cumulative effect due to continuous applications indicating a lack of residual effect of fertilizers on continuously cropped land (SF 30 643)

205 Kanwar, J S 1966 *Effect of Trace Nutrients on the Yield of Crops in Acid Soils of Kangra District of the Punjab* Bull Nat Inst Sci India No 26, 63 70 (Eng) (Agr Coll Ludhiana)

In the title area trace nutrient deficiencies and the effects of applying trace nutrients on wheat maize paddy potatoes tea, and apples were investigated The effect of trace nutrients with a basal dose of NPK was determined The yield data show that the soil or spray application of Zn significantly increased the yield of these crops Thus, there seems to be a widespread deficiency of Zn in acid soils of Kangra district (CA 66 28001n)

206 Kanwar, J S 1969 *Fertilizer–The Kingpin in Agriculture* Indian Farming 18(12) 5 7 9 (Eng)

Major aspects of fertilizers in rice production in India are reviewed Brief attention is paid to response per unit nutrient, fertilizers vs organic manure conservation of soil fertility, fertilizers and irrigation economics and yield response Planting three crops/year of the new high yielding varieties would entail removal of 380 kg N, 925 kg P_2O_5 and 570 kg K_2O/ha as well as considerable amounts of secondary and microelements Adequate compensation of these losses requires dressings of some 3 8 tons ammonium sulfate, 2 8 tons superphosphate, and 2 24 tons of muriate potash/ha, and various amounts of trace elements, taking into consideration the efficiency of the fertilizers on soil (Trop Abstr 25 1311)

207 Kanwar, J S Grewal, J S 1966 *Direct and Residual Availability of Native and Applied Potassium in Soil* J Res, Punjab Agr Univ 3 1 6 (Eng) (Punjab Agr Univ, Ludhiana)

In pot experiments on sandy loam soil of pH 8 3 applying 50, 100, or 200 ppm K_2O significantly increased the yield of a paddy crop and a subsequent wheat crop A second paddy crop following wheat was little affected K recovery from the fertilizer by the three crops was 53 0%-62 2% with balanced N and P application A large amount of fertilizer K became fixed in the soil 0 7%-43 7% of this K was taken up by the first paddy crop and 21 8%-53 1% by the wheat crop Increasing the K rate decreased the amount of fixed K released to the crops (SF 30 2861)

208 Kanwar, J S, Sekhon G S 1968 *Time of Application and Source of Nitrogenous Fertilizers for Paddy* J Res Punjab Agr Univ 5(1) 29 32 (Eng) (Punjab Agr Univ Ludhiana)

In a 3 year experiment with a short duration (95 days) variety Jhona 349, on sandy loam slightly alkaline soils moderate in organic C and high in available P a split application of 140 lb/acre N one third at puddling (or at planting), one third at tillering and one third at preflowering, gave higher yields of unhusked paddy than single applications of the full amount Splitting the application into two was slightly better than single applications $(NH_4)_2SO_4$ and urea were equally effective (SF 32 751)

209 Krishnan, R H, Manamohan Lal, S 1965 *Urea and*

Ammonium Sulfate for Short Duration Paddy and Their Time of Application Madras Agr J 52(9) 410 11 (Eng)

N fertilizer, as $(NH_4)_2SO_4$ or urea, applied entirely at planting or in two equal applications, recorded equal yields during the first year of the experiment In the second year, application of the entire quantity at planting produced the maximum yield The experimental data cannot conclusively prove the usefulness of the application of N fertilizer in split doses or in a single dose at planting

210 Kundu, K K, Sircar, S M 1968 *A Note on the Effects of Heavy Nitrogen and Potassium Fertilization on the Cellulose and Lignin Contents of Rice Culm at Different Stages of Growth* Int Rice Comm Newsl 17(4) 30 3 (Eng) (Univ Calcutta)

Cellulose and lignin contents of the culm were generally decreased by increasing N but increased by K (SF 33 3193)

211 Kundu, K K, Sircar S M 1969 *Studies on the Physiology of the Rice Plant 22 Effects of Heavy Fertilizer Stress on Carbohydrate Metabolism in Two Winter Varieties* Indian J Agr Sci 39 991 99 (Eng) (Univ Calcutta)

Four levels of N (34 68, 102, and 136 kg/ha) were combined with four levels of K (0 204 kg/ha) while P was applied at 68 kg/ha In the preflowering stages, total sugar content (and polysaccharides) decreased with increasing N, and increased with increasing K, in the postflowering stage this general trend was reversed Content of reducing sugars was generally decreased by increasing N, and increased by increasing K (SF 33 3195)

212 Lakhdive, B A Prasad R 1969 *Effect of Nitrification Inhibitor Treated Urea on Nitrogen Uptake and Yield of Rice in Relation to Fertilizer Placement and Time of Fertilizing* Z Pflanzenernaehr Bodenk 124(1) 23 9 (Ger) (Inst Agr Res New Delhi)

N Serve [2 chloro 6 (trichloromethyl)pyridine] or AM (2 amino 4 chloro 6 methylpyrimidine) treated urea increased N uptake by rice as well as grain and straw yields, independently of the method of application A single dressing of AM treated urea gave a higher N uptake than split applications of untreated urea Placement and pellet application of N increased rice yields, but split application failed to give a response to rice Only single and split application increased the N uptake by placement fertilization and pellet application compared to broadcast application Fertilizer application in three treatments did not result in differences in the N uptake due to different application methods (CA 72 78079p)

213 Lakhdive B A, Prasad, R 1969 *Effect of Urea, Containing Nitrification Inhibiting Agents, on Nitrogen Uptake and Yield of Rice, as Depending on Method and Time of Application* Z Pflanzenernaehr Bodenk 124 23 8 (Ger) (Inst Agr Res, New Delhi)

Dressings of urea (150 kg/ha N), applied in combination with N Serve" or 'AM' to rice on a sandy clay loam (pH 7 9), increased grain and straw yields irrespective of the method of application Placement to 6 cm depth or application in pelleted form (up to 2 cm diameter) increased yields over broadcasting, but split application failed to increase yields any further Compared with broadcasting, uptake of N was increased where placement or pellets were used, but only when the fertilizer was applied as a single dressing or given in two installments, with dressings in three installments, there was no difference between the methods of application (SF 33 2386)

214 Lakhdive, B A, Prasad, R 1967 *Response to Nitrogen in Relation to Plant Type in Rice* J Post Grad Sch 5(2) 242 45 (Eng) (Indian Agr Res Inst, New Delhi)

Low response varieties of rice are generally tall with thin culms, and show active tillering and large leafy expansion Such a growth habit leads to mutual shading and adversely affects light penetration to inner leaves These varieties are susceptible to lodging, which limits the response to N The plants of high response rice varieties are short in stature having stiff straw and narrow, short, erect dark green leaves This growth habit permits the use of heavy N dressings which make it possible to attain considerably higher yields as compared to low response varieties

215 Lakhdive, B A Prasad, R 1970 *Yield of a Tall and a Dwarf Indica Rice as Affected by Fertilizer Nitrogen With and Without Nitrification Inhibitors* J Agr Sci 75 375 79 (Eng)

Two varieties of irrigated rice N P 130 (a tall variety) and Taichung Native 1 (a dwarf variety of *indica* rice) were compared in 1966 and 1967 when grown with several amounts of sodium nitrate and ammonium sulfate Comparisons of ammonium sulfate treated with 'N Serve or with 'AM' against untreated ammonium sulfate were made Applying more than 60 80 kg N/ha did not increase the number of panicles per m^2 with N P 130 but lowered the number of spikelets and filled grain percentage Up to 120 kg N/ha panicle number and the number of spikelets of Taichung Native 1 increased significantly but the filled grain percentage was not increased, yield of grain responded significantly up to 120 kg N/ha Taichung Native 1 yielded more grain and less straw than N P 130 Increasing the N applied significantly increased the yield of straw from both varieties Ammonium sulfate increased panicle number and reduced the percentage of filled grain compared to sodium nitrate but the increase in panicle number was higher with Taichung Native 1 than with N P 130, as a result ammonium sulfate consistently increased the grain yield of Taichung Native 1 When the ammonium sulfate was treated with either inhibitor it gave more grain of Taichung Native 1 than untreated fertilizer, treated fertilizer gave more straw of both varieties

216 Lenka, D 1969 *Response of Indica and Ponlai Varieties of Rice to High Levels of Nitrogen in Wet and Dry Seasons* Indian J Agr Sci 39(7) 642 51 (Eng)

The response of Taichung Native 1 to 1 kg N was about 21 kg in the dry season and only 8 4 kg in the wet season as against 13 1 and 3 4 kg grain of Ptb 10 and 12 4 and 4 9 kg of Tkm 6 in the dry and wet seasons, respectively Ponlai varieties responded more than the tall indica varieties in the dry season than in the wet season

217 Lenka, D, Behera, P C 1967 *Response of Four Taiwan and Two Local Varieties of Paddy to High Levels of Nitrogen* Indian J Agron 12(4) 353 57 (Eng)

The Taiwan varieties yield more than the local varieties due to more effective tillers per plant and more grains per panicle These varieties respond well up to 120 kg N/ha whereas the local varieties respond only up to 80 kg N/ha

218 Mahapatra, I C 1969 *Fertiliser Needs of Rice* Indian Farming 18(12) 21, 23 5, 27 (Eng)

Response of rice to N, P, and K fertilizers in India is briefly reviewed, with particular reference to dwarf varieties Attention is paid to properties of waterlogged soil, environment, nutrient removal, sources of nutrients rates times, and methods of application The dwarf *indica* variety T R 8 outyielded other varieties irrespective of dose of N or season, its productivity in the dry season was some 50% more than that in the wet season Foliar application of 2% urea solution, equivalent to 25 kg N/ha in [illegible] or more split dressings between initiation of tillering and 10 days before panicle emergence, supplementary to a basic dressing of 50 kg N/ha, was found to be best for efficient utilization A response to 120 kg P_2O_5/ha was observed following the higher N dressings, while there was a response to 20 60 kg K_2O/ha depending on conditions (Trop Abstr 25 1312)

219 Mahapatra, I C 1969 *Recent Advances in Rice Agronomy* Indian Farming 19(5) 9 11 (Eng) (Cent Rice Res Inst, Cuttack)

Application of compost and ammonium sulfate in varying doses to the same plot over a period of 17 years showed that continuous application of ammonium sulfate at increasing rates during the same period did not bring about any change in soil pH but resulted in an increase in C L C and decrease in exchangeable Ca^{+2} and Mg^{+2} Application of lime also did not affect the grain yield Fertilizers containing NH_4 N are superior to those containing NO_3 N in waterlogged soils The relative ratings of ammonium sulfate nitrate, ammonium chloride, calcium ammonium nitrate and urea (untreated) are 99 24, 94 96, 93 81, and 92 18, respectively, taking ammonium sulfate as 100 Deep placements of fertilizers at the time of puddling and postplanting stages increase the efficiency of fertilizer is compared to surface application Two-split applications of N fertilizers for heavy soils (75% as basal and 25% at primordial initiation stage) and three splits for light soils (50% as basal, 25% within a fortnight after transplanting, and 25% at boot leaf stage) to supply 80 100 kg N/ha for high yielding varieties, have been found to be more efficient than the entire quantity applied in one dose The times of split dressings of fertilizer should coincide with tiller and flower primordial initiation stages For normal soils, N, P_2O_5, and K_2O levels recommended for the rice crop are in the ratio of 2 1 1

220 Mahapatra, I C Prasad, R 1970 *Response of Rice to Potassium in Relation to Its Transformation and Availability Under Waterlogged Condition* Fertilizer News 15(2) 34 41 (Eng)

Results from 665 trials conducted on cultivators' fields with rice under the All India Coordinated Agronomic Experiments Scheme (I C A R) are presented and discussed Although the yield levels were higher in the dry season, responses to K were higher in the wet season High yielding varieties, in general, gave higher responses to K as compared to locally improved varieties The average responses of high yielding and locally improved varieties to K on different soils varied from 472 to 1353 and 29 to 654 kg (grain)/ha, respectively Highest responses were obtained on red soils On these soils return per rupee invested in K fertilization was Rs 10 76 and 4 64 for high yielding and locally improved varieties, respectively

221 Mariakulandai, A, Chamy, A 1967 *Rice and Phosphates* Fertilizer News 12(2) 20 6 (Eng)

The response of rice to phosphate is shown to be very complicated and involved by limiting factors such as (a) placement (b) indirect manuring through legumes, (c) combination with green manure, farmyard manure N and K_2O (d) lime, chelates, and micronutrients and (e) soil type and soil reaction A general recommendation is a basal dressing of 30 lb P_2O_5 and 5000 lb of green leaf with 30 lb N and 10 lb $MnSO_4$/ha

222 Mehrotra, O N, Saxena, H K 1967 *Responses of Important Crops to Trace Elements in Uttar Pradesh 1 Paddy* Indian J Agron 12(2) 186 92 (Eng)

Response of rice to micronutrients was investigated at several locations in Uttar Pradesh Soil application of 1 12 kg B (as borax)/ha increased grain yields by 13 23% at four locations and that of 2 24 kg B/ha by 18% at one location Cu at 3 36 6 72 kg $CuSO_4$/ha increased yield by 2 2%-17 6% $ZnSO_4$ had little effect on yield A foliar spray of B + Cu + Mn raised grain yields to 2453 kg/ha compared with 1144 kg/ha for the untreated control at Luchnow while B + Mn was best at Varanasi (FA 2 756)

223 Mehrotra, O N, Sinha, N S, Srivastava, R D L 1968 *The Nutrition of Indian Cereals 2 Uptake of Nitrogen and Phosphorus at Different Stages of Growth by Early Paddy (Unhulled Rice) Under Varying Fertilizer Management* Plant Soil 28(3) 422 30 (Eng) (Crop Physiol Sect, Agr Dep, Kanpur)

The uptake of N and P was measured to determine at which stage of the rice growth N and P are in maximum demand The N absorption increased up to tillering in an early maturity variety of paddy rice irrespective of treatment Maximum uptake of N and P was noted when 66 kg N combined with 44 kg P_2O_5/ha was applied Of the total N uptake, 45% occurred from seedling to tillering, ~35% from jointing to ear initiation, and 20% up to maturity, whereas in the case of P, ~70% was taken up to panicle emergence Highest N recovery (64 8%) was noted with the application of 66 kg N + 44 kg P_2O_5/ha Application of N alone at 22 44, and 66 kg/ha produced 1315, 1539, and 1757 kg dry matter/ha while the addition of 22 and 44 kg phosphates/ha with the three doses of N increased the dry matter content (CA 69 2148c)

224 Menon, M K, Pisharodi, P N Ramankutty, N N 1967 *A Comparative Study of Urea and Ammonium Sulfate as the Source of Nitrogen for Rice in Kerala* Agr Res J Kerala 5 40 4 (Eng) (Agr Res Sta, Pattambi)

Over a period of four autumn and four winter seasons, yields increased linearly with up to 150 lb/acre N, but >90 lb/acre was uneconomic For autumn, a predominance of urea, and for winter a predominance of $(NH_4)_2SO_4$ was preferable in urea $(NH_4)_2SO_4$ mixtures (SF 32 1563)

225 Misra, S G, Singh, B 1968 *Relative Efficiencies of Ammonium Sulfate and Urea in Black and Saline Soils of Uttar Pradesh Under Paddy (Rice)* Indian J Agron 13(4) 224 29 (Eng) (Univ Allahabad)

Rice is one of the most important cereal crops in India and it is generally grown in those soils which have a good water holding capacity Effect of $(NH_4)_2SO_4$ and urea on shoot height, number of tillers and dry weight and uptake of N and P by paddy was studied under waterlogged conditions in pots containing 4 5 kg black or saline soil $(NH_4)_2SO_4$ had more significant effects on shoot height average tiller number, and dry weight in black soil than did urea The application of phosphate in combination with $(NH_4)_2SO_4$ was beneficial for dry weight and P content of paddy plants, while only shoot height was affected by addition of phosphate to urea In the case of saline soil, urea was superior to $(NH_4)_2SO_4$ with respect to shoot height, dry weight and average tiller number at 90 days (CA 71 122998t)

226 Mohanty S K Kibe, M M 1968 *Comparative Studies on Coated and Uncoated Fertilizers as Sources of N P, and K for Rice* Indian J Sci Ind 2(2) 65 8 (Eng)

The relative efficiency of coated and uncoated fertilizers containing all three major nutrients (NPK) was studied by carrying out a pot culture experiment using rice as a test crop on a clay loamy soil with neutral reaction The coated fertilizers were found to be significantly better than uncoated fertilizers in respect to absorption and utilization of N, P, and K by the rice plants

227 Moolani, M K, Sood P R 1966 *Effect of Nitrogen, Phosphorus and Potash on Paddy Yield* Riso 15(4) 257 60 (It)

A N x P x K fertilizer trial with the rice variety Jhona 349 was conducted on an irrigated clay soil in the Indian Punjab during 3 successive years Superphosphate, KCl, and half of the immonium sulfate were applied before transplanting the remainder of the N fertilizer 1 month after transplanting dosages of N, P_2O_5 and K_2O were 0, 28, and 56 kg/ha The average yield over 3 years was increased by N from 1678 to 2080 and 2427 kg/ha There was no response to K The lower dose of P had no effect, the higher dose depressed the yield This depressing effect was mitigated by N in the second year of the trial, but all other interactions were nonsignificant (Trop Abstr 22 456)

228 Mudholkar N J Sahay M N 1968 *Effect of Blue Green Algae on Rice Yield Under Different Soil Types* Indian J Agron 13 115 18 (Eng) (Cent Rice Res Inst, Cuttack)

In pot experiments, rice seedlings of variety Ptb 10 were inoculated with a mixture of *Anabaena* sp *Nostoc* sp and *Westiella* sp and grown in seven different rice growing soils Higher grain yields due to the algae were recorded on all soil types The effect of the algae was increased by the addition of 1000 kg/ha lime + 20 kg/ha P_2O_5 + 0 28 kg/ha $NaMoO_4$ The increased yield was 12 36% greater than that obtained by the application of 20 kg/ha N as $(NH_4)_2SO_4$ The uptake of N was greatest in the fertilizer + algae treatment (SF 33 4836)

229 Mudholkar, N J, Sankaram, A 1968 *Nitrogen Application to High Yielding Rice Varieties and the Beneficial Role of Blue Green Algae* Andhra Agr J 15(2) 57 9 (Eng) (Cent Rice Res Inst, Cuttack)

The extent to which algal inoculation and urea spray could be made additive so as to meet the high N requirement of rice (variety Taichung Native 1) was examined using a mixture of *Anabaena, Nostoc,* and *Scytonema* Plants inoculated with the mixture and sprayed with 75 kg N/ha as urea produced grain yields comparable to those of plants fertilized with 75 kg N/ha as soil application or as urea spray but not inoculated The efficiency of N utilization is also higher in the presence of algae The use of algal inoculation in conjunction with urea spray to meet the high N requirement of high yielding and N responsive varieties appears promising (CA 73 3053n)

230 Mukherji, S, Kundu K K, Sircar, S M 1968 *Studies on the Physiology of the Rice Plant XIX Effects of the Heavy Fertilizer Stress on Culm Characteristics of Two Winter Varieties in Relation to Yield and Lodging Behavior* Indian J Agr Sci 38(2) 326 37 (Eng) (Calcutta Univ)

A study was made of the culm of two winter rice varieties to ascertain the extent to which they were modified by heavy N fertilization with various combinations of N and K In 1962 63, Latisail and Jhingasail were grown under split plot design in the field Four levels of N (30, 60 90, and 100 lb/acre) were combined with four levels of K (0 60, 120 and 180 lb/acre) P was used at a basal dose of 60 lb/acre Observations were made on height, effective tiller number/hill, lengths of three consecutive internodes from the base, lodging resistance index percentage of lodged plants, number of filled grains/hill of three plants and yield Breaking weight of stem was measured Growth measurements grain filling percentage, and number of lodged plants were determined Increased N up to the maximum dose progressively increased height while continued further acceleration was noticed with K increments at 30 lb N N or K, together or alone had no noticeable effect on tillering Heavier N dosages tended to increase length of the three consecutive lower internodes Latisail did not lodge with 30 lb N, but showed some variable lodging at higher N concentrations, this, however, was checked to a certain extent by K Jhingasail, on the contrary, showed signs of lodging even at 30 lb N, and this could not be countered by applications of K Grain yield decreased with N beyond 30 lb/acre Significant effects of K were obtained only at very low and very high N levels In both varieties, the height of the plants and the length of internodes were positively correlated with percent lodging Grain yield and filled grain numbers were negatively correlated with lodging There was a negative correlation between lodging and effective tiller number in Latisail, while positive correlation was seen with Jhingasail (CA 69 95497d)

231 Mukherji, S, Sircar, S M 1968 *Physiology of the Rice Plant XX Effects of Heavy Fertilizer Stress on Nitrogen Metabolism in Two Winter Varieties* Indian J Agr Sci 38(6) 1040 52 (Eng) (Calcutta Univ)

Two winter varieties of rice were grown under different combinations of N and K fertilizer Four levels of N (34, 68, 102, and 136 kg/ha) were combined with four levels of K (0, 68, 136, and 204 kg/ha) P was used at a basal rate of 68 kg/ha Estimations of total, soluble, and protein N of leaf and

culm were made at two stages preflowering and postflowering An increase in the N supply resulted in an enhanced uptake of N in both varieties at both stages of growth K increased the protein level in the preflowering stage of Latisail rice, but not in Jhingasail rice At the postflowering stage, K at all N levels resulted in a lowering in protein N in most of the combinations in Latisail, an effect which could be related to its transport from the leaf to the developing grains On the other hand, Jhingasail showed a greater tendency to synthesize more protein in the presence of K in the postflowering stage, because its leaves could assimilate N even after the ripening of the grain (CA 71 123003b)

232 Mukherji, S , Sircar S M 1969 *Physiology of the Rice Plant XXI Effects of Heavy Fertilizer Stress on the Uptake of Phosphorus Potassium Calcium, Magnesium, and Silicon in Two Winter Varieties* Indian J Agr Sci 39(3) 244 54 (Eng) (Calcutta Univ)

In a split plot design, two varieties of winter paddy (Latisail and Jhingasail) were grown under 16 combinations of N and K At the preflowering stage an increase of N resulted in greater uptake of P, K, Ca, and Mg, but not of Si by leaves the culm content of P increased greatly and that of K moderately, while Mg increased progressively Postflowering leaf tests showed that P content had decreased markedly but the decrease was less with K and Ca P K Ca, Mg, and Si increased in the culm K additions increased Si in leaves, but N lowered it (CA 72 54232g)

233 Naphade, J D 1969 *Influence of Phosphate Application to Various Soils on the Response of Rice and P Uptake at Different Stages of Plant Growth* Riso 18 37 42 (Eng) (Inst Tech Kharagpur)

Three levels of single super (0, 45 and 90 kg/ha P_2O_5) were tested in pot experiments involving 11 different soils Rice showed a significant positive response to P and plant uptake of P increased with the increase in native and applied phosphate There was a significant positive correlation between grain yield and total uptake of P A rate of 45 kg/ha P_2O_5 is recommended for rice on the Indian soils investigated (SF 32 3201)

234 Naphade, J D Bapat M V 1968 *Correlation of Soil Test Values for Available Phosphorus by Various Methods With the Yield of Rice* Riso 17(4) 303 8 (Eng)

An investigation conducted in Maharashtra State showed that the amount of available P extracted by any of the eight soil test methods studied depends upon the nature of extracting solution (acidic, alkaline, or buffer), the soil extractant ratio used duration of extraction, and the pH of extractant solution The Jacquet and Le Nir s method, Spurway s method Morgan s method, and Bray's P_1 and P_2 tests yielded low values of available P, as compared to the Truog s method For soils having medium cation exchange capacity (c e c 20 m e to 45 m e /100 g soil) the values found by both the Olsen s and Bray s P_1 method were significantly correlated with the percentage increase of rice yield (Trop Abstr 24 1490)

235 Narasimham, R L 1965 *Active Transport of Phosphate in Rice Plant* Sci Cult 31(5) 250 51 (Eng) (Sugarcane Res Sta , Anakapalle)

Rice plants (variety N P 130) were grown in washed sand with Hewitt's nutrient solution The plants were washed with water and distilled water 68 days after transplanting then placed in solutions of known $CaH_4(PO_4)_2$ potential (½pCa + pH_2PO_4) Control plants were placed in solutions of the same phosphate potential with $10^{-4}M$ NaN_3 added to inhibit phosphate transport Water lost by transpiration was added at intervals After 24 hours the phosphate potential of each solution was analyzed The values of equilibrium $CaH_4(PO_4)_2$ potential of the rice plants under normal conditions and with addition of NaN_3 were 7 18 and 5 80, respectively corresponding to a free energy change ($-\Delta F$) of 9851 and 7958 calories respectively per equivalent of $CaH_4(PO_4)_2$ The difference or in additional free energy decrease of 1893 calories might be taken to represent the energy of 'active transport ' per equivalent of $CaH_4(PO_4)_2$ absorbed by the rice plants under the conditions of the experiment (CA 64 2422g)

236 Narayanaswamy, P , Venkataraman, R 1966 *Effect of Fractional Application of Ammonium Sulfate to Paddy Crop* Madras Agr J 53(6) 263 4 (Eng) (Agr Res Sta, Palur)

Applications of 30 lb N/acre increased rice grain yields, but responses to single or to split applications did not differ significantly (FCA 20 983)

237 Nayar, M A , Koshy, M M 1967 *The Influence of Different Forms and Levels of Magnesium on the Growth and Yield of Rice* Agr Res J Kerala 4(2) 32 8 (Eng) (Agr Coll Res Inst , Vellayani, Kerala)

A field experiment with a 9 x 4 randomized block design was carried out in the Vellayani lake area to study the effect of different forms and levels of Mg on the growth and yield of rice The different forms of Mg used were magnesium oxide, magnesium carbonate, magnesium silicate, and magnesium sulfate The levels of application were 25 and 50 kg MgO/ha Of the four forms of Mg tried, magnesium silicate and magnesium oxide induced the maximum height of plants at the harvesting stage The form or level of Mg had no significant effect on tillering The yields of grain and straw were not significantly influenced by the different forms of Mg at the rates of application used in this study The Mg treatments tended to increase the yield of rice over control This effect was more marked in the case of magnesium oxide and magnesium sulfate The 1000 g weight was also higher for treatments with these compounds (FA 1 606)

238 Nene, Y L 1968 *Khaira Disease of Rice and Its Control* Int Rice Comm Newsl 17(1) 1 7 (Eng)

The results of the trials where $ZnSO_4$ was applied to the plants support the conclusion that the Khaira disease is due to Zn deficiency Control of Khaira and consequently yield increases from 76 65% 1328 57% have been obtained The variations in the yield increases are due to the inherent differences in the available Zn at various locations where the trials were conducted Foliar spraying with $ZnSO_4$ appears to be the best

239 Okajima, H 1969 *Cultural Practices for High Yielding Rice Varieties* Indian Farming 19(5) 5 6 (Eng)

The yield of high yielding varieties like Jaya and IR 8 is directly dependent on N supply Even in fertile soils, which

supply about 100 kg N/ha, there is still a need to supplement 80 kg N through fertilizer Basal N should be incorporated deep in the soil and 5 cm or more water should be supplied to the main field until establishment of seedlings Whenever pale green appearance of the crop is observed from a distance, (although the border rows may be green) N should be supplied in small split doses till heading time In fertile soils or wherever there is no problem of establishment due to transplanting damage, 20 x 20 cm or wider spacing is recommended But for those fields having difficulty in establishment or showing patchy appearance due to salinity and under low fertility level 15 x 15 cm spacing is advocated

240 Padhi, S C Misra A 1968 *Response of Three Types of Rice to Varied Levels of Nitrogen and Spacing* Indian J Agron 13(3) 146 47 (Eng) (Agr Coll Bhubaneswar, Orissa)

In trials in 1966 three rice cv grown at three spacings received a basal dressing of 60 kg P_2O_5 + 80 kg K_2O/ha and 0 40 80 120 or 160 kg N/ha A spacing of 15 x 10 cm gave higher grain yields (29 36 hkg/ha) than 15 x 20 cm (27 41) or 15 x 30 cm (25 41) As N rates increased from nil to 120 kg/ha average grain yields increased from 19 13 to 32 05 hkg/ha N at 160 kg/ha gave yields of 31 48 hkg/ha There were marked differences in the response of different cv to various levels of N Tachung Native 1 Taman 3 and Ptb 10 showed a progressive increase in yield as N rates increased up to 160 120 and 80 kg/ha respectively The average grain weight/ear of the above cv was 1 48 1 82 and 1 34 g respectively The highest average yields 30 48 hkg/ha were given by Tachung Native 1 Taman 3 and Ptb 10 yielded 25 79 and 25 9 hkg grain/ha respectively (I C A 22 2730)

241 Padmaja P Verghese E J 1966 *Effect of Calcium Magnesium and Silicon on the Productive Factors and Yield of Rice* Agr Res J Kerala 4(1) 31 5 (Eng) (Agr Coll Res Inst Vellayani Trivandrum)

Rice cv Ptb 10 grown in pots was given combinations of 0 or 25 lb Si 0 or 100 lb Mg and 0 or 1 ton CaO/acre All treatments increased grain and straw yields increased root depth and weight and reduced the duration of flowering Grain/straw ratios were increased by Si and by Si + Mg but were decreased by all other treatments (I C A 20 1702)

242 Pande H K Bhan V M 1966 *Effect of Row Spacings and Levels of Fertilization on Growth Yield and Nutrient Uptake of Upland Paddy and on Associated Weeds* Riso 15(1) 47 67 (It) (Inst Tech Kharagpur)

In trials in India in 1961 63 rice sown at 140 kg/ha in rows 15 cm apart and dressed with 80 kg N/ha, grew best smothered the weeds and gave the highest grain yield The application of N at 80 kg/ha increased grain yield significantly over lower rate (I C A 19 2167)

243 Pande H K Khan R A 1969 *Effect of Varying Levels of Fertility and Moisture on the Sterility of Spikelets in Two Varieties of Rice* Riso 18(1) 43 6 (Eng)

An experiment was conducted with the rice varieties IR 8 and Kalimpong 1 The treatments were 60 kg N + 30 kg P_2O_5 + 20 kg K_2O/ha and 120 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha applied on soil either saturated with moisture or submerged to 5 cm depth Both the numbers of unfilled spikelets and sound grains per plant were positively correlated with fertilizer level but not with moisture level IR 8 produced more unfilled spikelets and more sound grains than Kalimpong 1 Significant correlations were found between the number of sterile spikelets and the number of fertile tillers, the number of sound grains, grain weight per plant, and dry matter per plant (Trop Abstr 24 2199)

244 Pande, H K Mittra B N 1970 *Response of Lowland Rice to Varying Levels of Soil Water and Fertility Management in Different Seasons* Agron J 62 197 200 (Eng) (Inst Tech Kharagpur)

The experiments on lateritic soil (pH 5 4) involved three levels each of flooding (shallow and deep submergence saturation) NPK fertilizing (low medium high) and soil manipulation (compaction shallow, and deep puddling) Grain yields were higher under submergence (5 or 10 cm) than under saturation increasing level of submergence caused P Fe, and Si contents in grain to increase and Mn content to decrease There was no significant difference between the 100/26 4/49 8 and 75/19 8/37 3 levels of fertilizing but the spring crop responded up to the 125/33/62 2 level Soil bulk density of 1 68 or above did not affect crop growth whether produced by compaction or puddling (SI 33 4090)

245 Pande H K Singh P 1969 *Effects of Moisture and Nitrogen on Growth Yield and Mineral Content of Rice* Exp Agr 5(2) 125 32 (Eng) (Inst Tech Kharagpur)

Limited moisture supply caused reductions in leaf area, number of effective tillers ratio of sound to unsound grains, and the N, P Fe and Mn content of rice Crop yield was adversely affected in the absence of standing water Two levels of N 40 and 60 kg N/ha caused no significant difference 1 year though the 60 kg N/ha level produced better yields the following year (CA 71 60214y)

246 Pande H K Singh, P 1970 *Water and Fertility Management of Rice Varieties Under Low Atmospheric Evaporative Demand* J Agr Sci 70 Pt 1 61 7 (Eng)

Four soil moisture and two N levels were combined in eight treatments to study moisture and N effects on Dular (June September crop) and Patnai 23 (June November crop) varieties of rice Both the varieties when grown under natural precipitation yielded significantly less than at other moisture levels Where is there were no significant differences among the three treatments of submergence (15 10 cm) cyclic submergence (15 0 cm) and cyclic wetting drying (saturation to field capacity) for Dular rice the former two treatments proved better than the latter for Patnai 23 rice Dular responded to the treatments of cyclic wetting drying in a way similar to that of submergence because the crop completed its life cycle during the period of low evaporative demand Among the levels of N 40 kg N/ha proved optimum for Dular rice and 60 kg N/ha for Patnai 23 rice The increase in yield of grain was associated with increase in the number of panicles, number of spikelets/panicle and percentage of ripened spikelets The concentration of N, P, Fe and Mn in the plant was maximum under submergence followed by cyclic submergence cyclic wetting drying, and natural precipitation Higher levels of N increased only N and P contents in the plant

247 Pande, H K, Tilak, K V B R 1970 *Effect of Varying Levels of Nitrogen and Phosphate Fertilization and Different Dates of Seeding on Growth and Yield of Upland Rice* Riso 19 87 94 (Lng) (Indian Inst Tech, Kharagpur)

Treatments consisted of combining four levels of N (0 80 kg/ha) with no or 40 kg P_2O_5 Application of $(NH_4)_2SO_4$ significantly increased the number of fertile tillers (at N rates up to 60 kg, whereas higher doses caused lodging), grain yields and the crop's N content increasing levels of N significantly increased P in the crop, and P fertilizing increased both grain yields and P and N contents of the crop (SF 33 4077)

248 Patel, J P 1967 *Interrelations of Different Proportions and Rates of N P Fertilizer Application, and Planting Patterns of Rice in the Jabalpur District* Indian J Agron 12(3) 222 30 (Eng)

The four fertilizer rates used were 0, 20, 40 and 60 lb N with equal quantities of P/acre 2 N P ratios 1 1 and 1 1 5 and five spacings 4 6 9 12 in apart in 9 in wide row and 4 in apart in an 18 in wide row There was no response to the application of fertilizers to the grain yield as it raised the percentage of unfilled spikelets and decreased the 1000 grain weight in a linear way Vegetative growth was promoted significantly with increased doses which directly reflected on the straw yield The two N P ratios showed no effect on the crop yield Increasing the row width from 9 to 18 in proved detrimental to the crop yield as it substantially reduced the number of panicle bearing culms per unit area which was not compensated by the increase in the yield per panicle Widening the distance between plants from 6 to 12 in reduced the number of panicle bearing culms per ft^2, but increased panicle length, number of spikelets per panicle, and finally the yield per panicle

249 Patnaik, S 1967 *Fertilizer Requirements of Taiwan Rice Varieties* Indian Farming 17(7) 7 9 (Eng) (Cent Rice Res Inst Cuttack)

In trials in 1966 four dwarf varieties of rice showed a linear grain yield response to the application of 0 120 kg N/ha, at the highest N rate Taichung Native 1 Taiman 3 Taichung 65, and Chianung 242 gave yields of 5 5 4 3 3 5, and 3 5 tons/ha, respectively, compared with 1 4 tons for Taichung Native 1, and 1 1 ton for each of the other cv on unfertilized plots (FCA 22 2722)

250 Patnaik S, Abichandani, C T 1970 *The Uptake of Nutrients in Relation to Growth of Indica Rice ("Oryza sativa" L)* Riso 19 17 35 (Eng) (Cent Rice Res Inst, Cuttack)

Graphs showing tiller and dry matter production and uptake and contents of nutrients (N, P, K, Ca, Mg, S, Mn, Fe) in successive growth stages are presented (SF 33 4082)

251 Patnaik S, Bandyopadhya A K Nandi B B 1968 *Effects of Different Liming and Phosphorus Materials on Rice Yields and Nutrient Uptake in Acid Lateritic Soil* Indian J Agr Sci 38(2) 261 69 (Lng) (Cent Rice Res Inst, Cuttack)

Pot experiments were conducted on ground limestone, paper mill sludge and blast furnace slag on acid lateritic soils to determine effect on yield and release of P from fused Ca Mg phosphate and superphosphate All were added at a rate sufficient to increase the pH of the sandy loam soil from 4 85 to 6 5 Porcelain pots of 4 l capacity contained 6 5 kg of soil with a basal content of 0 5 g N and 0 2 g K After addition of the above the soils were planted with rice, with two seedlings/pot After harvest and weighing of grain the soil from each pot was tested for pH and available P The pooled plant samples were analyzed for P, Ca, and Mg Paper mill sludge and blast furnace slag could be used as effective substitutes for lime to correct soil acidity and to increase rice yields Fused Ca Mg phosphate was an alternative source of P Addition of the liming materials increased the availability of native and added P For the purpose of soil test crop response studies available P by Truog's method was superior to Olsen's or Bray and Kurtz' methods in these acid lateritic soils (CA 69 85775d)

252 Patnaik S, Bandyopadhya, A Sahoo R 1968 *Management of Upland Rice for Increased Fertilizer Efficiency* Int Rice Comm Newsl 17(1) 8 13 (Lng) (Cent Rice Res Inst, Cuttack)

Pot experiments and field tests with direct seeded rice conducted in India showed that moderate soil compaction significantly increased rice yield through increased absorption of plant nutrients The increase of nutrient availability is due to greater water retention and lower percolation loss Decreased absorption of nutrients at higher compaction was possibly due to impeded root penetration Rice yields at 50 kg N/ha with moderate compaction were comparable to those at 100 kg N/ha without soil compaction In the case of direct seeded rice moderate compaction of medium to light textured soils will help to reduce water duty and to increase rice yields and fertilizer efficiency (Trop Abstr 24 537)

253 Patnaik, S Bhadrachalam A John J 1967 *Productive Efficiency of Nitrogen Absorbed During Various Growth Stages of High Yielding Taiwan Rice Varieties Under Tropical Conditions* Indian J Agr Sci 37(4) 282 89 (Lng) (Cent Rice Res Inst Cuttack)

Seedlings (24 days old) of rice cv (a) Taichung Native 1 (b) Taichung 65, (c) Taiman 3 and (d) Chianung 242 grown in pans were transferred to and grown in culture solutions during June October 1965 N (as ammonium nitrate) was supplied at 10 or 60 ppm for various periods treatment starting 5 days after transplanting At 10 ppm N there were two peaks of productive efficiency (maximum growth rate) in (a) (c) and (d) one during early growth (about 1 week after transplanting) and the second during reproductive growth after ear initiation but before flowering at 60 ppm these cv showed one peak only during vegetative growth 3 5 weeks after transplanting and before panicle initiation (b) had only one peak at both levels of N which occurred before and after panicle initiation at 60 and 10 ppm respectively It was concluded that N was best applied as a split application for (a) (c), and (d) 75% 80% of the total being applied at puddling and the remainder as a topdressing during internode elongation to the boot stage (FCA 22 1870)

254 Patnaik S, Broadbent, F E 1967 *Utilization of Tracer Nitrogen by Rice in Relation to Time of Application* Agron J 59 287 88 (Eng) (Cent Rice Res Inst, Cuttack)

Uptake of N^{15} tagged $(NH_4)_2SO_4$ by rice plants was used

to evaluate the efficiency of fertilizer applications Applying two thirds of the basal N at planting and topdressing one third at the boot stage resulted in higher recovery of fertilizer N than did application of the full rate at planting or topdressing it all at tillering (SF 30 4580)

255 Patnaik S Gaikawad, S T 1969 *Efficiency of Phosphorus and Potassium Absorbed During Various Growth Stages of 'IR 8 for Grain Production* Indian J Agr Sci 39(1) 117 21 (Eng) (Cent Rice Res Inst, Cuttack)

The concept of partial productive efficiency (increase in grain yield per unit increase in absorption during a given period) has been used to evaluate the efficiency of P and K absorbed during various growth stages of the rice variety 'IR 8', for grain production For both the nutrients only one peak of partial productive efficiency' was obtained during the active vegetative growth period, indicating that the nutrients absorbed during this period were most efficiently utilized for grain production These results suggest that basal application of P and K was desirable for high yielding varieties (FA 3 105)

256 Patnaik, S Gaikawad, S T 1969 *Utilization of ^{32}P Tagged Phosphate by Rice in Different Soils* J Indian Soc Soil Sci 17(2) 257 58 (Eng)

Tagged superphosphate was used in an effort to correlate 'A values of soil with uptake of fertilizer P Results showed that P utilization ranged from 7 3% to 27 9% and did not demonstrate any relationship with A values of the soils used

257 Patnaik, S Misra C S Bhadrachalam, A 1965 *The Plant Nutrition of the Rice Plant (Oryza sativa) VIII Productive Efficiency of Phosphorus Absorbed at Various Growth Stages of India Rice* Proc Indian Acad Sci Sect B 61(6) 309 15 (Eng) (Cent Rice Res Inst, Cuttack)

Two varieties of rice early duration (1) and medium duration (2) were raised in pans, transferred to pots containing culture solution and the P additions started after 5 days Marked increase in the grain yield was observed in plants (1) treated with 2 and 10 ppm solutions of NaH_2PO_4 H_2O for 30 and 20 days respectively Similar results were observed with (2) after 40 and 30 days, respectively Further increase in the period of treatment did not materially alter the yield The P content in the various parts of the plants was more or less constant up to the period corresponding with the peak grain yield Beyond this there was a marked increase in the P content of the grains (CA 64 2705e)

258 Patnaik S Nanda B B 1969 *Uptake of Nutrients in Relation to Growth of High Yielding Rice Varieties Under Tropical Conditions* Indian J Agr Sci 39(4) 341 52 (Eng)

In India, data on the dry weight and nutrient content of the rice varieties Taichung Native 1 Taichung 65, Taiman 3, and Chianung 242 showed a relationship between the absorption of the nutrients and the specific growth stages of the crop On the basis of absorption pattern it was found that (1) N, P, and K were vigorously absorbed from the initial growth stage up to the flowering stage, (2) Ca and Mg were slowly absorbed during the initial growth stage, their absorption increased during the reproductive stage and continued up to the dough stage, and (3) Fe and Mn were absorbed up to the flowering stage Most of the absorbed N and P was translocated from the vegetative parts to the panicle, while the magnitude of translocation of the other elements was comparatively less (Trop Abstr 25 1304)

259 Patnaik, S, Rao, M V, Nanda, B B 1968 *Some Considerations of Nitrogen Uptake by High Yielding Varieties* Int Rice Comm Newsl 17(2) 26 37 (Eng) (Cent Rice Res Inst Cuttack)

Dry matter production, grain yield, N content, and uptake were determined for Taichung 1, Taichung 65, Taiman 3, Chianung 242, IR 8, Ptb 10, and a cross between Bluebonnet 50 and PI 215936 rice varieties fertilized with up to 200 kg/ha N (SF 32 4022)

260 Perumal, R, Varadarajan, S 1967 *Efficacy of Organic and Inorganic Forms of Phosphate on the Growth and Yield of Paddy Crop–1* Madras Agr J 54(11) 580 86 (Eng) (Agr Coll Res Inst, Coimbatore)

Two rice cv received 15 60 lb P/acre as (a) superphosphate, (b) green manure (*Sesbania*), and (c) combinations of (a) + (b) in different proportions (c) gave the highest grain yields, yields of the long duration cv Co 19 increased more where the proportion of (b) in (c) was higher and that of short duration cv Co 29 where (a) in (c) was higher The highest straw yields of both cv resulted from (b) (FCA 21 1774)

261 Pillai, K M 1967 *Response of Paddy to Application of Micronutrients* Indian J Agron 12 151 55 (Eng) (Agr Coll Res Inst Coimbatore)

On soil, prepared for planting by green manuring and receiving basal application of super and $(NH_4)_2SO_4$ average yields over 3 years were increased significantly by $MnSO_4$ and $ZnSO_4$ at rates of 11 2 kg/ha respectively, there were no further significant increases with higher rates of application Responses to Cu were much lower and even negative at higher rates of application (SF 30 2861 FA 2 755)

262 Pillai, S 1968 *Potash Response to Paddy NK Top Dressing Gives Higher Response in Andhra Pradesh* Potash News Letter 3(11) 4 pp (Eng)

Optimum results were obtained at 28 kg K_2O/acre (N K ratio 1 1) when applied in two equal split doses The average yield for this treatment amounted to 2200 kg/acre and gross returns after deducting cost of fertilizers Rs 956/ acre ADT 27 variety responds well to higher levels of potash equivalent to that of N

263 Prasad, K 1967 *A New Technique for Identifying the High Nitrogen Responsive Character in Rice* Oryza 4(1) 76 7 (Eng) (Cent Rice Res Inst Cuttack)

Seeds of 17 rice cv differing in response to N fertilizers were soaked for 48 hours in distilled water, and then treated with 0% 1 5% ammonium sulfate solutions which were replaced every 24 hours for 2 days On the fifth day, in treatments using 1% ammonium sulfate solutions, root/shoot ratio was highest in high response cv and lowest in low response cv (FCA 22 1886)

264 Prasad, R 1968 *Dry Matter Production and Recovery of Fertilizer Nitrogen by Rice as Affected by Nitrification*

Retarders 'N Serve' and 'AM' Plant Soil 29(2) 327 30 (Eng) (Agr Res Inst, New Delhi)

A pot study was conducted to study two nitrification inhibitors, each at three levels, on dry matter production by rice and recovery of N applied as ammonium sulfate One kg of a clay loam soil with a pH of 8 2 was treated with 100 mg of N, and 0, 0 5, or 2 mg of N Serve or 1 or 5 mg of AM Taichung Native 1 rice was planted three crops were raised and each was then harvested at the end of 15 days Total dry matter yield was increased nearly 8% by use of the nitrification inhibitors Additional recovery of N due to N Serve and AM was, respectively, 16% and 10% greater than the 37% recovered from ammonium sulfate alone (FA 2 229)

265 Prasad, R, Bains, S S 1968 *Nitrification Inhibitors for Increasing Efficiency of Fertiliser Nitrogen in Paddy Soils* Fertiliser News 13(5) 37 8 (Eng) (Agr Res Inst New Delhi)

Two nitrification inhibitors were evaluated on paddy soils at the Indian Agricultural Research Institute's farm at New Delhi The inhibitors were Dow Chemical s N Serve and Toyo Koatsu's AM Evaluation was based on fertilization of Taichung Native 1, IR 8 and NP 130 rice varieties with urea at rates of 75 150 kg/ha of N Both inhibitors increased yields about 10% 13% Differences between the two were not statistically significant (FA 1 1482)

266 Purohit, D S Tripathi, R S 1965 *Performance of Some 'Japonica Rices Under High Fertility in Chambal Commanded Area* Rice News Teller 13(4) 118 19 (Eng) (Regional Res Sta, Borkheri, Kota Rajasthan)

At 40 lb N and 40 lb P_2O_5/acre the *indica* cv NP 130 outyielded all the five *japonica* varieties tested At 120 lb N and 60 lb P_2O_5/acre the *japonica* varieties Asahi, Kamto 52, and J 11 outyielded NP 130 (FCA 20 227)

267 Ramachandra Reddy, T K 1968 *Plant Treatment in Relation to the Rhizosphere Effect III Foliar Application of Certain Trace Elements and Metallic Chelates in Relation to Rhizosphere Microflora of Rice (Oryza sativa L)* Plant Soil 29(1) 114 18 (Eng)

In India, foliar spraying of 3 weeks old rice seedlings with Zn, Mn, Mo each at a concentration of 50 ppm with B at 25 ppm, and with chelates of Zn, Fe Cu, and Mn each at a concentration of 100 ppm had a pronounced effect on the distribution of the rhizosphere microflora and on the percentage of occurrence of soil fungi such as interalia penicillia and aspergilli None of the chelates was toxic at the concentration used In the absence of direct evidence regarding the influence of sprays on the physiology and root exudate pattern, it is suspected that the rhizosphere effect is due to possible changes in root exudates in consequence of foliar sprays (Trop Abstr 24 57)

268 Ramamoorthy, B Paliwal, K V 1965 *Potassium Adsorption Ratio of Some Soils in Relation to Their Potassium Availability to Paddy* Soil Sci 99(4) 236-42 (Eng) (Agr Res Inst, New Delhi)

Rice response to K on 40 soils with widely varying characteristics was compared with soil K levels determined by conventional soil test methods and by the K adsorption ratio A high correlation was obtained between response to K fertilization and the K adsorption ratio calculated by a rapid method (CA 63 4901b)

269 Rangaiah, P K, Kannan, S, Rajarathnam, S 1966 *The Relative Efficiency of Calcium Ammonium Nitrate on A S D 11 Paddy ('Oryza sativa')* Madras Agr J 53(1) 38 40 (Eng) (Agr Coll Res Inst, Coimbatore)

Field trials were conducted in the wetlands of the Central Farm, Coimbatore (Madras State India), during 1964 65 in order to find the response of paddy (A S D 11) to Ca NH_4 nitrate (CAN) Ten treatments, consisting of control CAN, $(NH_4)_2SO_4$, and urea applied at 15 30 and 45 lb N/acre were given All plots received a basal dressing of 5000 lb green manure Fertilizers were applied in two equal doses one at the time of planting and the other at tillering A significant increase in grain yield was recorded at 45 lb N as CAN over other levels, but urea and $(NH_4)_2SO_4$ gave no differences in yield at any of the three levels (CA 69 43099f)

270 Ranganthan T B Palaniswamy K M, Srinivasan V 1970 *Rice–The Quest for High Yield* Indian Farming 19(10) 15 18 (Eng)

Fertilizer was applied to local and high yield varieties at two levels 50 kg N 25 kg P_2O_5 and 25 kg K_2O/ha and twice that amount At the first level, local strain Co 32 recorded the highest grain yield 5063 kg/ha but IR 8 and other high yield varieties responded better to the higher level of fertilization Maximum profit at the higher level was obtained from IR 8, followed by Taichung Native 1 ADT 27 and Taiman 3 At the lower level maximum profit was returned from Co 32

271 Rao I V S Rao D V K 1965 *Ionic Effects and Interactions of Phosphorus and Molybdenum in Rice 1 On P and N Contents* Andhra Agr J 12(6) 187 200 (Eng) (Agr Coll Bapatla Andhra Pradesh)

Rice was grown with 0 15 30 45 or 60 lb P_2O_5/acre plus 0 2, or 4 oz Mo/acre P uptake was increased significantly by increasing P rate up to 45 lb P_2O_5/acre and by 2 oz Mo/acre Efficiency of P utilization decreased with increasing P rate but was increased by applied Mo Up to 30 days after planting, plant N content increased with increasing P rate Available soil P level showed a significant positive correlation with both plant P content and grain yield (FCA 20 257)

272 Rao, I V S Rao, D V K 1966 *Ionic Effects and Interactions of Phosphorus and Molybdenum in Rice 2 On Mo and Ca Uptake* Andhra Agr J 13(1) 1 10 (Eng) (Agr Coll Bapatla Andhra Pradesh)

Plant Mo and Ca contents decreased with increasing P fertilization up to 60 lb P_2O_5/acre (FCA 20 1703)

273 Rao M V, Manna, G B Mahapatra I C 1970 *Nitrophosphate and Other Complex Fertilizers on Rice, Field Studies* Fertilizer News 15(4) 41 3 (Eng)

Of the number of complex fertilizers tested against $(NH_4)_2SO_4$ the results showed that N applied in the ammoniacal form gave better responses than the pure nitrate forms

274 Ray, S B, Pandey, R G 1969 *Water Management Studies in Rice* Indian Farming 19(8) 15 21 (Eng) (Cent Rice Res Inst, Cuttack)

To determine the magnitude of variations in water requirement caused by different plant densities and fertility levels in a rice field, an experiment was conducted during the second crop season (December May) of 1967 68 First year results show that neither spacings nor manuring levels affected the water requirement of the crop to a material degree Consumptive use of water by rice has been observed to increase slightly by manuring, particularly with $(NH_4)_2SO_4$ Irrigation water is best utilized by the crop if it is adequately fertilized

275 Relwani, L L Mannai, G B 1964 *Effec of Blue Green Algae in Combination with Urea on Rice Yield* Curr Sci 33(22) 687 (Eng)

In a pot trial conducted at Cuttack, urea applied to the soil at the time of transplanting increased the grain yield of rice by 20% at a rate of 10 kg N/ha and by 66% at a rate of 20 kg N/ha foliar spraying with the same doses 50 days after transplanting was ineffective Inoculation of the soil with a mixture of blue green algae at transplanting about doubled the yields in all treatments including the controls (Trop Abstr 20 763)

276 Richharia R H Bhattacharyya R K 1967 *Effect of Ammonium Sulfate and Superphosphate on Paddy in Saline Soil* Proc Semin Sea Salt, Plants, 1st, Bhavnagar, India, 1965 143 45 (Eng) (Cent Rice Res Inst Cuttack)

Three levels each of N [as $(NH_4)_2SO_4$] and P_2O_5 (as superphosphate) were applied to a salt resistant soil SR 26 B Forty day old seedlings were used in the 2 year experiment $(NH_4)_2SO_4$ and superphosphate increased the yield when applied singly or together $(NH_4)_2SO_4$ was more effective than superphosphate The highest grain yield was obtained with the application of a N P ratio of 80 20 (CA 69 85792g)

277 Richharia R H Bhattacharyya, R K 1967 *Preliminary Report on the Effect of Ammonium Sulfate and Superphosphate on Paddy in Saline Soil* Proc Semin Sea Salt Plants, 1st, Bhavnagar, India, 1965 143 45 (Eng)

The highest yield (3159 kg/ha) was obtained by applying ammonium sulfate and superphosphate at the rate $N_{80}P_{20}$ kg/ha, however the maximum profit could be expected from applying the fertilizer at the rate $N_{40}P_{20}$

278 Roy B P Dhua S P 1967 *Effects of Different Micronutrients on Growth and Yield of Paddy* Technology 4 146 47 (Eng)

Of the six trace elements (B, Cu, Fe, Mn, Mo, and Zn) used in replicated trials on a sandy loam, paddy responded only to $MnSO_4$ (up to 20 lb/acre) and $ZnSO_4$ (up to 10 lb/acre) Soil treatment was more effective than foliar spraying at the lower levels of Mn application and the reverse was true for higher rates, with Zn, lower rates significantly increased yields and increasing rates (especially in the form of foliar sprays) progressively depressed yields (SF 30 4504)

279 Sadanandan A K Verghese, L J 1968 *Studies on Silicate Nutrition of Rice in the Laterite Soil of Kerala 1 Effect on Growth and Yield* Madras Agr J 55 260 63 (Eng) (Agr Coll, Coimbatore)

In pot experiments, rice was given 30, 60, or 90 lb N/acre and 0 or 100 lb SiO_2/acre as Na_2SiO_3 or $CaMgSiO_3$ SiO_2 increased grain and straw yields, Na_2SiO_3 increased tillering more than $CaMgSiO_3$, but $CaMgSiO_3$ increased grain yield most (SF 33 3198)

280 Sahay, M N 1966 *Nitrogen Uptake by the Rice Crop in the Experiments with Blue Green Algae* Proc Indian Acad Sci (B) 63(4) 223 33 (Eng) (Cent Rice Res Inst Cuttack)

In field and pot experiments on three rice crops during 1962 65, treatments were (a) none, (b) 1000 kg of lime plus 20 kg P_2O_5, plus 0 28 kg of sodium molybdate/ha, (c) rabbing (burning organic matter on the seedbed), (d) rabbing plus applications as in (b) and (e) 20 kg N/ha Replicates of treatments (a), (b) (c), and (d) were with or without inoculations of blue green algae N contents of grain and straw were determined Treatment (d) with inoculation usually gave the highest crop N uptake–followed by (b) with inoculation Within treatments, inoculation usually gave higher crop N uptake than no inoculation This effect tended to increase with each successive crop For the 1963 64 crops, all treatments were discontinued except (e) In some instances the N content of crops grown after inoculated treatments (b) and (d) were comparable with those still receiving (e) (FCA 20 255)

281 Sahu, B N 1968 *Bronzing Disease of Rice in Orissa as Influenced by Soil Types and Manuring and Its Control* J Indian Soc Soil Sci 16(1) 41 54 (Eng) (Orissa Univ Agr Tech)

The effect of farmyard manure applied in three levels in conjunction with three levels of each of N and phosphate in lowland loamy sand latosol and swampy (*Dahal*) soil of Bhubaneswar, Orissa, on the incidence of 'bronzing disease' of rice has been studied The disease was also studied in the *Bahal* land of the Hirakud Dam irrigated area Sambalpur The control measures were investigated in latosol soil of Bhubaneswar Fe toxicity in loamy sand latosol sulfide injury in swampy (*Dahal*) soil, and Mn toxicity in *Bahal* land appear to be the main causes of "bronzing Drainage of the field, liming the soil to bring the reaction to neutrality a combined application of phosphate and potash, and spraying of urea at active tillering phase reduced the incidence of attack (FA 1 1521)

282 Sahu, B N 1965 *Effect of Farmyard Manure, Ammonium Sulfate and Superphosphate on the Yield of Paddy* Indian J Agron 10 155 64 (Eng) (Orissa Univ Agr Tech)

Mean grain yields were 19 71, 21 54, and 23 08 q/ha, respectively after 0, 90, and 180 q treatments with farmyard manure They were 19 59, 22 01, and 22 74 after 0, 22 5, and 45 kg N and 21 00, 21 21 and 22 12 q after 0, 22 5, and 45 kg P_2O_5 The interaction of responses to N, P, and farmyard manure in acid laterite soil was not significant Responses to farmyard manure and N were linear N in farmyard manure was 36% as effective as that in $(NH_4)_2SO_4$ at 45 kg N, and 58% as effective at 90 kg N Use of farmyard manure was barely profitable The optimum rate of N as $(NH_4)_2SO_4$ was 22 5 kg/ha (SF 30 3022)

283 Sahu, B N 1966 *Response of Different Crops to*

Fertilizer Application in Different Soil Types of Orissa J Indian Soc Soil Sci 13 241 49 (Eng) (Orissa Univ Agr Tech)

Results of simple NPK fertilizer trials in cultivators' fields in eight districts are reported for various crops including rice ragi, sugarcane, potato, and moong There was a universal response to N and moderate to good response to P and K for all crops in all soil types Calcium ammonium nitrate was a better source of N for rice than were urea or ammonium sulfate nitrate Moong responded to P, super was a better source than dicalcium phosphate (SF 29 4380)

284 Sahu B N Lenka, D 1966 *Cultural Cum Manurial Trials on Paddy Studies on the Effect of Dates of Planting Spacing Rates of Planting and Levels of Nitrogen and Phosphate on the Yield of Paddy* Indian J Agron 11 127 37 (Eng) (Orissa Univ Agr Tech)

Planting dates were July 1 15 and 30, interhill spacings were 15 x 15 20 x 20 and 25 x 25 cm, rates of planting per hill were 2, 4 and 6 seedlings and levels of applied N and P_2O_5 were 0 and 45 kg/ha each N applied to the late planted crop was twice as efficient as that applied to the early planted crop Closer spacing and heavy N manuring ensured good yields from late planted crops Response to P was small but increased when N was applied P like N, counteracted the effect of late planting and wider spacing (SF 30 3028)

285 Sahu, B N Lenka D 1967 *Nutrition of Rice Crop by Soil and Foliar Application of Urea* Indian J Agr Sci 37(6) 437 44 (Eng)

A field experiment was conducted at the Orissa University of Agriculture and Technology Bhubaneswar, during the winter seasons of 1961 64 to test the efficiency of foliar application in comparison with soil application of similar doses of N Three varieties of spring *dalua* rice Mtu 15 N 136 and Ptb 10 maturing within 115, 105 and 110 days, respectively were used Three levels of N, 22 50 33 75 and 45 00 kg N/ha in the form of urea were tried over a basal dressing of 22 5 kg/ha of P_2O_5 Three methods of application were adopted soil application of urea in two split doses, foliar application of urea in three split doses, and application of half the fertilizer to the soil at puddling and the remaining half in the form of foliar sprays in three split doses Observations were recorded on the yield of grain and straw, the height of plants, number of effective tillers per plant and number of fertile and sterile grains per earhead Spraying of urea when leaf area is large and the crop is in active vegetative growth (25 50 days) was the best Spraying at the boot stage of the crop caused leaf scorching and tip burn while spraying at the flowering period resulted in discoloration of grain of N 136 Foliar application of urea promoted growth and productivity The yield increase was 19 3% over the control Soil application of urea was more efficient than foliar application, the yield increase being 25 7% over the control However, supply of urea half as basal application and half as foliar application at the later growth stage induced better growth and yield than either soil or spray application of the full dose The yield increase was 33 8% over the control It was found that the longer the duration or larger the leaf area of a variety (like Mtu 15) the greater was the benefit from foliar application Soil application was efficient for short duration varieties (FA 1 1353)

286 Sahu, B N, Raut, S P 1969 *Water Requirement and Response of Lowland Rice to Nitrogen and Phosphate at Different Soil Moisture Regimes* Indian J Agron 14(1) 46 55 (Eng) (Orissa Univ Agr Tech)

The cumulative water use of lowland rice was studied under three soil moisture regimes with three levels of N and PO_4^{3} Cumulative water use increased with increase in soil moisture The use of water from transplanting to harvest was 1560 mm under submergence 812 mm at field capacity, and 200 mm at 75% available soil moisture The consumptive use was 1 2 cm day during the vegetative phase 1 5 cm day during the reproductive stage 0 65 during the milky stage and 0 60 cm day during the yellow ripe stage under 15 cm submergence The reproductive phase is the most critical period and water requirements are highest then Fertilizing with N and P enhanced the total water requirement but increased water use efficiency Lowland rice thrives best and produces most in submerged soil Moisture levels below saturation have a stunting effect, while deep submergence reduces tillering Yield is reduced 29 2% at 75% available soil moisture Weed control is better under flooded conditions (CA 72 89330q)

287 Sahu, B N, Sahoo, B 1969 *Response of Lowland Tall Indica Rice to Time of Application of Phosphate and Potash* J Indian Soc Soil Sci 17 79 83 (Eng) (Orissa Univ Agr Tech)

On sandy loam soil of pH 6 5 there were no significant yield differences due to different times of application of P and K There was little advantage in split application as regards P uptake, P recovery was better from basal application than from topdressing With one variety, split application of K gave better K recovery than topdressing, but with another variety topdressing was superior (SF 33 681)

288 Sahu R K 1970 *IR 8 Performs Well Even Sown Broadcast* Indian Farming 20(1) 33 (Eng)

IR 8 was used in the experiment under the guidance of the All India Coordinated Rice Improvement Project One hundred kg of inorganic N/ha was applied in three split doses (20 kg N basal, 60 kg N 3 weeks after sowing, and 20 kg N at panicle initial stage/ha) P_2O_5 and K_2O at 50 kg each/ha were also applied as basal dressing NPK was added in the form of ammonium sulfate single superphosphate, and muriate of potash The results show a marked and consistently higher grain yield with broadcast method of sowing at 100 kg seed/ha

289 Sankaram, A 1969 *Biochemical Transformations and Nutrition of Rice Under Waterlogged Conditions* Indian J Agr Sci 39(4) 299 323 (Eng) (Cent Rice Res Inst, Cuttack)

A discussion and review of the properties of waterlogged soils, including biological transformations of N P, K Fe Mn, S, and Si and nutrition and growth under anaerobic conditions (CA 72 54100n)

290 Sankaranarayanan R Dhanaraj L Ranganathan T B 1967 *Study of Split Application of Ammonium Sulfate to Paddy Crop* Madras Agr J 54(11) 603 (Eng)

The split application of $(NH_4)_2SO_4$ has no definite advantage in increasing grain yield in either short or long

duration paddy varieties In the *Samba* season, there was some response to the application of the fertilizer in split doses, especially when applied one third at planting, one third 30 days after planting, and one third 60 days after planting

291 Savant, N K, Kibe, M M 1969 *Effect of Alternate Submergence and Drying of Soil Prior to Resubmergence on Extractable Aluminum Iron and Manganese in Rice Soils of the Maharashtra State, India* Soil Sci 108(6) 440-44 (Eng)

Four acid rice soils of the Maharashtra State were subjected to alternate 30 day submergence followed by air or oven drying with the following results (a) the extractable Al increased in cycle 1 while it decreased in cycles 2 and 3, (b) the extractable Fe and Mn increased in cycle 1 but in cycles 2 and 3 alternate submergence and air drying decreased, and alternate submergence and oven drying increased the extractability of Fe and Mn The changes in extractable Al due to submergence and drying appear to be of a chemical nature, whereas those of extractable Fe and Mn may be due to changes in chemical as well as electrochemical properties of the soil

292 Sen, P K, Das Gupta, D K 1969 *Studies in Water Relations of Rice III Effect of Varying Water Regimes and Levels of Nitrogen on the Growth and Yield of Rice* Indian J Agr Sci 39 1000 9 (Eng) (Univ Calcutta)

Interaction of N (45 and 90 kg/ha or no treatment) and water (pots kept in dry tanks or in tanks filled 7½ cm deep with water, saturation, submerged) was studied in pot experiments under controlled conditions Significantly higher yields under high water regime and moderate N level, and under moderate water regime and high N level, point to a mutual interdependence of water and N in determining fertilizer uptake and crop yields Under limited moisture supply, greater yield could be obtained with higher rates of N and vice versa (SF 33 3197)

293 Sharma, J P, Singh, M, Relwani, L L 1967 *Effect of Placement of Fertilizers in Conjunction with Pruning and Earthing Up on the Yields of Paddy* Indian J Agron 12(2) 169 74 (Eng)

Investigation on the effect of placement of fertilizers in conjunction with pruning and earthing up on the yield of paddy was conducted at the I A R I Research Sub Station, Karnal, from 1959 61 The main factors consisted of three levels of N–33 6 kg, 67 2 kg, and 100 8 kg N/ha, three methods of fertilizer placement–broadcasting at puddling, applying in pellet form in the root zone, and placing the fertilizer with a special implement, and three cultural practices–no pruning, one pruning 50 days after transplanting, and earthing up of the crop 50 days after transplanting In addition, three extra treatments–control 67 2 kg N and 67 2 kg P_2O_5/ha placed by special implement and earthing up of the crop 50 days after transplanting, and 67 2 kg N + 67 2 kg P_2O_5 + 67 2 kg K_2O placed by special implement and earthing up of the crop 50 days after transplanting Significant increase in the paddy grain yield was obtained with the increase of N dose from 33 6 to 67 2 kg N/ha Further increase in the N dose from 67 2 to 100 8 kg N/ha did not significantly increase the grain yield Average yields for a period of three years with 33 6, 67 2, and 100 8 kg N/ha were 32 2, 35 8, and 36 8 q/ha, respectively Grain yields (average of 3 years) of 36 40 and 34 86 q/ha obtained with pellet form and placement with special implement were not significantly different from each other, although both of them were significantly higher than the average grain yield of 32 09 q/ha obtained with broadcast application Pruning and earthing up treatments did not differ significantly from each other and were found significantly better than control treatment The average yields were 36 39, 35 83, and 33 73 q/ha, respectively (FA 2 728)

294 Shingarey, M K, Waghmare, R E 1968 *A Study into Economics of Cultivation of Taichung Native 1 Paddy in Kolaba District of Maharashtra* Indian J Agr Econ 23(4) 61 5 (Eng)

In Kolaba district of Maharashtra (India) a field survey was conducted to study the economics of the introduced rice variety Taichung Native 1 and local varieties The study indicated that Taichung Native 1 yielded higher than the local varieties Taichung Native 1 responds to high doses of fertilizers, and is susceptible to pests and diseases The recommended dose of fertilizers for this variety is 100 kg of N, 60 kg of P_2O_5, and 50 kg of K (Trop Abstr 24 1492)

295 Sikder, H P 1965 *Effects of Fertilizers on the Viability of Paddy Seeds* Rice News Teller 13(3) 89 91 (Eng) (Rice Res Sta Chinsurah, W Bengal)

The weak stemmed rice varieties Latisall, Bhasamanik, Rupsail, and the stiff strawed cv NC 220, were given NPK at equal rates ranging from 0 to 100 lb/acre Seed longevity, as measured by precentage germination 270 days after harvest, was greatest from plants receiving NPK each at 100 lb/acre in cv NC 200, and 30 lb/acre in the other varieties Cv Bhasamanik was also given 0 or 100 lb N plus 0, 300, or 600 lb P/acre The deleterious effects of P on seed longevity were greatly increased by the addition of N (FCA 20 245)

296 Singh, G 1966 *Studies on the Concentration of Potassium, Sodium, Phosphorus, Iron, and Manganese in Rice Plant and Their Total Uptake by the Crop Grown on Colusa and Glenview Soils of California Part II* Indian J Agron 11 304 9 (Eng)

Results are given of a greenhouse study on the effect of soil pH, P, Fe and organic matter on uptake of K, Na, P, Fe, and Mn by rice grown under flooded and unflooded conditions (SF 31 1413)

297 Singh, H G, Singh, R M 1966 *Role of Iron in Preventing the Death of Rice Seedlings in Nursery* Indian J Agron 11 310 11 (Eng) (Coll Agr, Udaipur)

When soil application of 5 kg/ha Fe EDTA was supplemented by foliar sprays with Fe citrate or tartrate at an equivalent rate in three applications to nursery raised paddy seedlings, a survival rate of 80% was obtained, compared with complete mortality in the untreated plots (SF 31 1415)

298 Singh, H P 1967 *Effect of Nitrogenous Fertilizers on the Uptake of Phosphorus by Paddy Rice* Agrokem Talajt (Agrochem Soil Sci) 16(3) 395-402 (Hung)

In a pot trial with rice conducted at Kanpur, India, superphosphate was applied at a rate of 87 kg P_2O_5/ha in

combination with 6 N fertilizers at 0, 32, and 64 kg N/ha Uptake of N and P per plant as well as per g of dry matter produced increases with N fertilizer Application of ammonium sulfate resulted in the highest P concentration in the rice plants, followed in descending order by Na nitrate, ammonium sulfate nitrate, ammonium chloride, K nitrate, and Ca nitrate Grain yields increased with uptake of P (Trop Abstr 23 262)

299 Singh, I J, Chowdhury, T K, Rao, D 1968 *Response of Some High Yielding Paddy Varieties to Nitrogen An Economic Analysis* Indian J Agr Econ 23(4) 69 72 (Eng) (Uttar Pradesh Agr Univ, Pantnagar)

N application rates for maximum production were 180, 100, and 80 kg/ha for IR 8, Taiman 3, and China 4 varieties, respectively The most profitable N levels for IR 8, Taiman 3, and China 4 were 151, 96, and 57 kg/ha, respectively (SF 33 686)

300 Singh, M 1969 *Availability of Manganese in Paddy Soils* Riso 18(2) 139-43 (Eng)

The availability of Mn in different soils under waterlogged conditions, as desired for lowland rice cultivation, was studied Waterlogging of soils to a 1 5 soil water ratio increased the availability of active Mn in acid, neutral, and alkaline soils with 7 7%, 13 4%, and 14 4%, respectively However, the highest total release was noticed in acid soils Therefore, bronzing disease of rice due to Mn toxicity is most likely in acid soils Neutral and alkaline soils released comparatively lower amounts of active Mn, which may increase the yield of rice Addition of organic material and manganese sulfate increased the amount of active Mn Aeration of waterlogged soils decreased the amount of active Mn, causing oxidation of bivalent Mn to trivalent and tetravalent (Trop Abstr 25 551)

301 Singh, R M, Jain, G L 1964 *Response of Paddy to Iron and Zinc* Indian J Agron 9 273 76 (Eng) (Rajasthan Coll Agr Udaipur)

Soil application at 2 53 kg/ha Zn increased dry weight and tillering, and foliar application also increased grain yield At lower levels foliar spray was superior to soil application Zn increased crude protein and P and Ca content of grain, but response to Fe was poor (SF 28 3495)

302 Singh, S, Singh, K K 1965 *Studies on the Effect of Soil Moisture Conditions and Potassium Application on the Growth Behavior of Rice Plant* J Sci Res Banaras Hindu Univ 15(1) 8 18 (Eng) (Coll Agr, Banaras Hindu Univ)

Flooding of the soil at every stage of growth was essential for normal growth of rice cv N_{22} grown in pots in a glasshouse Split applications of K improved rice growth slightly, particularly when soil moisture was low (FCA 19 901)

303 Sinha, H, Prasad, K 1967 *Performance, Transformation, and Movement of Urea in Acid Soils* J Indian Soc Soil Sci 15(4) 281 87 (Eng)

In pot experiments with various acid soils of Kanke in Bihar State (India), using rice and wheat as test crops, the growth and yield increased linearly with the increase in the levels of urea as did the N contents of the plants Most of the transformations to ammoniacal and nitrate N were complete by the fourth week In a leaching experiment very little of the urea in the top 10 cm of the soil leached down below this depth Its retention in soils appears to be mainly because of its conversion to the ammoniacal form (Trop Abstr 23 1384)

304 Sinha, R N 1969 *Effect of Pre Soaking Seeds with Plant Growth Regulators and Nutrient Solution on Dry Matter Production of Rice* Madras Agr J 56(1) 16 19 (Eng) (Bihar Agr Coll, Sabour)

In trials during 2 years, rice seed was given presowing treatment for 24 hours with solutions containing 50, 75, and 100 ppm NAA or IAA or with 1*M* solution of K_2HPO_4 Seed for control pots was treated with distilled water NAA or IAA at 75 ppm significantly increased the plant dry matter weight determined 60 days after sowing in the first year and 75 days after in the second year K_2HPO_4 also increased dry matter weight, but the differences were significant in the first year only (FCA 23 340)

305 Sinha, R N, Ram, A 1969 *Effect of Pre Soaking Seeds with Plant Growth Regulators and Nutrient Solution on Yield of Rice* Indian J Sci Ind 3 151 54 (Eng) (Bihar Agr Coll, Sabour)

Seed soaking in solutions containing 75 ppm of NAA, IAA, and 1*M* K_2HPO_4 gave the highest rice yields as a result of increases in number of productive tillers number of fertile spikelets per panicle, and 1000 grain weight (SF 33 4081)

306 Sood, P R, Singh, N 1968 *Response of Rice Varieties to Nitrogen Levels* J Res, Punjab Agr Univ 5(4) 471 74 (Eng) (Reg Rice Res Sta Kapurthala)

With a view to critically studying the response of rice varieties to various levels of N and the costs involved therein, a field trial was conducted at the Regional Rice Research Station, Kapurthala (Punjab) for 2 years (1964 65) There was a progressive increase in yield with the increase in the level of N in both the coarse (Jhona 349) and fine (Basmati 370) varieties, and the differences in yields due to doses of N were highly significant in both the years, however, the difference in the yield of varieties, as well as the interaction between varieties and doses of N in both the years were not significant Though there was a gradual decrease in response of rice varieties to higher levels of N, net profit over control increased progressively with an increase in the dose of N and the highest net profit accrued from the highest fertilizer level, showing thereby that even local standard varieties do possess an economic fertilizer response up to 88 kg N/ha (CA 72 20976n)

307 Sridhar, R 1970 *Nitrogen Fertilization and the Rice Blast Disease* Plant Dis Rep 54(7) 632 (Eng)

Susceptibility of rice plants to the rice blast disease must be considered when recommending the N dosages for fertilization Lesions developed in the unfertilized plants and in treatments up to 40 lb N, lesions were limited in size and turned brown within 7 days after inoculation In plants supplied with 60 and 80 lb N, the lesions were broader and the browning reaction was delayed N fertilizers had little effect on the blast resistant cultivars

308 Srinivasan, V 1965 *A Note on the Time of Application of Nitrogenous Fertilizers to Short Term Rice Crop* Rice News Teller 13(4) 114 16 (Eng) (Agr Coll Res Inst, Coimbatore, Madras)

In a 3 year trial, rice cv ASD 1 and ASD 8 were given 30 lb N/acre, (a) at the time of transplanting, (b) in equal doses at transplanting and 30 days later, or (c) 30 days after transplanting Grain yields from (b) and (c) were significantly higher than those from (a) (FCA 20 228)

309 Srinivasan, V, Kalyanikutty, T, Narayanan, T R 1968 *Optimum Spacing and Nitrogen Dose for High Yielding Rice Varieties in Madras State* Indian Farming 18(6) 12 17 (Eng) (Agr Coll Res Inst, Coimbatore, Madras)

Trials to determine the effect of 0 200 kg N/ha, in addition to a basal dressing of 50 kg each of P_2O_5 and K_2O/ha and six spacings on grain yields of five rice cv and one hybrid (*japonica x indica*) rice were carried out during 3 years in the kharif (summer) and rabi (winter) seasons Cv Taichung Native 1, IR 8, ADT 27, and Hybrid 2410 gave higher yields in the rabi than in the kharif season, but the reverse held for Taiman 3 and Co 32 Taichung Native 1 and Hybrid 2410 grown at a spacing of 15 x 20 cm with 160 and 80 kg N/ha, respectively, and IR 8 and ADT 27 at 20 x 10 cm with 200 and 160 kg N/ha, respectively, gave the highest respective yields of 6250, 5218, 6255, and 4414 kg/ha Taiman 3 and Co 32 at 20 x 10 cm and receiving 200 and 120 kg N/ha, respectively, gave the highest yields of 6366 and 5041 kg/ha (FCA 22 2712)

310 Srinivasulu, K, Pawar, M S 1965 *Studies on the Influence of N, P, and K on Some Quantitative Characters in Two "Indica x Japonica Rice Hybrids* Rice News Teller 13(3) 81 3 (Eng) (Rice Res Sta, Machilipatnam, Andhra Pradesh)

In field and pot trials, two rice hybrids (Hr 19 x Norin 18), cultures 48 and 73, received N, P, and K each at 0, 45, and 90 lb/acre Culture 48 had more grains/panicle and gave significantly higher grain and straw yields than culture 73 N at 45 lb/acre gave the highest yields under normal climatic conditions (FCA 20 226)

311 Sriramamurthy, V M M, Kumarasastry, V V 1968 *Relative Efficiency of Ammonium Phosphate, Nitrophosphate and Single Superphosphate as a Source of Phosphate to Rice* Fertiliser News 13(3) 29 31 (Eng)

N and P were applied to H R 19 rice at rates of 0, 33 6, 50 4, and 67 2 kg/ha using ammonium sulfate + ordinary superphosphate, 20 20 0 ammonium phosphate, and 20 20 0 nitrophosphate as sources N and P rates varied simultaneously The test was conducted for 3 years (6 seasons) on a black clay loam of pH 7 8 and extremely low in available P according to soil tests Yield response was in the order ammonium sulfate + superphosphate > ammonium phosphate = nitrophosphate The authors suggest that S in ammonium sulfate and gypsum in superphosphate may have contributed to the higher yield of this treatment (FA 1 1200)

312 Srivastava, S C 1970 *Appraisal of Nitrogen Fertilization Practices for Paddy, Wheat, Sugarcane, and Potato* Plant Soil 33 265 71 (Eng) (Indian Inst Sugarcane Res, Lucknow)

In crops where early tillering is a critical factor in building up commercial crop yields, early N fertilization to build up a high N composition early in plant growth is essential The quantity of fertilizer required to achieve this is usually more than would be justified by the quantity actually utilized because of a low root foraging capacity at this stage in the plant's growth (CA 74 3110z)

313 Subbarayalu, M, Rethinavelu P 1968 *Optimum Requirements of Nitrogen, Method, and Time of Application for Paddy Crop in the Manimuthar Project Area in Tirunelveli District* Madras Agr J 55(2) 74 7 (Eng)

The optimum dose of N was found to be 50 kg N/ha for *samba* season and 33 kg/ha for summer season Broadcasting half the quantity at planting and the remaining half a month after planting was found to be the best for *samba* season, while application of the entire quantity in the form of pellets near the root zone at a depth of 2 in 3 weeks after planting and broadcasting the entire quantity at the time of last plowing and incorporating into the soil were found to be equally good for summer season

314 Subbiah, B V, Bajaj, J C 1968 *Association of Certain Soil Factors with Higher Paddy Yields* J Indian Soc Soil Sci 16(3) 297 300 (Eng) (Agr Res Inst, Delhi)

Greenhouse and field trials on factors affecting rice yields were determined Increased yields and response to N fertilization were positively correlated with the soil organic matter content There was little correlation with clay content, cation exchange capacity, pH, or available P or K (CA 70 114258r)

315 Subbiah, B V, Venkateswarlu J 1965 *Availability and Transformation of Sulfur in Rice Soils* Isotop Radiat Soil Plant Nutr Stud, Proc Symp Ankara, pp 563 78 (Eng) (Agr Res Inst, Delhi)

Studies were carried out using the isotope dilution technique (*A* values), to evaluate and correlate some of the important methods for studying selected rice soils Pot culture experiments with 13 soils showed that dry matter varied with different soils and the yield response due to S application varied from 0 0% to 17 4% The *A* values varied from 95 to 227 ppm When rice is grown under waterlogged conditions the regression equation worked out was $Y = 15\ 65\ 0\ 87X$ (Y = percent yield response and X = sulfate reducing capacity in mg H_2S/g soil) In the case of S in rice receiving green manure, the amount of S varied from 2% to 8% of the total S in the rice plant From 3% to 13% S was taken up by the rice crop and 2% 12% was found in the soil organic matter Incubation studies showed that mineralization of organic S is favored under aerobic conditions and decreased under flooded or anaerobic conditions S uptake by the rice crop was significantly correlated with the total and 0 5*M* $NaHCO_3$ extractable organic matter Total S values may be taken as an index of S availability of rice soils, 0 5*M* $NaHCO_3$ may be used as an extractant (CA 65 16015d)

316 Subrahmanyan, R, Manna, G B 1966 *Relative Response of the Rice Plant to Blue Green Algae and Ammonium Sulfate in Bulk Trials* Curr Sci 35(19) 482 83 (Eng)

At Cuttack, a plot of rice receiving 30 kg N/ha as ammonium sulfate after transplanting showed considerable development of green algae A similar plot received a basal dressing of 1000 kg lime + 30 kg P_2O_5 in the form of superphosphate per ha, and a mixture of the N fixing blue green algae *Anabaena* sp and *Nostoc* sp at a rate of 2 g dry weight/ha after transplanting In this plot *Anabaena* soon became the dominant alga, and growth of the rice was more vigorous than in the first plot After some time the crop in both plots became chlorotic this was cured by applying a mixture of trace elements The plot with blue green algae yielded 24% more grain per ha than the plot with ammonium sulfate, the difference was due to a higher number of tillers, larger panicles, and heavier grains (Trop Abstr 22 254)

317 Subramanian, S 1968 *A Preliminary Study of the Time and Method of Application of Ammonium Sulfate to Rice Crop* Oyrza 4(1) 48 54 (Eng) (Agr Coll Res Inst, Coimbatore)

In trials during 3 years, two rice cv were given 30 lb N/acre by different methods in addition to a basal dressing of 5000 lb (unspecified) green leaf and 150 lb superphosphate/acre Grain yields of the long duration (195 days) cv Co 25 increased more from applying N in three split doses at transplanting and again 30 and 60 days later than applying the N as a single dose 60 days after transplanting or in two split doses The short duration (110 days) cv Co 29 gave higher yields from applying N in a single dose 30 days after transplanting than applying it on other dates in two split doses (FCA 22 1875)

318 Subramanian, S Parimbaramani C Srinivasan, V 1966 *A Preliminary Study on the Efficacy of Calcium Ammonium Nitrate for Fertilizing Rice* Madras Agr J 53 458 63 (Eng) (Agr Coll Res Inst Coimbatore)

$(NH_4)_2SO_4$ was superior to calcium ammonium nitrate (SF 30 2240)

319 Subramoney, N 1965 *Injury to Paddy Seedlings by Production of H_2S Under Field Conditions* J Indian Soc Soil Sci 13(2) 95 8 (Eng)

The symptoms of the physiological disease of rice known as kuttipachal in Kerala State were found to be similar to those resulting from H_2S damage Uprooted plants had a black crust on the roots which evolved an odor of H_2S when treated with dilute HCl Damage was due to soluble Fe as well as to H_2S Factors contributing to the physiological disease were a pH below 4 5, the presence of soluble Fe, the application of $(NH_4)_2SO_4$, and occurrence of the sulfate reducing bacteria Absence of any one of these factors limits the damage of rice under Kerala conditions It is suggested as measures against the disease to add lime to bring the pH above 5, to use nonsulfatic nitrogenous fertilizers, and to apply Mg silicate (Trop Abstr 21 1470)

320 Sundaram, K M, Subbiah, V, Murugesan, M 1969 *Response of Rice to Fertilizer Application in Cultivators Fields in Tamil Nadu* Madras Agr J 56 803 11 (Eng) (Agr Coll Res Inst, Coimbatore)

Responses to N were greater than responses to P and K Little or no response to P occurred with N rates of >60 lb/acre With 30 lb/acre N, no marked K responses occurred to applications >30 lb/acre K_2O (SF 33 4076)

321 Tewari, S N, Das, M, Deka, A K 1969 *Iron Manganese Interrelations in Soil and Plant* J Inst Chem, Calcutta 41 (Pt 4) 135 37 (Eng) (Assam Agr Coll, Jorhat)

In a pot culture experiment with an acid soil (pH 5 5) with a sufficient amount of available Mn (77 1 ppm), response of rice to Mn application was studied When the ratio between available Fe and Mn was lowered due to Mn treatment the dry matter yield as well as Mn content of plants increased This supports the concept that it is not the absolute concentration of available Fe and Mn but rather their ratio in the medium that determines the growth of plants (CA 71 123012d)

322 Thakur, B S 1970 *Effect of Rates and Time of Application of Nitrogen on Paddy* Fertiliser News 15(7) 32 (Eng)

Application of 100 kg/ha of fertilizer N in three split doses (60 kg N at planting + 20 kg N at tillering + 20 kg N at panicle initiation) was superior to other treatments for paddy, variety IR 8

323 Tiwari, B P 1965 *Urea is Good Fertilizer for Paddy* Rice News Teller 13(1) 25 (Eng) (Agr Res Inst Jabalpur)

Experiments in Madhya Pradesh on light soils showed equal performance of $(NH_4)_2SO_4$, NH_4 sulfate nitrate, and urea, on medium heavy soil, split application of N was better than basal application urea and $(NH_4)_2SO_4$ being equally effective (SF 29 2101)

324 Urs, Y S V Havanagi, G V 1969 *Response of IR 8 and Taichung 65 Varieties of Paddy to the Time and Method of Application of Nitrogen in Visvesvaraya Canal Tract* Mysore J Agr Sci 3 313 22 (Eng) (Reg Res Sta, Mandya)

In 2 year experiments with high yielding paddy varieties on leached sandy soils the most effective method of applying 100 kg/ha N was a dressing of 50 kg/ha to the soil at transplanting + four sprayings of urea at rates of 12 5 kg/ha (SF 33 3204)

325 Vachhani, M V Rao, M V 1965 *Relative Efficacy of Nitrogenous Fertilizers for Rice in Orissa* Rice News Teller 13(3) 71 5 95 (Eng) (Cent Rice Res Inst Cuttack)

Trials during 4 years showed that NH_4Cl NH_4 phosphate, and NH_4 sulfate nitrate were nearly as effective as $(NH_4)_2SO_4$ as nitrogenous fertilizers for rice Urea and NH_4NO_3 were only moderately effective $CaCN_2$ and $NaNO_3$ were almost ineffective All of the compounds were used in amounts sufficient to supply either 20 or 40 lb N/acre (CA 65 12818f)

326 Varghese T, Money, N S 1965 *Influence of Calcium and Magnesium in Increasing the Efficiency of Fertilizers for Rice in Kerala* Agr Res J Kerala 3 40 5 (Eng)

Applications of Ca and Mg increased soil pH and available P, Ca tended to increase available K Mg increased P content of rice grains and the grain to chaff ratio Ca increased N in grains (SF 29 622)

327 Varadharajan, G, Rao, P R N 1965 *The Influence of Nitrogen and Phosphoric Acid on the Incidence of Rice Stem Borer, "Tryporyza incertulas" Wlk* Rice News Teller 13(4) 105 7 (Eng) (Agr Coll Res Inst, Coimbatore, Madras)

Yields of grain and incidence of stem borer attack on rice

grown during August February of 1962 63 and 1963 64 increased with increasing N rates from 0 to 60 lb/acre P applied at two levels had no significant effect (FCA 20 229)

328 Venkataraman, G S , Goyal, S K 1969 *Influence of Blue Green Algae on the High Yielding Paddy Variety IR 8* Sci Cult 35(2) 58 (Eng) (Agr Res Inst , New Delhi)

In trials with rice cv IR 8 given a basal dressing of 89 kg P_2O_5 + 50 kg K_2O/ha, application of 112 1 kg N/ha plus inoculation with blue green algae (*Aulosira ertilissima Tolypothrix tenuis Cylindrospermum muscicola* and *Nostoc* sp) at 2 5 kg (dry weight)/ha 7 days after transplanting resulted in yields of 4007 4 kg grain/ha, compared with 3567 3 and 3372 3 kg for treatments with N alone and algae alone, respectively, and 2762 kg for untreated controls (FCA 23 288)

329 Venkateswarlu, J , Krishna Rao, D V 1965 *Studies on Foliar Application of Nitrogen as Urea to Rice* J Indian Soc Soil Sci 13(2) 127 34 (Eng)

The effects of (1) 0, 25, and 50 kg N as urea applied to the soil, (2) 1, 2, and 3 additional sprayings with 1125 l urea solution/ha and (3) urea concentrations of 1%, 2%, and 3%, on the yield and N content of rice plants were studied in a trial conducted at Hyderabad India, during three successive seasons Yields increased with the dose of N applied to the soil and with the spray concentration, not with the number of sprayings The effect of spraying was reduced by N application to the soil Young leaves absorbed N from foliar sprays more readily than did stems or older leaves, N sprayed before flowering was absorbed more efficiently than N from sprayings applied at a later stage The protein content of the kernels increased with the number of sprayings as well as with the spray concentration (Trop Abstr 21 1469)

330 Venkateswarlu, J , Subbiah, B V 1969 *A Comparison of Several Procedures for Estimating the Sulfur Status of Rice Soils* J Indian Soc Soil Sci 17(2) 155 59 (Eng)

The available native soil S as measured by the isotopic dilution technique using radioactive S (*A* values) correlated significantly with the S supplying power of rice soils, as measured by the uptake of S in soil without S treatment Among the chemical methods, total, organic, 0 5*M* $NaHCO_3$ extractable, 500 ppm P extractable, and isotopically exchangeable sulfate were found to be almost at par and correlated significantly with the S uptake

331 Venkateswarlu, J , Subbiah B V , Tambane, R V 1969 *Vertical Distribution of Forms of Sulfur in Selected Rice Soils of India* Indian J Agr Sci 39(5) 426 31 (Eng) (Agr Res Inst , New Delhi)

The vertical distribution of forms of S and its interrelation with C, N, and P in the organic fraction were studied in surface soils obtained from rice growing tracts of India The total S in the soils (depth range in cm, S in ppm) was at depths 0 15, 112 5 275, 15 30, 20 7 196 9, 30 46, 50 171, 46 61, 43 8 181, and 61 92, 31 3 150 Thus, in general, the total S decreased with increase in depth Organic S, which constituted 14%-18% of the total S, also decreased Sulfate S, which formed 7% 62% of the total S, was inconsistently distributed in the profiles There was considerable nonsulfate inorganic S (up to 57%) particularly in the surface soils that were rich in phosphates and high in pH or calcareous in nature The mean C N S P ratio was 100 9 2 1 0 0 3 for the organic matter in the samples of surface soil (CA 72 54139g)

332 Verma, A B S , Nalamwar, R V , Nema, M L 1968 *Response of Four Varieties of Paddy to Three Fertility Levels* Indian J Agron 13(2) 88 91 (Eng) (Agr Coll , Jabalpur, Madhya Pradesh)

In trials with four rice cv during 2 years, higher grain yields were obtained from applying 40 kg N + 40 kg P_2O_5 + 10 kg K_2O/ha than from applying 20 kg N + 20 kg P_2O_5, or from 60 kg N + 60 kg P_2O_5 + 20 kg K_2O/ha Among cv, Cross 4 2 gave the highest yields of 2759 kg/ha, followed by 2598 kg/ha for Nusahi, 2491 kg/ha for Chhatri and 2481 kg/ha for C R 203 (FCA 23 290)

333 Verma, S K C , Thakur, C 1968 *Nitrogen Response Curve and Economics of Fertiliser Application in Early Winter Rice Transplanted by Modified Techniques* Fertiliser News 13(4) 36 40 (Eng) (Tirhut College of Agr , Dholi, Bihar)

Field experiments were conducted during 1963 65 to study five methods of transplanting rice and four rates of N application Maximum economic response for conventionally transplanted rice was obtained with 50 3 kg N/ha, net profit was 578 71 rupees/ha When seedlings were transplanted twice, optimum rate of N increased to 70 kg/ha but net profit dropped to 414 40 rupees/ha Seedlings pulled and allowed to root essentially in a moist atmosphere for 25 days prior to planting responded linearly to rates of N up to 84 kg/ha, the maximum used This response was linear regardless of whether or not roots were pruned before setting into the field and whether or not pruned roots were treated with a rooting hormone Maximum profit increased to 705 765 rupees/ha for the modified methods of transplanting (FA 1 1352)

334 Vijayan, P K , Menon M K 1965 *Varietal Response to Manuring with Ammonium Sulfate* Rice News Teller 13(1) 16 18 (Eng) Dep Agr Kerala)

An experiment was conducted for three first crop seasons with transplanted rice to determine the effect of $(NH_4)_2SO_4$ and superphosphate in different levels, separately and in combination on two strains of rice, Ptb 2, a selection from the variety Ponnaryan, and Ptb 9, a selection from Thavalakkannan The soil (pH 6 8) had a high content of fine clay and silt particles, contained high levels of Fe and Al, and contained extremely low levels of available P_2O_5 and CaO Both fertilizers were applied at rates of 0, 30, 45, and 60 lb of N or P_2O_5 /acre All of the P and 50% of the N were applied at the time of transplanting, the remaining N being applied 1 month later Strain Ptb 2 gave significantly higher yields than Ptb 9 N at 30 lb/acre gave significantly higher yields than the control, while the effect of P was not significant (CA 66 94354f)

335 Virmani, S M 1967 *Evaluation of Comparative Efficiency of Super Digested Compost on Phosphorus Uptake by Rice by Using P^{32}* Indian J Agr Sci 37(5) 302 7 (Eng)

The uptake by rice seedlings of P, applied as a superphosphate compost mixture or a super digested compost obtained by incubating the superphosphate compost mixture

beforehand for 4 weeks at 30° C, was studied Uptake efficiency was measured by using labeled P The incubation treatment increased the P uptake efficiency, the extent of the increase being dependent on the P fixing capacity of the soil While in an alluvial soil the efficiency was only increased by about 16%, the increase was 69% in a laterite soil For the four soil types studied the increase averaged 35% Composting organic material with superphosphate may be particularly useful in fertilizing rice grown on soils with a high P fixing capacity (Trop Abstr 23 925)

336 Yesoda Raj, A 1968 *Studies on Interracial Hybrids of Rice* Indian J Sci & Ind 2(3-4) 105 15 (Eng)

In Hyderabad three *japonica* varieties were crossed with two *indica* varieties, and four *javanica* with three *indica* varieties *Indica japonica* hybrids exhibited vigor regarding height, number of tillers and yield, and showed response to heavy manuring *Indica javanica* hybrids exhibited vigor in tiller number and yield, but showed no response to manuring The crosses showed pollen and spikelet sterility More sterility was recorded in *indica japonica* hybrids than in *indica javanica* hybrids In successive generations sterility decreased (Trop Abstr 24 2195)

INDONESIA

337 National Academy of Sciences–Lembago Ilmu Pengetahuan Indonesia (Indonesian Institute of Science) *Workshop on Food Means Toward Increased Rice Yield* (Background paper working Group III) Bogor, May 27 June 1, 1968 (Eng)

The largest average increase [34 kg paddy/kg ($N + P_2O_5$)] resulted from 30 kg N + 30 kg P_2O_5 The average relative efficiency rating for sulfate of ammonia, urea, ammonium chloride, ammonium sulfate nitrate, and calcium cyanamide was 100, 105 103, 99 and 81, respectively A quickly available phosphate fertilizer is preferable, applied as basic dressing, before transplanting The common practice is to apply N fertilizer at 4 and 8 weeks after transplanting, broadcast between rows, and trampled into the soft mud during the weeding process

338 National Academy of Sciences–Lembago Ilmu Pengetahuan Indonesia (Indonesian Institute of Science) *Workshop on Food Nitrogen Response and Yield Potentials of PB 5 and PB 8 (IR 5 and IR 8)* (Background paper working Group III) Bogor, May 27 June 1, 1968 (Eng)

The tall weak strawed Syntha yielded 4 4 ton unhusked rice/ha at 120 kg N/ha during the wet season IR 8 and IR 5 produced 3 9 tons and 5 5 tons unhusked rice/ha A heavy incidence of bacterial leaf blight prevented IR 8 from showing its high yield potential during the wet season During the dry season IR 8 and IR 5 gave yields of more than 7 5 tons unhusked rice/ha at 120 kg N/ha The efficiency of N fertilizer during the wet season at 60 kg/ha for Syntha, Sukanandi, IR 8, and IR 5 was 29 1, 19 9, 21 5, and 32 9 kg unhusked rice while at 120 kg/ha it was 18 6, 15 1, 13 6 and 25 3

339 Siwi, B H 1968 *Rice* (Background paper of Working Group III) Workshop on Food (Eng) (National Academy of Sciences–Lembago Ilmu Pengethuan Indonesia, Djakarta, May 27 June 1, 1968)

Rice varieties in Indonesia, both the local or improved, are generally tall and leafy and lodge easily therefore, not more than 60 kg/ha N is recommended

340 Tan, K H 1968 *The Genesis and Characteristics of Paddy Soils in Indonesia* Soil Sci Plant Nutr 14 117 21 (Eng) (Bogor Inst Agr Sci)

Comparative studies of andosols, reddish brown and red latosols from the hills and lowlands of west Java indicated that soil formation under water resulted in surface pseudogley formation and release of soluble SiO_2 Mobilization of Fe and Mn has resulted in the formation of accumulation layers of Fe and Mn within the profile Under the reducing conditions, part of the allophane in the andosol was transformed into halloysite, gibbsite, and goethite (SF 30 740)

IRAN

341 Dewan, M L, Mahdavi, A F 1968 *Soils in Relation to Rice Production in Iran* Trans, 9th Int Congr Soil Sci 4 41 51 (Eng) (Soil Inst, Iran)

In Iran, rice is grown essentially on hydromorphic and on alluvial soils The major hydromorphic soils found in Iran are low humic and humic gley soils, wet alluvials pseudogley or gray hydromorphic soils, and a small area of half bog soils In other areas rice is grown on alluvial soils, especially where irrigation water is plentiful Different soil types, soil test data, and responses to fertilizer were studied, correlated, and reported An application of 30 kg/ha increased yield by 4 2 kg/ha of paddy for each unit of N The application of phosphate gave a similar response The coefficient of the regression of yield response to 20 kg P_2O_5/ha on available soil P (ppm) was b = 4 9 kg/ha of paddy Although the present average yield of rice is about 2 5 tons/ha, if suitable fertilizer and management practices are combined on suitable soils, the yield can rise to an average of 5 6 tons/ha (CA 72 42361k)

IRAQ

342 Ito, H 1965 *The Necessity, the Possibility, and the Means of Rapidly Increasing Rice Production in Iraq* 82 pp (Eng) (Bagdad Government Press)

JAPAN

343 Abe, K, Matsui, M 1966 *Residual Effect of the Growth and Yield of Rice in the Four Elements Fertilizer Experimental Field* Res Rpt Fukuoka Agr Exp Sta 4 33 41 (Jap)

344 Akamatsu, S 1968 *Direct Sowing of Rice Seeds on a Submerged Paddy Field 8 Effects of the Amount of Fertilizer and Different Proportions of Basic Fertilizer to Topdressing on the Growth and Yield of Rice* Nippon Sakumotsu Gakkai Kiji 37(1) 25 31 (Jap) (Okayama Univ)

Field culture experiments of Hooyoku variety rice plants

were carried out at 150 hills/m² spacing, 6, 9, 12, 15, or 180 kg total N/ha of fertilizer and 5 1 1 5 ratio of basic fertilizer to the topdressing The increase of the rice yield and the grain weight was marked at 150 80 kg total N/ha and 1 5 fertilizer ratio (CA 73 24383k)

345 Akamatsu S 1967 *Studies on Broadcasting Method of Rice 9 Relation Between the Quantity of Fertilizer and Yield in Direct Sowing Culture at Drained Field* Proc Chugoku Br Crop Sci Soc Japan 10 1 (Jap)

346 Ando J Shimazaki, L Akiyama T 1968 *Flotation of Granulated Mixed Fertilizers on Flooded Paddy Fields and Its Prevention* Nippon Dojo Hiryogaku Zasshi 39(6) 314 18 (Jap)

347 Ando, S 1968 *Techniques of Application of Gradually Acting Nitrogen Fertilizer to Rice* Shikoku Nogyo no Shin Gijutsu 5 99 115 (Jap)

348 Araki, K Suzuki S 1964 *Studies on Nutrio Physiological Characters of Direct Sown Rice Plants 2 Significance of Basal Dressing of Nitrogen for Direct Sown Rice Plant Under Upland Field Condition* Shikoku Nogyo Shikenjo Hokoku 11 30 9 (Jap)

Until the weeding period growth of stem, P content and the oxidizing ability of roots were increased by the basal dressing of N Until a week or two after waterlogging, growth and P absorption were increased Therefore it was considered that the basal dressing of N up to 0 5 kg/acre was effective If 60 kg/acre of rice yield is expected N should be applied as basal dressing of 0 40 0 56 kg/acre (FCA 19 1487)

349 Arikawa H, Kimata H, Shimozaki, M Maeno M Nonaka, F 1968 *Studies on the Method of Nitrogen Fertilization of Direct Sowing Cultivation of Rice Plants in the Well Drained Paddy Fields* Bull Kanagawa Agr Exp Sta 106 20 35 (Jap)

350 Ashi F Isaki R 1966 *Studies on Method of Fertilizer Application and Planting Density in Warm Region* Proc Kinki Symp Crop Sci Plant Breeding Soc 11 37 9 (Jap)

351 Biba, I, Inada K Iwata, I 1969 *Physiological Studies on the Hidari Aodachi Disorder of the Rice Plant 1 Relationship Between the Occurrence of the Disorder and Soil Properties* Nogyo Gijutsu Kenkyusho Hokoku D 20 79 92 (Jap) (Nat Inst Agr Sci Tokyo)

After supplying various amounts of water to air dried soil samples, considerably greater decreases in Eh and NH_3 N production occurred in two soils inducing this disorder (straight head) than occurred in soils on which the disorder was rare or absent (SF 33 2389)

352 Baba I Tajima K 1969 *Physiological Studies on the Hidari Aodachi Disorder of the Rice Plant 2 Relationship Between the Occurrence of the Disorder and Environmental Factors* Nogyo Gijutsu Kenkyusho Hokoku D 20 93 142 (Jap) (Nat Inst Agr Sci Tokyo)

In pot experiments the disorder was induced by moderate drying following flooding on soil previously showing symptoms of the disorder in the field The symptoms were most severe at a soil moisture content of 50% 70% of maximum water holding capacity Flood irrigation during the period from 20 to 12 days before heading (corresponding to the stage of reduction division) inhibited the disorder, but if done before or after that period its occurrence was promoted High rates of N and lime topdressing suppressed it (SF 33 2390)

353 Chamura, S 1969 *Effects of Nitric Acid in Irrigating Water on the Growth and Yield of Paddy Rice* Nippon Sakumotsu Gakkai Kiji 38(2) 253 60 (Jap)

354 Chiang C T 1965 *Availability of Phosphorus in Paddy Soils* Nippon Dojo Hiryogaku Zasshi 36(4) 90 4 (Jap)

In several paddy field soils, available P was examined by the Neubauer method So called available P extracted commonly from soils appeared not always to coincide with the P absorbed by rice plants Water soluble P was most available for the plant growth With the increase of soil acidity, Al P or Fe P was made less available for the plant while Ca P became more so In other words Ca P was more absorbed by the plant in soils containing much Fe P or Al P, while Al P or Fe P was more readily absorbed in soils high in Ca P Occluded P was not available to the plant Al P in soils was more available for the plant than Al phosphate The amount of available P in soils was related to soil organic matter it was of lower availability in acid soils but of higher availability in neutral soils As for P fertilization the fertilizer with citrate soluble P was recommended for the soils high in Fe P or Al P, that with water soluble P for those high in Ca P (CA 64 10354)

355 Chino, M, Kitagishi, K 1966 *Heavy Metal Toxicities in Rice Plants 1 Growth of Rice Plants at High Levels of Copper, Nickel, Cobalt, Zinc, and Manganese* Nippon Dojo Hiryogaku Zasshi 37 342 47 (Jap) (Nat Inst Agr Sci, Toyko)

In water cultures, the order of toxicity was Cu>Ni>Co>Zn>Mn, the series corresponding closely to stability of metallo organic complexes and to electronegative state of the metals Mobility of the metals from roots to tops was in the order Mn>Co>Ni>Cu The ratio of ear to straw was decreased by each metal and was lowest with Zn or Mn Of various yield components, the percentage of ripened grains was the most severely affected by metal toxicities The second most severely affected was in the Cu and Ni series, number of panicles per pot, and, in the Zn and Mn series, number of spikelets per panicle (SF 30 2948)

356 Chino M, Kitagishi K 1966 *Heavy Metal Toxicities in Rice Plants 2 Toxicities of Copper, Nickel Cobalt, Zinc, and Manganese at Different Stages of Plant Growth* Nippon Dojo Hiryogaku Zasshi 37 372 77 (Jap) (Nat Inst Agr Sci, Tokyo)

Rice plants were grown in nutrient solutions supplied with Cu, Ni, Co, Zn, and Mn at concentrations of 0 6, 1 5, 3 0, 15, and 65 ppm, respectively Applications were started at transplanting, commencement of vigorous tillering, maximum tillering or at heading and were continued to complete

ripening Symptoms included malformation of roots and sudden withering at ripening in the Cu and Ni series, necrotic leaf spots in the Mn series and Fe chlorosis in the Co, Ni, and Zn series but not in the Cu and Mn series In the Mn series grain yields were reduced most by application at the reproductive stage due to decreases in percentage ripened grains and number of spikelets per panicle In the Cu series, maximum reduction occurred with application at ripening due to decrease in the percentage of ripened grains Generally, at high toxicity levels, grain yields were severely affected by application during vegetative growth and at ripening, whereas at low toxicity levels a similar effect occurred with applications at the reproductive stage In the Cu and Ni series application at the ripening stage decreased percentage of ripened grains most, whereas in the Zn and Mn series application at the reproductive stage had most effect Apparently, the mechanism involved differs between the Cu Ni group and the Zn Mn group, in the Cu and Ni series water deficiency in the plants at ripening was thought to be the main factor involved (SF 30 3812)

357 Chino, M Mitsui, S 1968 *Effect of Manganese Toxicity on Carbon Assimilation of Rice Plants at the Ripening Stage* Nippon Dojo Hiryogaku Zasshi 39(6) 320 (Jap) (Univ Ibaragi, Mito)

Fixation of CO_2 by rice plants on maturing was influenced by the application of Mn (up to 65 ppm) The application did not hinder the photosynthesis of the leaves per se, but caused an apparent decrease of CO_2 fixation by decreasing leaf area and increasing respiration (CA 69 105421r)

358 Chino, M , Mitsui S 1967 *Studies on the Occurrence of Heavy Metal Induced Iron Chlorosis in Plants 1 The Effects of Heavy Metal Excesses on the Absorption Translocation, and Distribution of ^{59}Fe in Rice Plants 2 The Effects of Heavy Metal Excesses on the Iron Concentrations in Tops of Rice Plants* Nippon Dojo Hiryogaku Zasshi 38(7) 249 59 (Jap) (Ibaragi Univ)

1 Rice plants grown for 2 months in nutrient solutions containing high rates of Cu, Co, or Mn were transplanted to solutions containing the same levels of nutrients plus ^{59}Fe Chlorosis developed 72 hours after transplanting in plants fed Co Fe content markedly decreased in the tops of all plants, particularly those fed Co Cu greatly depressed the plant growth Treatments had little effect on the Fe content in roots, or distribution of Fe among leaves or tillers and within leaf blades It was concluded that the main factor inducing chlorosis was the decrease in Fe content in the tops 2 The amount of Fe in tops was affected by (a) suppression of plant growth and (b) inhibition of Fe absorption (a) was affected by nutrients in the order Cu>Ni>Co>Zn>Mn Chemical form of Fe determined the ability of metals to influence (b) effect in the presence of chloride or citrate of Fe was in the order Cu, Co, Ni>Zn>Mn Chelated Fe markedly reduced the inhibitory effect of metals, particularly of Cu (FCA 21 2529)

359 The Compound Fertilizer Research Council 1970 *Crop Responses to Ammonium Polyphosphate (VI)* Tokyo, Japan 15 pp (Jap)

Experiments were conducted at four different sites in the cool region where the soils are highly responsive to phosphate application APP tends to result in a slight delay in the early growth of the rice plant particularly tillers are likely to be reduced, as compared with AOP application but this delay is recovered after the middle stage of growth Translocation of phosphate from leaves to panicle is slightly higher with APP The size of the granules (1 3 mm) has no effect The response of the rice plant to APP is slightly better than to AOP the pyrophosphate content in APP making the difference

360 Dokiya, Y , Owa, N , Mitsui, S 1968 *Comparative Physiological Study of Iron Manganese and Copper Absorption by Plants 3 Interaction Between Iron Manganese, and Copper on the Absorption of the Elements by Rice and Barley Seedlings* Soil Sci Plant Nut 14(5) 169 74 (Eng) (Tokyo Univ)

Absorption experiments were carried out using radioisotopes of Fe, Mn, and Cu at concentrations of 0 01, 0 02, 0 04 0 08, and 0 16 ppm, with the pH adjusted to 5 5 As the concentration of Fe was increased, a decrease of Cu absorption was observed in rice Addition of Cu to the solution accelerated Fe absorption In barley plants, Fe concentration had no effect on Cu absorption, but Cu apparently inhibited Fe absorption Mn inhibited absorption of Fe in barley plants, but its effect on Fe absorption by rice was inconclusive The effect of Mn on Cu absorption was inhibitory in both plants (CA 71 21283a)

361 Goto, K 1969 *Soil of Rice Fields and Improvement of Manure* Nogyo Oyobi Engei 44(2) 365 68 (Jap)

362 Gotoh, S , Yamashita, K 1966 *Oxidation Reduction Potential of a Paddy Soil in Situ, with Special Reference to the Production of Ferrous Iron Manganous Manganese, and Sulfide* Soil Sci Plant Nutr 12(6) 230 38 (Eng) (Kyushu Agr Exp Sta MAF Chikugo)

There are in soil several redox systems with various levels of standard redox potential (E_h) Many soil constituents undergo great changes with flooding and drainage and these can be followed from the measurements of the E_h of the soil Drainage and increased porosity of the soil help the oxidation of Fe^{+2}, Mn^{+2}, and S^{2} and raise the E_h value Increase in the reduced forms of these ions with consequent decrease in E_h is enhanced with the level of compost and also, to a certain extent, with flooding Too much decrease of the E_h under heavy application of compost has a retarding effect on the rice plants at the early stage of growth The reduction process takes place in succession from high potential to low in the order of Mn, Fe, and S systems (CA 67 31955c)

363 Hara, M 1968 *Fertilizing and Double Cropping in Rice Cultivation* Farming Japan 2(2) 55 (Eng)

Fertilizing and double cropping require conditions different from and better than usual Preparation should center around the control of water supply for land improvement new techniques in fertilizing, cultivation pest control, and selection of improved varieties When these conditions are met in harmony, fertilizing and double cropping of rice becomes feasible

364 Harada, T , Takaki, H , Yamada, Y 1968 *Effect of Nitrogen Sources on the Chemical Components in Young*

Plants Soil Sci Plant Nutr 14(2) 47 55 (Eng) (Kyushu Univ, Fukuoka)

Sugar beet, tomato, and rice plants were grown for 4 5 weeks in nutrient solutions that supplied either nitrate N or ammonium N or various combinations of these two forms In comparison to plants receiving nitrate N, those receiving ammonium N were higher in free ammonium N, amides, and free basic amino acids such as arginine and lysine Soluble sugars also were higher but organic acids, such as malic, were much lower (FA 1 1349)

365 Hishimoto, Y 1968 *Influences of Pentachlorophenol (PCP) Supplied with Compound Fertilizers on Plant Growth 3 A Connection Between PCP Toxicity on Rice Plant and Method of PCP Addition to Fertilizer Granules* Nippon Dojo Hiryogaku Zasshi 39(8) 387 91 (Jap)

366 Hirose, S Kumada, K 1968 *Nitrogen Economy of Paddy Soils 5 The Influence of Temperature on Immobilization of Ammonium Nitrogen Under the Field Conditions* Nippon Dojo Hiryogaku Zasshi 39(12) 543-47 (Jap)

367 Honya, K, Hiyami, A 1964 *The Physiological Study on the Adjustment of Paddy Rice Growth* Tohoku Nogyo Shikenjo Kenkyu Hokoku No 30, 13 93 (Jap) (Tohoku Nat Agr Exp Sta Morioka)

Environmental factors influencing rice growth were studied Rice growth was analyzed in terms of the changing balance of protein and carbohydrate metabolism Temperature, soil oxygen status soil moisture content, and nutrient supply were important in that order Implications of the study are discussed for transplanting date, drainage, irrigation, and manuring practices (FCA 19 934)

368 Horie M, Yamamura, I, Hosoyama, T 1969 *Statistical Studies on Various Characteristics of Crop Plants 6 Varietal Differences of a Morphological Nature Characterizing Rice Varieties with Three Nitrogen Fertilizer Levels at Various Levels of Plant Spacing* Nippon Sakumotsu Gakkai Kiji 38 675 80 (Jap) (Nat Inst Agr Sci, Tokyo) (SF 33 3205)

369 Ide K Kobayashi S Tokuyasu, M 1968 *Manuring of Rice Plants in the Warm District of Japan II Relations Between Amounts and Application Methods of Fertilizers and Planting Densities* Kyushu Noji Shikinjo 30 149 53 (Jap)

370 Ide, K, Kobayashi S Tokuyasu M, Shimomura, T 1968 *Manuring of the Rice Plants in the Warm District of Japan III Application Amounts of Nitrogen Fertilizers* Kyushu Noji Shikinjo 30 154 55 (Jap)

371 Ikenaga, N, Morita, R, Masuo, Y 1966 *Short Period Cultivation of Direct Sown Rice Plant V Effect of Topdressing of Nitrogen at Heading Time on the Yield* Nippon Sakumotsu Gakkai Kiji 35(3-4) 223 26 (Jap) (Shikoku Agr Exp Sta, Kagawa)

With a topdressing of urea of 0 80 kg N/ha at heading time, the grain yield of early maturing rice varieties increased with increased N application The relative grain yield increase was much less than the total dry matter increase The effect of such N application was more significant in the case of delayed heading time (CA 67 2450d)

372 Inoue, T, Kojo, S 1965 *Studies on the Time of Sowing, Variety, Drill Spacing Fertilizing Method and Quantity of Nitrogen in the Dry Sowing Culture of Paddy Rice* Proc Kyushu Br Crop Sci Soc Japan 25 34 8 (Jap)

373 Ishida, H Fujiwara, A 1965 *Nutrio Physiological Studies on Low Temperature Damaged Rice Plants 4 Relationship Between the Amount of Available Manganese in Soil and the Manganese Uptake by Rice Plants Grown Under Low Temperature Conditions* Nippon Dojo Hiryogaku Zasshi 36 107 12 (Jap) (Tohoku Univ)

Under low temperature rice plants on volcanic ash soil poor in available Mn absorbed nearly as much Mn as those on Mn rich alluvial soil The exchangeable Mn content of the latter was lower under upland than under lowland conditions At moisture corresponding to primary wilting point, Mn uptake was greater from upland soil than from lowland soil Although lowland soil contained more exchangeable Mn under high temperature, Mn uptake was greater under lower temperature In water culture, rice plants absorbed more Mn under low temperature The acceleration of Mn uptake by low temperature is attributed to changes in physiological conditions in the plants (SF 29 2099)

374 Ishida, H, Fujiwara, A 1965 *Low Temperature Damaged Rice Plants 5 Relation Between Enhancement of Manganese Uptake and Change of Physiological Conditions of Rice Plants* Nippon Dojo Hiryogaku Zasshi 36(5) 113 16 (Jap) (Tohoku Univ)

In rice plants with clear physiological symptoms of deficiencies of N, P, K, S, Ca, or Mn, the growth and the uptake of Mn, Fe, or P were studied With a Mn deficiency, growth and absorption of Fe or P decreased but the uptake of Mn increased Increased Mn absorption was also found with plants deficient in Mg or S (CA 64 5454h)

375 Ishizuka, Y, Ando, T 1968 *Interaction Between Manganese and Zinc in Growth of Rice Plants* Soil Sci Plant Nutr 14(5) 201 6 (Jap) (Hokkaido Univ, Sapporo)

Seedlings of *japonica* rice cv Shin ei were grown in nutrient solutions containing five levels of Mn (0 50 ppm) and Zn (0 30 ppm), covering a range from deficiency to toxicity In the solution without Mn, growth of rice plants showing Mn deficiency was more strongly inhibited at higher Zn levels The effect of Zn on growth of rice plants was slight at the 1 ppm Mn level, at Mn levels higher than 5 ppm, Mn toxicity symptoms were severe at low Zn concentrations and Mn toxicity decreased with increasing Zn level Optimum growth and yields were obtained by growing plants at a Mn/Zn ratio of 0 1 10 The amount of Mn absorbed by plants declined as Zn concentrations increased, and depression of Mn absorption by Zn was thought to be one of the effects of Zn in reducing Mn toxicity Since growth of rice plants depended not only on the concentration of Mn or Zn in the tissues but also on the Mn/Zn ratio, it was concluded that Mn and Zn interacted to reduce the phytotoxicity of each other and that Mn and Zn interacted antagonistically on the growth of rice plants (FCA 22 2757)

376 Ito, A, Fujiwara, A 1966 *Calcium Nutrition of Rice Plant Changes of Calcium in the Rice Plant with Different Calcium Concentrations in the Medium* Nippon Dojo Hiryogaku Zasshi 38 126 30 (Jap) (Tohoku Univ)

In Ca deficient media, growth was poor and upper leaves became chlorotic, necrotic, and then died In media with 0 5 ppm Ca growth was also poor, typical Ca deficiency symptoms occurred and no ears developed In media with 5 500 ppm Ca, growth was normal Ca contents of the plants at each sampling increased with increasing Ca supply, being highest at harvest (the only sampling time at which Ca contents on a dry weight basis changed) Most of the Ca was extractable by 70% ethyl alcohol, 2% CH_3COOH, or 10% HCl Alcohol (70%) soluble Ca and nonextractable Ca were extremely low at all Ca concentrations and sampling times Amounts of CH_3COOH and HCl extractable Ca generally increased with increasing Ca supply, but the amount of HCl extractable Ca decreased at the time of ear development, subsequently increasing again at harvest time (SF 31 1414)

377 Iyama, J Hashimoto, A, Kondo, M 1968 *Effects of Application Methods of Fertilizers on the Growth and Yield of Rice Varieties* Kyushu Noji Shikinjo 30 79 82 (Jap)

378 Kawabe, Y 1967 *Study on Subsoiling and Deep Placement of Basic Fertilizer in Rice Culture* Noji Shikenjo Kenkyu Hokoku, No 10, 1 22 (Jap) (Cent Agr Exp Sta, Konosu)

In trials during 8 years on poorly drained soil, subsoiling increased the vigor of plant growth in the later stages of development and the number of spikelets per plant compared with plants in soil receiving normal tillage Placement of basal fertilizer at depths of 6 21 cm at the time of subsoiling significantly increased grain yields The most suitable spacing for the use of this treatment was 30 hills/m^2, using a 2 wheel tractor, subsoiling and fertilizer placement was more effective at intervals of 60 cm than at 30 cm (FA 2 130)

379 Kawaguchi, K 1966 *Tropical Paddy Soils* Jap Agr Res Quart 1(1) 7 11 (Eng)

The differences between the paddy soils of Japan and those of Southeast Asia, particularly of Thailand and Malaysia, are considered with respect to soil profile, rate of weathering of soil materials, composition of clay materials, and contents of N, P, Mg, Ca, Fe, available Si, and easily reducible Mn The distinct horizon differentiation of Japanese soils, which is uncommon for soils in Southeast Asia is connected with the different way of sedimentation, this also results in considerable differences in texture The tropical soils are generally much more deficient in N and P than the temperate soils of Japan, while in several cases they also show deficiences in K, Fe, available Si, and easily reducible Mn (Trop Abstr 22 2203)

380 Kiuchi, T 1968 *Fertilization for Lowland Rice* Agr Asia Special No 6, 70 8 (Eng)

Further high yield of rice may not be achieved in Japan by only changing the amount and method of application of N, P, and K It is necessary to apply well balanced amounts of Mg, Ca, Si, and other trace elements such as Fe and Mn for the improvement of soil characteristics and nutritional status of the soil

381 Komatsu, Y, Nakano, K, Kawasaki, I 1965 *Short Period Cultivation of Directly Sown Rice 1 Effect of Nitrogen and Seeding Density on Early Growth* Nippon Sakumotsu Gakkai Kiji 33 205 13 (Jap) (Shikoku Agr Exp Sta Zentsuji)

During the growing season N content of the soil depended on rate of applied N, but loss of fertilizer N due to nitrification was high Nearly total disappearance of 30 kg/ha occurred in the first second leaf stage with early season rice, in the second third leaf stage with ordinary season rice and in the third leaf stage with late season rice Nitrification was checked by addition of dicyandiamide to $(NH_4)_2SO_4$ and there was a marked effect on growth Growth increased with increasing N particularly between 0 3 kg and 0 6 kg/ha Dry matter weight and N content of plants decreased with increasing seeding density (SF 28 3494)

382 Komoto, Y, Sakai, H 1967 *Studies on High Yielding Fertilization Method for Rice Plants in Warmer Regions I On the Mode of Manuring Effect of Slow Acting Nitrogenous Fertilizer (esp Guanyl Urea)* Chugoku Nogyo Shikenjo Hokoku 1 137 49 (Jap)

N mineralization of guanyl urea can be controlled by irrigation practices to change soil oxidation reduction and its application might strengthen the possibility of improving the growth status of rice plants (top growth type) and make high yielding rice culture easier

383 Kono, Y, Yamada, N 1969 *The Developmental Physiology of the Cortical Disintegration in Rice Roots* Nippon Sakumotsu Gakkai Kiji 38 477 88 (Jap) (Nagoya Univ)

Cortical disintegration in rice roots is a catabolic process affecting cytoplasmic protein and is related to energy consumption for elongation of the root axis and lateral root growth With inadequate N and P supply to the main roots cytoplasmic N and P of the root cortex is utilized as an energy source (SF 33 2391)

384 Kurihara, K, Tanaka, T 1966 *Slow-Release Fertilizers by Coatings II Preparation of Coated Granular Fertilizers and the Response of Rice Plants* Ann Rep Div Chem Fert Nat Inst Agr Sci, pp 33 7 (Jap)

A pot experiment was conducted to determine if coated fertilizer could supply the amount of nutrients, N in particular, matching the needs of rice plants grown on waterlogged soil Granular fertilizers which were coated with five different kinds of materials were used Generally coated fertilizers gave slower growth through the whole season than noncoated fertilizers The growth yield and N recovery by the plant were closely related to the rate of N release into water On soil leached with the equivalent of 1 cm water/day coated fertilizers, in which 60%-90% of N was released into the water within 5 weeks gave significant increases in yield and N recovery over the noncoated, but less yield and N recovery were obtained with less than 30% release rate because N was not released fast enough for optimum growth Leaching losses of N can be almost prevented by use of coated fertilizers even

where considerably severe leaching occurred with noncoated fertilizers

385 Kusaka, Y, Chen P Y, Tsuji, H, Imai, S 1967 *Radioactivation Analysis of Trace Elements in Rice Plant Determinations of Manganese, Magnesium, Sodium, Potassium, Chlorine Bromine, Copper and Zinc* Radioisotopes (Tokyo) 16(10) 526 30 (Jap) (Konan Univ, Kobe)

The seed chaff grain, stem, and leaf of rice plants were irradiated at a flux of 2 4 x 10^{12} thermal neutrons/cm^2/sec and Mn, Na and K were determined by the nondestructive method and Cl Br, Cu, and Zn by radiochemical separation methods The experimental errors were Mn 3 5, Na, K, Cl, Br, and Cu 5 10, and Zn 10%-20% Cl is found chiefly in the seed, Mn, Na and Br in the leaf and K in the stem (CA 68 36644f)

386 Kutsuna, A 1966 *Application of Liquid Fertilizer for Rice Culture* Nogyo Oyobi Engei 41(8) 1209 213 (Jap)

387 Matsuda K 1968 *Effects of EDTA on Crop Plants IV Comparison Between Various Synthetic Chelating Agents in Alleviating Manganese and Iron Deficiencies of Upland Rice Plants* Nippon Dojo Hiryogaku Zasshi 39(6) 300 4 (Jap) (Univ Shizuoka)

The effects of chelating compounds on the growth of upland rice plants, cultured in Mn or Fe deficient soil, were studied Chelates, including EDTA and nitrilotriacetic acid (NTA), were applied at 100 ppm to mineral acid soils neutralized with CaO The growth and yield of the plants were improved, NTA having the most favorable effect This effect of chelates did not seem to be explained by increased absorption of Fe or Mn by the plant Some chelates had an undesirable effect by retarding the growth of the root (FA 2 275)

388 Matsumara, Y Hayashi K 1968 *Formation of Harmful Substances in Paddy Fields and Their Influence on Rice Plants of Different Nutrient Status* Fertilite, No 31, 20 6 (Eng) (Tokai Kinki Nat Agr Exp Sta)

Deficiency of inorganic nutrients in culture solution decreased the ability of paddy to absorb other nutrients and lowered its resistance to harmful substances (organic acids, sulfide S) produced in paddy fields under certain conditions The importance of a proper supply of K, SiO_2, CaO, and Mg is stressed (SF 30 746)

389 Matsushima T Hosoda, K 1968 *On the Method of Fertilizer Application in Direct Sowing Culture at Submerged Field* Tohoku Nogyo Kenkyu 10 115 18 (Jap)

390 Matsushima S, Suzuki, H Wada, G 1969 *Analysis of the Yield Determining Process and Its Application to Yield Prediction and Culture Improvement of Lowland Rice 79 An Experiment for Maximizing Yield by Producing 'Ideal Plant Types' by the Circulation of Irrigation Water Containing Nitrate Fertilizers* Nippon Sakumotsu Gakkai Kiji 38 1 10 (Jap) (Nat Inst Agr Sci, Konosu)

Grain yields were increased by 5%-27% by restricting the N supply (preferably as NO_3) in the irrigation water during the period when the leaf number index increased from 69 to 93 (approximately from 43 to 20 days before heading) (SF 33 1540)

391 Matsushima, S, Tanaka, T, Hoshino, T 1968 *Analysis of Yield Determining Process and Its Application to Yield Prediction in Culture Improvement of Lowland Rice 81 Combined Effects of Air Temperature Water Temperature, Shading and the Amount of Fertilizers in the Seedling Period on the Characteristics of Rice Plants* Nippon Sakumotsu Gakkai Kiji 37(2) 169 74 (Jap) (Nat Inst Agr Sci, Konosu)

Experiments were carried out at 16° 21°, 31°, and 36° for air and water temperatures by using a light shading treatment (20% shading), and with a heavy fertilizing treatment The plant height and top dry matter were more strongly influenced by the water temperature than by air temperature, these characteristics showing maximal values at 31° air and water temperature The N and carbohydrate content decreased progressively with the increase of air temperature The shading treatment had a detrimental effect on the parameters investigated, excluding plant height Heavy fertilization of the seedlings had a beneficial effect especially on the ratio of the top dry matter to the plant height (CA 73 24385n)

392 Matsushima S Tanaka T Manaka, T, Shiomi M 1967 *Analysis of the Yield Determining Process and Its Application to Yield Prediction and Culture Improvement of Lowland Rice 76 Responses of Rice Plants Grown Under Different Types of Weather Condition to Different Nitrogen Fertilizing Methods* Nippon Sakumotsu Gakkai Kiji 36(4) 435-42 (Jap) (Nat Inst Agr Sci Konosu)

Experimental cultivations (1959 61) were carried out in a paddy test field (Konosu, Japan) by using victoria lawn sheets (70% light transmission) for controlling lighting conditions and $(NH_4)_2SO_4$ 4 5 kg/acre was applied at the same transplanting or in 2 4 equal doses during growth Shading during the period of heading had the greatest deleterious effect on yield, and full sunlight was required for maximum yield during the ripening period No optimum fertilization regime was found for all weather conditions the full dose applied at transplanting gave as good overall results as any other (CA 73 24382j)

393 Matsushima S, Wada, G Matsuzaki, A 1969 *Analysis of the Yield Determining Process and Its Application to Yield Prediction and Culture Improvement of Lowland Rice 80 An Experiment for Maximizing Yield by Producing Ideal Plant Types by Nitrate Application in an Ordinary Paddy Field Without Circulating Irrigation* Nippon Sakumotsu Gakkai Kiji 38 11 17 (Jap) (Nat Inst Agr Sci Konosu)

In a field with water permeability 10 15 mm/day target yields were obtained by applying NO_3 during early growth and by discontinuing the N supply by irrigating with fresh water at the start of the critical period (SF 33 1541)

394 Matsushima, S, Wada, G, Matsuzaki A, Yamaura M 1967 *Relation Between Nitrogen Content and Starch Content in Rice Plants with Special Reference to a Critical Evaluation of the Diagnosis by Iodine Reaction of the Nitrogen Requirement at the Panicle Initiation Stage* Nippon Sakumotsu Gakkai Kiji 36(2) 248 53 (Jap) (Nat Inst Agr Sci, Konosu)

A positive correlation was found between the starch content in the rice plant and the degree of staining of a leaf sheath by I in KI The correlation was the closest when the

third leaf sheath from the top was used The negative correlation between starch and N content in the plant became less significant when the varieties and conditions of the samples such as time of transplanting and of topdressing and climate were different There was little correlation between the number of spikelets and N content in the plant Topdressing of N at the panicle initiation stage increased the number of spikelets, which resulted in a higher yield of grain, but did not have much effect on the content of N and starch The I starch color did not seem to be a good index for estimating the requirement of rice plants for topdressing (FA 1 449)

395 Matsushima, S , Wada, G , Matsuzaki, A , Yamaura, M 1968 *Analysis of Yield Determining Process and Its Application to Yield Prediction and Culture Improvement of Lowland Rice 82 Effect of Nitrogen Depletion at Different Growth Stages on the Growth and Yield of Rice* Nippon Sakumotsu Gakkai Kiji 37(2) 175 81 (Jap) (Nat Inst Agr Sci , Konosu)

Rice plants were cultured in nutrient solutions containing ammonium N 30 P O_5 15 K_2O 40, MgO 7 CaO 7, Fe_2O_3 5 and SiO_2 150 200 ppm The removal of N supply for 20 days from 59 49 and 42 days before the heading increased the grain yield and the percentage of ripened grains This might be ascribed to the decrease of the number of spikelets per unit area, the increase of carbohydrate content in straw at the heading stage, and the prevention of excessive growth and lodging The amount of photosynthetic production after heading was mainly governed by the N content in leaf blades at heading and the N supply after heading and was scarcely affected by the leaf area indexes leaf length and light utilizing efficiency (CA 73 24386p)

396 Matsushima, S , Wada, G Tanaka T Matsuzaki, A , Hoshino, T 1964 *Analysis of Developmental Factors Determining Yield and Yield Prediction in Lowland Rice 72 Effects of Toparessing with Ammonium Sulfate on Yield and Conponents of Grain of Directly Sown Rice* Nippon Sakumotsu Gakkai Kiji 33 141 44 (Jap) (Nat Inst Agr Sci , Konosu)

Unlike transplanted rice, topdressing of N to sown rice just before the reduction division stage was ineffective in decreasing the number of degenerated spikelets No method was consistent in producing either increased or lowered yields, but methods of topdressing which increased both the number of spikelets per unit area and the percentage of ripe grains were the most suitable (SF 28 2758)

397 Matsumura Y , Iwasaki S 1965 *Method of Fertilizing Rice in Direct Sowing Culture on Dry Fields* Tokai Kinki Nogyo Shikenjo Kenkyu Hokoku No 14, 44 pp (Jap)

After basal dressing of NH_4 fertilizer to surface soil much of it was converted to NO_3 and leached Placement of NH_4 in the furrows under the seed suppressed nitrification but leaching of NH_4 occurred Basal N dressings at sowing or submergence caused overgrowth at early and late stages of growth and decreased grain yields and should be omitted on paddy soils of southwestern Japan, where kaolin clays have weak absorptive power for nutrients Plants sown at 30 hills/m² (3 4 grains/hill) by mid May should be fertilized from the time of submergence, omitting a basal N dressing and N topdressing at submergence In both, N topdressing at young ear formation increased yields For direct sowing plants, P should be given not as a basal dressing but as a topdressing after tillering (SF 29 3561)

398 Matsuura, K , Iwata, T , Hasegawa T 1969 *Effect of Deep Placement of Fertilizers on Rice 1 Yield Analysis* Nippon Sakumotsu Gakkai Kiji 38(2) 215 21 (Jap) (Fukui Agr Exp Sta)

Injection of liquid fertilizer (15 6 6) at 12 cm depth increased yields on standard planting (22 2 hills/m²), dense planting (29 7 hills/m²) and dense planting/heavy manuring plots by about 1%-3%, 5%-6%, and 10% 11%, respectively, it also increased the number of spikelets per m² and 1000 kernel weight but decreased the number of panicles per m² and the percentage of ripened grains the latter was partly associated with a less favorable light receiving habit of the plants The increased number of spikelets was attributed to increased N content in the leaves and increased net assimilation rate at intermediate growth stages these effects also resulted in increased husk size with which 1000 kernel weight was correlated (SF 33 1529)

399 Mikoshiba H Takase T 1965 *Response to Application of Fertilizer in Indica Rice Effects of Different Quantities of Nitrogen Application on Growth and Yield in Indica Rice* Nettai Nogyo 9(1) 19 23 (Jap)

High application rates of N fertilizers accelerated vegetative growth of indica rice while reproductive growth was retarded Grain/straw ratio decreased according to the increased amounts of N

400 Mikoshiba, H Takase, T 1966 *Response to Application of Fertilizer in Indica Rice 3 Effects of the Split Application of Nitrogen on the Growth and Yield in Indica Rice* Nettai Nogyo 10(1) 5 9 (Jap) (Cent Agr Exp Sta Konosu)

In pot experiments using the *indica* cv T 136 the split application of N at five dates during the growing season reduced plant height number of tillers (per plant) culm length number of panicles and weight of straw compared with a single basal application of N but increased the length and weight of panicles and 1000 grain weight Panicle length and weight and 1000 grain weight were higher in the *indica* cv than in the *japonica* cv Honen wase The weight ratio of grain to straw in T 136 was higher with the split than with the basal treatment In T 136, grain yield was highest with the split application, whereas in Honen wase it was highest with the basal application (FCA 22 256)

401 Mimoto, H Mikami N , Odagiri, T 1968 *Response of Lowland Rice to the Difference of the Situation of Deep Placement as Additional Fertilizer* Rep Tohoku Br Crop Sci Soc Japan 10 35 6 (Jap)

402 Mimoto H , Mikami, N , Odagiri, T 1968 *Studies on the Morphological Variation of Lowland Rice in the Systematic Difference of the Rate of Basic Fertilizer and Additional Deep Fertilizer* Rep Tohoku Br Crop Sci Soc Japan 10 33-4 (Jap)

403 Mimoto, H, Y, Imai, S 1965 *Effect of the Injection of Additional Fertilizer at Different Stage of Growth on Grain Yield and Its Components of Lowland Rice* Bull Aomori Agr Exp Sta 10 129 36 (Jap)

Urea solution was injected to a depth of 12 cm at various growth stages of lowland rice The most effective time for fertilization was 30 40 days prior to heading At first the growth of the plants was inferior to the nontreated plants but was much greater at the later stages in the percentage of panicles and tillers produced The 1000 grain weight was higher due to the larger number of kernels per panicle

404 Minomo, R Murayama, H 1965 *Effects of the Solar Irradiation and the Method of Nitrogen Supply on the Yield of Rice in Kuma Basin* Proc Kyushu Br Crop Sci Soc Japan 24 49 50 (Jap)

405 Mitsui, S 1968 *Mechanized Application of Liquid Fertilizers with Irrigation Water to Paddy (Including Certain Herbicides and Insecticides)* Nippon Agr Res Inst, Tokyo 104 pp (Jap)

Successful ways of applying liquid fertilizer with irrigation water are discussed Bentonite application minimized loss of N fertilizer Pesticides can be simultaneously applied to further cut costs

406 Moritimi, M Chiba, T 1965 *Effect of Fertilizer Applying Position on Rice Growth 2 Relation Between Fertilizer Applying Position and Rice Growth in Latter Period* Tohoku Nogyo Kenkyu 7 63 5 (Jap)

407 Murakami, H 1968 *Effect of Sulfur Oxidation on the Chemical Nature of Soil and on Rice Plant Growth V Acid Sulfate Soils* Nippon Dojo Hiryogaku Zasshi 39(11) 514 18 (Jap) (Prefect Agr Exp Sta Shimane)

Chemical changes caused by S oxidation were studied in newly reclaimed polder soils with much acid sulfate The soils contained S mostly as pyrite The results of lysimeter experiments showed that HCl soluble free Fe and easily decomposible organic matter hindered rice plant growth $FeSO_4$ and $Al_2(SO_4)_3$ interfered with P absorption by rice Not only liming but also draining were necessary for good rice yields Reductive soil conditions were harmful to plant growth Oxidizing soil S, followed by liming and draining, is a good way to improve acid sulfate soils for rice growth (CA 70 95840f)

408 Murayama, N 1967 *Nitrogen Nutrition of Rice Plant* Jap Agr Res Quart 2(2) 1 5 (Eng)

Japanese publications on the timing of N fertilizer applications to rice are reviewed N uptake on fertile soils was found to continue until maturation but as soils are poorer less and less is taken up after heading In northern Japan grain yields increase linearly with an increase of N uptake before heading in southern Japan the rate of increase in yield decreases as N applications increase because most of the extra N is used to increase the production of straw These findings indicate that the highest yields can often be attained only by increasing the uptake of N after heading, for example, by splitting the dosage of N fertilizer into a basal dressing and a topdressing Experimental results confirmed this and have shown that, even after heading, topdressings are desirable under certain conditions (FA 2 225)

409 Nagai, K 1967 *Changes in Properties of a Series of Upland and Paddy Field Soils with Same Conditions of Formation and Different Productivities XV Adsorption of Nitrate Nitrogen to the Soils* Ibaraki Daigaku Nogakubu Gakujitsu Hokoku 15 43 8 (Jap) (Ibaraki Univ, Ami)

Air dried top soils of four groups of upland fields and five pairs of paddy fields were examined One g of each soil was mixed with 0 5 ml solution containing 1 5 or 0 5 mg nitrate N After drying at 30°, the soil was leached with a constant volume of MeOH Nitrate N was determined by microdiffusion analysis The amount of nitrate N left in the soil decreased as the soil became more productive in each group Decreases in the positive charge of a soil (leaching of active Fe and Al) and increases of the negative charge (oxidation of soil organic matter) were considered to be the cause (CA 69 51212c)

410 Nagai M 1967 *Ecological Studies on Vegetative Growth in Rice Plants 6 Effect of the Underground Nutrient, Especially Nitrogen Nutrient on the Tiller Emergence* Shizuoka Daigaku Nogakubu Kenkyu Hokoku No 17 231 37 (Jap) (Shizuoka Univ)

In two experiments, (a) four rice cv were grown in soil with various rates of ammonium sulfate and (b) two cv were grown in standard culture solution or in culture solutions lacking N for 20 days at various growth stages Increasing N supply hastened percentage and date of tiller emergence In (a), the last tillers to develop were those of the 11th or 12th leaf, but tiller emergence was prolonged in (b) The N content of plants was high during early development and fell as growth progressed, but this was not correlated with irregularity in tiller emergence after the turning stage (FCA 22 291)

411 Nakamura, K, Moriyama, T 1965 *Preparations of Magnesium Ammonium Phosphate and Magnesium Ammonium Chloride Fertilizers and Pot Experiments on Their Fertilizing Efficiencies* Asahi Garasu Kenkyu Hokoku 15 55 71 (Jap) (Asahi Glass Co, Ltd Yokohama)

Mg NH_4 phosphate (*I*) and Mg NH_4 chloride (*II*) were prepared by the following reaction $2H_3PO_4 + 3Mg(OH)_2 + 3NH_4Cl + 12H_2O \rightarrow 2I + II$ The fertilizing effects of I and II were investigated by pot experiments using rice, millet, and wheat N and Mg of I had gradual as well as immediate effects on the growth of these plants II had the combined effect of NH_4Cl and $MgSO_4$ (CA 63 14000g)

412 Nishi, K, Kaneki, Y 1968 *Studies on the Difference in Characters of Indica Rice From "Japonica Rice 2 Effect of Topdressing at the Stage of Young Panicle Formation on the Growth and the Yield of Panicle Number and Panicle Weight Type of 'Indica and Japonica Rice* Nettai Nogyo 12(2) 73 8 (Jap) (Tokyo Univ Agr)

The effect of topdressing at panicle formation on growth and yield of rice was investigated in pot trials with the *indica* cv Kaladi nai and Dular and the *japonica* cv Honen Wase and Norin 17 Grain yield per hill was higher following a basal application rather than topdressing for all cv, the increase being due to increased tillering and increased panicle number Topdressing after panicle formation increased 1000 grain

weight for *japonica* but not for *indica* cv Root activity per unit root weight and leaf N content after heading were greater in *indica* than in *japonica* cv It was concluded that 1000 grain weight and percent ripened grains could not be increased in *indica* cv by topdressing at panicle formation (FCA 22 1874)

413 Nishihara, T , Tsuneyoshi, Y 1964 *The Availability of Urea Mixed with Nitrification Inhibitors to Direct Seeding Paddy Rice* Kogoshima Daigaku Nogakuba Gakujutsu Hokoku 15 91 9 (Jap)

On plots receiving N applied twice (basal + topdressing) or three times (basal + flooding stage dressing + topdressing) plant height at later growth, grain yields and amount and rate of N absorbed were increased by addition of nitrification inhibitors Grain yields were larger with two applications + inhibitor than with three applications without inhibitor Dicyanodiamide, anbam, and maneb increased N absorption on plots receiving no N (SF 28 4178)

414 Nishihara T , Tsuneyoshi Y 1968 *Effect of Some Nitrification Inhibitors on the Availability of Basal Dressed Nitrogen to Directly Sown Rice Plants on a Dry Paddy Field* Kagoshima Daigaku Nogakuba Gakujutsu Hokoku 18 133 41 (Jap)

In pot experiments, urea mixed with a nitrification inhibitor was applied as a basal dressing to direct sown paddy, the soil moisture being kept at 60% of maximum water capacity for 4 weeks before flooding Inorganic N in the percolates decreased greatly with 2,5 dichlorophenyl isothiocyanate (2 5 CPI) 2 methyl 4 amino 6 (trichloromethyl) triazine (triazine derivative), and particularly with 2 chloro 6 (trichloromethyl) pyridine (N serve), but not with 2 amino 4 chloro 6 methyl pyrimidine (pyrimidine derivative) or dicyanodiamide (DDA) N serve was harmful to growth only during the period before flooding, otherwise leaves in N serve pots were greener and the number of tillers greater than in topdressed controls The order of effectiveness based on grain and straw yields and N uptake was N serve > 2,5 CPI ⩾ triazine derivative ⩾ pyrimidine derivative = DDA ⩾ control Except with 2,5 CPI, grain yield responses were little affected by increasing the rate of application of nitrification inhibitor from 15 to 30 or 50 ppm of soil (SF 30 741)

415 Noguchi, S 1968 *Studies on the Early Sowing Paddy Rice Grown on the Upland Field 2 Its Fertilizing Application Methods* Kyushu Noji Shikinjo 30 34 7 (Jap)

416 Okabe, T , Satoh K 1968 *Method of Fertilizing Mulched Rice* Nogyo Oyobi Engei 43(7) 50 4 (Jap)

417 Okamoto, Y 1969 *Effects of Silicic Acid on Rice Plants 9 On Growth Under High and Low Temperature of the Culture Solution 10 On Growth Under High and Low Air Temperatures* Nippon Sakumotsu Gakkai Kiji 38 743 52 (Jap) (Univ Wakayana)

Si ameliorated the growth retarding effect on rice plants of high or low temperatures With adequate Si, the uptake of NPK and the accumulation of NPK, total sugar and starch in the panicle, and dry weight of the plants increased (SF 33 3200)

418 Omori, T , Ono, Y , Kawanaka, K , Tsuboi, I 1968 *Effect of Direct Seeding Without Cultivation on Soils and Fertilization I Crop Yield and Physicochemical Properties of Soils in the Case of Successive Direct Seeding* Chika Shigen Chosasho Hokoku, No 38, 19 21 (Jap) (Prefect Agr Exp Sta , Okayama)

Direct seeding without cultivation, repeated for 5 years, did not decrease the yield or growth of rice or wheat Applying N in increasing amounts was required to keep good yield With successive noncultivation, humus Ca, Si, and P tended to accumulate Direct seeding without cultivation in succession was applicable for grayish brown soil or gleyed soil, of loamy or clayey loamy texture with good drainage (CA 73 87016p)

419 Onishi, M , Ono, T 1968 *Fertilization for Rice Plant Reproductive Growth II Manurial Effect of Ammonium Nitrate or Magnesium Hydroxide at Earing* Chugoku Nogyo Kenkyu, No 38, 22 3 (Jap) (Prefect Agr Exp Sta , Tottori)

Pot experiments were carried out with field soils of shale with granitic sand The first fertilization at earing had to be increased by two times for NH_3 N or 2 5 times for NO_3 N of that of $(NH_4)_2SO_4$ sulfate N By the addition of $Mg(OH)_2$ fertilizer (50% soluble in citric acid, pH 9 9), the earing was quickened and increased, and N and MgO were more absorbed by the plant, resulting in an increase of yield (CA 73 87017q)

420 Oritani, T , Yoshida, R 1969 *Nitrogen Metabolism in Crop Plants 5 Changes in the Nitrogen Compounds in Rice Plants with Aging* Nippon Sakumotsu Gakkai Kiji 38 575 86 (Jap) (Toyama Ootami Tech Coll)

Alanine, asparagine, and glutamine contents decreased rapidly from early spikelet initiation to the boot stage and tended to increase greatly in plants supplied with N at the early spikelet initiation stage In the ripening period, arginine and proline were predominant as compared with asparagine and glutamine especially in plants supplied with N at full heading (SF 33 3196)

421 Osada, A 1967 *Photosynthetic Character and Fertilizer Response of Rice Varieties* Jap Agr Res Quart 2(1) 4 8 (Eng) (Nat Inst Agr Sci)

Varietal differences in fertilizer response, especially in N response, of rice plants is concerned with not only resistance to disease or lodging, but also with physiological and morphological characteristics Factors contributing to dry matter production, as well as the rate of photosynthesis per unit leaf area, are easily influenced by N Experiments were set up to investigate the relations between the photosynthetic characteristics and the N response of japonica and indica rice varieties (CA 73 87040s)

422 Oshima, M 1966 *Iodine Starch Test for Determination of Nitrogen Topdressing to Rice Plant* Shiga Kenritsu Tanki Daigaku Gakujutsu Zasshi, No 7, 41 4 (Jap)

A sheath was taken 24 25 days before the rice plant was eared Then the crosscut area of the sheath was immersed in a solution containing KI and I When the area showed a distinct purple blue color, additional feeding in the form of $(NH_4)_2SO_4$ was recommended in order to secure the high yield However, when the area was not stained at all, there was no need for further fertilization (CA 65 14371a)

423 Oshima, M , Nakamura, M 1970 *Effects of Ammonium and Nitrate Nitrogen on the Growth of Tomato and Rice Plant* Shiga Kenritsu Tanki Daigaku Gakujutsu Zasshi, No 11, 44 7 (Jap)

Tomato and rice seedlings were cultured for 2 9 days with different levels of NH_4^+ and NO_3 The seedlings were harvested and N in the seedlings was determined The relation between growth inhibition and concentration of ammonium N and nitrate N was studied Tomato growth was inhibited at lower concentrations of ammonium but it was not inhibited at fairly higher concentrations of NO_3 Rice showed better growth on NH_4^+ than NO_3 at lower concentrations, but it was inhibited more by NH_4^+ than NO_3 at higher concentrations (CA 73 130291p)

424 Ota, Y 1968 *Mode of the Occurrence of Bronzing in Rice Plant* Jap Agr Res Quart 3 1 5 (Eng)(Nat Inst Agr Sci , Tokyo)

Symptoms and physiological aspects of bronzing and the properties and location of soils which induce bronzing are reviewed Bronzing was thought to result from high soil Al content plus Ca deficiency Control measures using fertilizers and resistant varieties are discussed (SF 33 2388)

425 Ota, Y 1968 *Techniques for Applying Fertilizer to Rice in Southeast Asia* Nippon Sakumotsu Gakkai Kiji (Special issue), 181 91 (Jap)

426 Sakagami, Y , Konno, H 1965 *Effect of Nitrohumate on the Growth of Rice and Wheat Seedling* Nippon Dojo Hiryogaku Zasshi 36(8) 243 47 (Jap) (Tech Univ , Tokyo)

Nitrohumic acid derived from the nitrification of lignite or brown coal, indirectly improved soil conditions and directly promoted plant growth (CA 64 8885c)

427 Sakai, H 1968 *Increase Paddy Rice Yields with Soil Management Irrigation* Nogyo Oyobi Engei 43(10) 52 7 (Jap)

428 Sakai, H , Nonoyama, Y , Komoto, Y 1968 *Studies on the Soil Management and Fertilization Method for the Unplowing Rice Culture 1 High Yielding by Fertilizer Placement* Chugoku Nogyo Shikenjo Hokoku E 2 193 227 (Jap)

Placement of fertilizer in the planting hole at depths of 5 cm in plowed fields and 5 or 15 cm in unplowed fields gave yield increases of up to 63 2 kg/acre (15 cm in unplowed field) Unplowed soils had higher Eh value and retained fertility until the later growth stages of the plants Topdressing 34 30 days before heading increased yield to over 75 kg/acre Band application of lime and N increased yield 12%-24% over broadcast application and is recommended because it is easily mechanized

429 Sakanoue, Y , Iguchi, T 1968 *Effect of Low Soil Moisture at Ripening on the Growth and Nutrient Absorption of Rice Effect of Drought Damage on the Growth and Mineral Uptake of Crops 1* Nippon Dojo Hiryogaku Zasshi 39 171 75 (Jap) (Yamaguchi Agr Exp Sta)

Simulated drought conditions (pF 3 3) at ripening resulted in stems and leaves of poor appearance, dark grains and low grain yields, and 1000 grain weights In damaged plants, P_2O_5 and SiO_2 contents were lower and MnO contents higher than in normally ripened plants, N, P_2O_5 and Mno contents in stems and leaves were much increased The degree of reduction in nutrient absorption at ripening in drought damaged plants was in the order P_2O_5, $K_2O > SiO_2 > CaO = MgO > N > MnO$ (SF 32 1562)

430 Sakanoue, Y , Iguchi, T 1968 *Effect of Less Soil Moisture at Generative Growth Upon Growth and Nutrient Absorption of Rice Plant Studies on Drought Damage Upon Growth and Mineral Element Uptake of Crops 2* Nippon Dojo Hiryogaku Zasshi 39(3) 210 13 (Jap) (Yamaguchi Agr Exp Sta)

In an experiment, rice plants were subjected to drought (pF 3 7 3 3) at the reproductive stage Heading and ripening were retarded and stem and panicle lengths were shortened Grain yields were reduced by 83% and 1000 grain weight by 69%, but straw weight was little affected The P content of the plant decreased and N and Mn increased, while root N, P, K, and Mn contents were increased Absorption of nutrients was reduced in the order P > K > Si > Ca + Mg > N > Mn (FCA 22 1913)

431 Sakanoue, Y , Iguchi, T 1968 *Effect of Moderate or Low Soil Moisture at Vegetative Stages on the Growth and Mineral Uptake of Rice* Nippon Dojo Hiryogaku Zasshi 39 214 18 (Jap) (Yamaguchi Agr Exp Sta)

Straw weight was decreased by 18% and grain weight was somewhat decreased by moderate soil moisture (pF 1 7), both were decreased appreciably by low soil moisture (pF 3 5) At pF 1 7, nutrient uptake was depressed in the order P > Si > K > Ca, Mg, but a little more N and noticeably more Mn were taken up than with normal moisture At pF 3 5 the order of depression was P > Si > K > Ca, Mg > N > Mn (SF 32 3191)

432 Sakanoue, Y , Matsubara, K 1967 *Effect of Stirring Soil After Waterlogging on Mineralization of Original Organic Nitrogen in Paddy Soils II Fallowing Paddy Rice Field* Nippon Dojo Hiryogaku Zasshi 38(2 3) 70 3 (Jap) (Prefect Agr Exp Sta , Yamaguchi)

N was absorbed more by rice plants grown on stirred soils than by those on nonstirred soils All the soils, stirred or nonstirred after waterlogging, were kept in bottles, corked, and paraffined, at 30° for 4 weeks Ammonia N was higher in all stirred soils than in nonstirred Mineralization of original organic N was probably accelerated by stirring (CA 67 72833e)

433 Sekiya, F 1968 *Tillering Primordium and Tillering Bud in Rice Seedlings 11 Effect of Calcium Deficiency on the Development of Tillering Buds* Nippon Sakumotsu Gakkai Kiji 37(4) 465 71 (Jap) (Yokohama Nat Univ)

In Ca deficiency at the early growth stage the tillering buds in each stem node developed and tillered as well as in the control plots However, when the Ca deficiency became too long, the development of the tillering buds was significantly reduced, especially at lower pH's of the nutrient solution (CA 73 24388r)

434 Shibata, M , Sasaki, K , Honma, A 1969 *A Study on the Responses to Nitrogen, Phosphoric Acid, and Potash of Rice Varieties* Jap J Breed 19(1) 28 38 (Jap) (Hokkaido Agr Exp Sta , Sapporo)

In field trials in 1966 and 1967, three rice cv received N as a basic dressing and as two topdressings, the first at tillering and the second at the boot stage P_2O_5 and K_2O were applied as basic dressings Panicle number per hill, grain number per panicle, percentage fertile grains, and grain yield were measured Significant varietal differences were observed in the effects of individual fertilizers on these characters and in interactions between the fertilizers (FCA 23 289)

435 Shimada N 1970 *Salt Injury of Crops III Responses of Crop Roots to Salt Treatment* Nippon Dojo Hiryogaku Zasshi 41(4) 162 66 (Jap) (Univ Chiba)

The relation between the concentration of salts and the ability of the plant roots to reduce TTC (2,3,5 triphenyltetrazolium chloride) was studied with several kinds of plants Effects of the salts on water holding power or evaporation of the plant were examined Root of rush, rice plants, or cucumber showed lowered TTC reduction when treated with salts of Mg or NH_4^+ in lower concentration than that of K, Ca, or Na This slowing of TTC reduction of the root by Mg salts was weakened at pH 5 6 5 Mg concentration (5m*M*) that retarded TTC reduction also reduced evaporation in the cucumber, but not absorption of water by cucumber roots Mg in the root was not changed by the supply of Mg up to 5m*M*, unfavorable for the root (CA 73 108835x)

436 Shimizu, M , Kuno, K 1968 *Effects of Iron on the Appearance of Morph genetically Abnormal Spikelets Due to an Unfavorable Low Temperature in Rice Plants* Nippon Sakumotsu Gakkai Kiji 37(2) 224 29 (Jap) (Nagoya Univ , Aichi)

Rice plants grown in nutrient solutions were supplied with Fe (10 ppm) in the form of FeEDTA, ferric chloride, or ferric citrate FeEDTA prevented the development of morphogenetic abnormalities in the spikelets even under unfavorable low temperatures The ineffectiveness of ferric citrate and ferric chloride was due to their inefficient uptake by the plants (FCA 22 1901)

437 Shimose, N , Miyake, Y 1965 *Crops Grown on Polder Soils V Growth Injury of Rice Plants by Hydrogen Sulfide and Other Sulfides* Nippon Dojo Hiryogaku Zasshi 36(5) 117 20 (Jap) (Univ Okayama)

The effect of interrupted irrigation on H_2S injury to rice plants was studied on a newly reclaimed field Plant growth on waterlogged plots was inferior to that on interrupted irrigation plots, more so in the second year, causing "akagare" (physiological browning) in late July From the results of chemical analyses of leaves, inferior growth on waterlogged plots was considered to be due to inhibited K^+ uptake and abnormal protein and carbohydrate metabolism On the waterlogged plots, H_2S and other sulfides developed, resulting in decreased plant growth On the same plots, incomplete removal of salts from the field probably hindered plant growth (CA 64 10358g)

438 Sugawara, T 1965 *Direct Sowing Cultivation of Paddy Rice Plants in a Dry Field I Method of Fertilizer Application* Utsunomiya Daigaku Nogakubu Gakujutsu Hokoku 6(1) 51 61 (Jap)

Seedlings from direct sowing are grown for a period without watering The bulk of N should be applied shortly after watering, but it is profitable to supply some N at sowing and some as topdressing at the young panicle stage P is applied basally but heavier application is necessary on dry fields Besides a basal dressing K was effective applied about 30 days before heading K absorbed after the formation of young panicles acted mainly on grain weight PCP urea is used extensively a little after irrigation on direct sown fields (SF 29 4330)

439 Sugawara T 1968 *Constant High Productivity of Paddy Rice Under Irrigation* Nogyo Sekai 63(6) 110 15 (Jap)

440 Tadano, T , Tanaka, A 1970 *Iron Nutrition of the Rice Plant I Iron Absorption Affected by Potassium Status of the Plant* Nippon Dojo Hiryogaku Zasshi 41(4) 142 48 (Jap) (Hokkaido Univ , Sapporo)

When cultured in a medium high in Fe, rice plant roots could reject this Fe the less the supply of K, the weaker the rejection In a medium low in Fe, the rice plant root could absorb Fe metabolically, the better the K nutrition, the more Fe absorbed High Fe media required addition of large amounts of K in order to avoid K deficiency For acid soil of Hachirogata and peat soil of Bibai addition of K and neutralization of soil acidity increased K and decreased Fe in the plant, resulting in disappearance of brown spots or darkened color of the leaf blade, and in an increase of growth rate Disappearance or signs of Fe toxicity was due to the activity of the root strengthened by supplying K as well as lowering soil acidity, and to the higher E_h of the soil solution (CA 73 108834w)

441 Takahashi, E 1968 *Silica as a Nutrient to the Rice Plant* Jap Agr Res Quart 3(3) 1-4 (Lng) (Kyoto Univ)

The silica content in the stem and leaves of rice ranges from 10% 20% The mode of silica uptake by rice is an active uptake linked with aerobic respiration Widely used as a silicate material are Fe slags The effect of silicate materials on the rice yield becomes visible when the amount of available silica in the soil is < 10 5 mg SiO_2/100 g soil in terms of the pH 4 acetate buffer solution extractable, and when the silica content in straw is $<11\%$ (CA 73 86924w)

442 Tanaka, A , Mulleriyawa, R P , Yasu, T 1968 *Possibility of Hydrogen Sulfide Induced Iron Toxicity of the Rice Plant* Soil Sci Plant Nutr 14(1) 1 6 (Eng) (Hokkaido Univ , Sapporo)

Lusiana clay has a pH of 4 7, 3 2% organic matter, and an active Fe content of 2 9% Cellulose (1 25%) and S (2 5%) were applied to a 2 kg sample of the soil, and the soil was flooded with H_2O Peta rice seedlings were planted and the soil solution was analyzed for Fe and S The Fe content of the straw and the oxidizing power of the roots were determined Fe toxicity was evident after 3 weeks only in plants with the S treatment The degree of toxicity correlated positively with the Fe content in the straw The oxidizing power of the roots 35 days after transplanting was high in the control, low in the

cellulose only treatment, and very low in the cellulose and S treatment Six week old Peta plants grown in nutrient solution were exposed to $FeSO_4$ plus H_2S at pH values of 5, 6, and 7 Respiration measurements showed S inhibited respiration and increased Fe content of the shoot This inhibition decreased with pH increase Pretreatment with 100 ppm S as H_2S and then subjection to an $FeSO_4$ solution caused rapid Fe toxicity If Fe and S concentrations in the soil solution exceed certain levels, the oxidizing power of the roots is destroyed by S Fe is taken up more readily causing toxicity (CA 69 18312n)

443 Tanaka, A Navasero, S A 1966 *Interaction Between Iron and Manganese in the Rice Plant* Soil Sci Plant Nutr 12(5) 29 33 (Eng) (Hokkaido Univ , Sapporo)

In pot experiments, increased Fe or Mn levels in the growth medium decreased Mn and Fe contents, respectively, in the rice plant The range within which Fe toxicity could be remedied by Mn application was fairly narrow Mn toxicity was rare and application of Fe to prevent it would rarely have practical significance (SF 30 3808)

444 Tanaka, I Nojima, K Uemura, Y 1965 *Influence of Drainage on the Growth of Rice Plants in Rice Fields 3 The Influence of Irrigation Management on the Nutrient Uptake Yield of Rice Plant, and the Mineral Nitrogen Content in Soil* Nippon Sakum Otsu Gakkai Kiji 33(4) 335 43 (Eng) (Cent Agr Exp Sta , Konosu)

Experimental treatments consisted of early, intermittent, and late irrigation, shallow (5 cm) and deep (17 cm) plowing, and four levels of applied N Results showed that yield of grain under intermittent irrigation at low N was 20% less than on plots irrigated early, yet at high N there was little difference between yields of these two treatments It was also noted that the highest yields under the three irrigation treatments were similar Uptake of N, P, K and Si by plants on intermittently irrigated plots was less than on the other two irrigation treatments, but uptake of Mn was much higher Plants under late irrigation showed higher uptakes of N, K, and Mn but lower uptake of P and Si than on early plots The influence of the movement of water in the soil on the mineral N content was also examined Results indicated that large losses of N occurred when the water table was 0 10 cm below the surface, when there were regular fluctuations in water table and when well drained soils were subjected to heavy irrigation or precipitation The main conclusions were (a) provided rainfall is adequate and evenly distributed, continuous submergence is not always necessary for rice cultivation, (b) the effect of irrigation management depends primarily on the change in N uptake, which is affected by variations in the water table as much as by distribution of rainfall (FCA 20 223)

445 Tange, M , Yamada, M 1966 *Effect of Fertilizers on Rice Growth* Proc Kinki Symp Crop Sci Plant Breeding Soc 11 21 32 (Jap)

446 Tanno, M , Midorikawa, K , Hashimoto, H 1968 *Studies of the Effects of Phosphatic Fertilizer on Paddy Rice in the Volcanic Ash Soil Under Temperate Climate* Bull Ibaraki Agr Exp Sta 9 67 117 (Jap)

447 Torii, T 1966 *Effect of Applying Nitrohumates III Pot Experiments on Upland Rice* Nippon Dojo Hiryogaku Zasshi 37(2) 172 78 (Jap) (Gakugei Univ , Tokyo)

For normal growth of upland rice plants the concentration of ammonium nitrohumate (*I*) was critical With change of form of phosphate fertilizer the effect of I was changed, superphosphate tending to increase ear weight less than fused phosphate In spite of the inhibition of earing by I, ear weight was increased By supplying I in the proper amount, absorption of N, P, K, and Ca by the plant was increased (CA 65 1337g)

448 Tsunoda, H 1965 *Fertilizer and Herbicidal Effect of a Pentachlorophenol (PCP) Ammonium Chloride Fertilizer Mixture III Effects of PCP Compound Fertilizer Mixture on Rice Plant Growth* Nippon Dojo Hiryogaku Zasshi 36(3) 49 52 (Jap) (Toyo Soda Mfg Co , Yamaguchi)

The effect of the mixture on plant growth was compared with that of single material, such as granular PCP, a commerical herbicide, or a fertilizer When 40 ppm was placed in the soil, PCP retarded rice plant growth, decreasing root weight or number of tillers, but not plant height This retardation was soon recovered Rice grain did not change its weight between two plots, with or without PCP Compared with a plot given 20 ppm PCP, the ratio of rice grain weight to straw weight was higher on the plot given 40 ppm, the weight of the grain decreasing The difference in rice grain weight between the plot with the PCP fertilizer mixture and that with granular PCP with fertilizer was not great The injury to plant growth was less on the plot with the mixture *IV Herbicidal Effects of PCP Compound Fertilizer Mixture Ibid* 53 6 The herbicidal effect of the compound of fertilizer with PCP on barnyard grass was in the following order depending on the depth of soil where PCP was placed surface soil > 0 4 cm > 0 8 cm For weeds other than barnyard grass the effect was 0-4 cm > soil surface > 0 8 cm The herbicidal activity of the mixture was about the same as that of granular PCP or commercial herbicides, but the mixture had greater activity, when it was applied 0-4 cm deep under rainy condition and at the soil surface in sunny conditions Granular PCP was leached from the soil more and decomposed more in the surface water (CA 63 12270e)

449 Uexkuell, H R von 1968 *More K for Paddy in the Future* World Farming 10(7) 18 (Eng)

Many soils of the tropics are inherently low in K Increased N use will aggravate this condition K hungry grains produce a protein of inferior nutritional value and quality K supply also affects the number of filled grain and the susceptibility of plants to paddy diseases

450 Wada, G , Matsushima, S , Matsuzaki, A 1968 *Analysis of the Yield Determining Process and Its Application to Yield Prediction and Improved Culture of Lowland Rice 87 Effect of Nitrogen on Dry Matter Production Before Heading and the Relationship Between the Number of Spikelet Components Per Unit Area and Dry Matter Production* Nippon Sakumotsu Gakkai Kiji 37 557 64 (Jap)

For plants of a single variety sown on the same date, the dry weight of the plants at the neck node initiation stage correlated positively with their N content, number of panicles, and number of differentiated rachis branches Between

neck node initiation and late spikelet initiation, the increase in dry weight of plant and photosynthate production in the leaves correlated positively with N uptake for the period Between late spikelet initiation and heading the dry weight increase correlated positively v th N uptake and with total N content of the pla it at headi g The amount of stored carbohydrates in sheaths and culms at heading was related to N uptake between late spikelet initiation and heading only when plants had absorbed equal amounts of N by the time of late spikelet initiation (SF 32 4020)

451 Yamasaki, T 1968 *Possibilities of Increasing Rice Yield Through Increased Fertilizer Application* Fertilite, No 31, 3 19 (Eng) (Tottori Univ)

The possibility of increasing rice yields by applications of heavy rates of complete and well balanced fertilizers is discussed with reference to Japanese conditions The problem of lodging is considered, and the effects of N [as $(NH_4)_2SO_4$ and NH_4Cl] and K topdressings are discussed (SF 32 744)

452 Yamazami, K , Yanagisawa, M Sekiguchi, T 1967 *Fertirrigation of Liquid Fertilizer in Paddy Field III Distribution of Radioactive P by Fertilization* Nippon Dojo Hiryogaku Zasshi 38(1) 29 36 (Jap) (Prefect Agr Exp Sta , Toyama)

With two field soils, alluvial and ando, of different capabilities for P fixation, distribution of P by fertirrigation was studied with ^{32}P applied either basally or as topdressing P in water layer varied the variation coefficient in the range 4%-10% indicating that ^{32}P was distributed quite uniformly The d stribution was not influenced by tillage, irrigating velocity, or concentration of liquid fertilizers, especially under wet soil conditions In the field where water prev ously irrigated to 1 cm depth of soil, the fertirrigation could not transport the ^{32}P in liquid fertilizer to the remote part of the field Paddy fie l had to be drained before the fertirrigation in order that the P in liquid fertilizer could attain its maximum distribution Variation of the amount of P was higher in soils than in irrigating water Of total ^{32}P, 80% was in the soil depth of 2 cm Radioactivity in water and soil layer was higher at water inlet than at water outlet of the field, more so for ando soil than for alluvial soils (CA 67 43008j)

453 Yanagisawa, M , Irobe, A , Iida, S , Yamazaki, K 1967 *On the Efficiency of N Received by Direct Sown Paddy Rice at Different Growth Stages* Nippon Dojo Hiryogaku Zasshi 38(1) 37 42 (Jap) (Toyama Prefect Agr Exp Sta)

N applied to direct sown rice cv Koshijiwase at the initiation of panicle primordia or at flowering, reduced the dying off of lower leaves and was related to the length of the upper leaves N applied at the time of flooding gave the highest yield Utilization efficiencies of applied N were basal dressing, 7 2%, topdressings at first flooding, 25%, at tillering, 34%, at formation of panicle primordia, 44%, at flowering, 49%, at 15 days before heading, 55% (FCA 21 1767)

454 Yoshida, T 1968 *Dynamic Aspects of Photosynthate Supply and Metabolic Pattern in Paddy Rice Roots* Nippon Dojo Hiryogaku Zasshi 39 258 63 (Jap) (Nat Inst Agr Sci)

Paddy rice receiving NH_4 or NO_3 showed a higher ability to translocate ^{14}C to the roots than the rice with no N source The specific activities of ^{14}C in the components of the roots were in the order sugar > amino acid > protein > cellulose, hemicellulose > lignin Plants grown with NH_4 N maintained more ^{14}C in their cytoplastic components, compared with plants supplied with NO_3 N or no N The importance of roots in amino acid synthesis is discussed (SF 33 4843)

455 Yoshida, T , Nakamura, M 1968 *On the Difference in Rubidium 86 and Phosphorus 32 Uptake at Different Zones of Paddy Roots* Nippon Dojo Hiryogaku Zasshi 39(4) 253 57 (Jap)

The uptakes of ^{86}Rb and ^{32}P at different zones of the excised roots of rice seedlings were investigated at different root ages Regions showing the most vigorous uptake of ions were not stable, but moved successively in association with elongation and development of roots Patterns of the movement were complicated Relative importance as the central site of ion absorption altered with root growth among the three characteristic zones of roots, namely the meristem, the root hair, and the lateral generating zone The uptake of ^{86}Rb by the elongated roots and that of ^{32}P by root tips at all ages were sensitive to low temperatures and respiratory poisons, indicating dependence upon metabolic processes The salt absorbing regions moved with age and the contribution of nonmetabolic ion uptake in the salt absorption changed successively This suggested the importance of age as a factor that governs the salt uptake by plant roots (FA 2 547)

KOREA

456 Ahn, S B 1968 *Carbohydrate Metabolism of Rice Varieties in Relation to Their Response to Nitrogen* Nongsa Sihom Yon'gu Pogo 11(1) 131-43 (Korean) (Crop Exp Sta , Suwon)

Heavy application of N markedly lowered the starch content of low N responsive varieties The high N responsive variety maintained a relatively high starch content even when fertilized with high levels of N The high starch content at a high N level may be used as a biochemical parameter for high N responsiveness of rice varieties The contribution of carbohydrate assimilated and stored before flowering to grain carbohydrate was much lower in wet seasons than in dry and for early maturing varieties than for late maturing ones Total sugar was just as important as starch in carbohydrate balance between flowering and harvest (CA 71 80328s)

457 Choi, H O , Leer, J H 1968 *Effects of Split Application of Nitrogen at Major Growth Stage of Paddy Rice on Agronomic Characters and Grain Yields* Nongra Sihom Yon'gu Pogo 11(1) 23 42 (Korean)

N was applied as a basal dressing and as a topdressing at various stages of growth N applied 25 32 days before heading increased length of leaves and panicles Dry matter weight was increased up to the maximum tillering stage Yield was increased by topdressing in all cases

458 Heu, H , Ota, Y 1969 *The Effect of Deep Placement of Fertilizer and Intermittent Irrigation on the Physiological and Ecological Characters of Rice Plants* Nippon Sakumotsu Gakki Kiji 38 501 6 (Jap) (Ho Nam Crop Exp Sta Iri)

Deep placement increased plant height, and increased yields by 20%, lodging resistance increased due mainly to retarded elongation of the lower internode and increased breaking strength of the stem, the degree of chlorophyll destruction in the leaves was lower, α naphthylamine oxidizing activity of the roots increased Deep placement + intermittent irrigation increased the yield by 24%, produced erect flag leaves, and gave the higher α-naphthylamine oxidizing activity of the root and the highest K and SiO_2 contents of the plant at heading and harvesting (SF 33 2383)

459 King U R 1967 *Effect of Trace Elements on Nitrogen Metabolism in the Early Growing Stages of Rice Planted in Dry Ground* Nongop Kwahakwon Hakbo, No 10, 4 8 (Korean)

Lower contents of total N, protein N and nonprotein organic N were obtained in the early growing stage of rice planted in dry ground than from rice planted in an ordinary paddy however the inorganic N (as NO_3) content was higher in the former indicating that planting in dry ground prevented the assimilation of inorganic N The addition of Zn and Mo increased the assimilation of inorganic N and increased the protein and nonprotein organic N levels 1 2 1 3 fold Addition of Zn and Mo to the fertilizer is essential for rice planted in dry ground especially in the early growing stage (CA 69 35024n)

460 Kim H S Cho B H Lee, C Y, Lee, E W Shim, S C Yoo, S H 1966 *Effect of Nitrogen Fertilizers on the Growth of Rice Plants I Duration and Rate of Nitrogen Fertilizer Application and Its Influence on the Effect of Phosphorus Fertilizers Using Nitrogen 15 and Phosphorus 32* Soul Taehakkyo Nonmunjip Chayon Kwahak, Saengnongge 17 1 6 (Korean)

N plays a determinative role in the growth, tillering, and yield of rice plants The optimal amount of N to be applied was >3 kg/10 acres N uptake from the fertilizer by rice plants was most efficient when the fertilizer was applied at the time of prime growth However, most efficient N utilization did not necessarily accompany the maximum rice yield P efficiency was not affected by time and rate of N application (CA 68 77294k)

461 Kwack, B H 1968 *Liming Effects on Rice Growing in Degraded Paddy Soils* Nongsa Sihom Yon'gu Pogo 11(3) 43 53 (Korean) (Korea Univ, Seoul)

An adequate level of liming on Akiochi degraded rice paddies increased grain yield of rice (approximately 30% increase) and rehabilitated the soil The straw weight also increased and the rate of leaf spot disease of *Helminthosporium* was reduced greatly The liming effect, however, was not as pronounced in normal paddy soils as in the degraded soils (CA 71 90362n)

462 Lee C, Lee, L W 1967 *Effect of Nitrogen, Silicon, and Their Interaction on the Agronomic Characters in Paddy Rice* Soul Taehakkyo Nonmunjip, Chayon Kwahak, Saengnongge 18 97 117 (Eng)

The role of N was more apparent in the vegetative stages than at the reproductive stages whereas Si was more effective during the reproductive stages of paddy rice in wet and dry soils Interactions between N and Si were observed in the number of grains per panicle, the maturing rate, 1000 grain weight, and in the total yield A sufficient amount of N facilitates a higher yield in dry soil, no relationship was observed between dry soil and the effect of Si

463 Lee, C Y, Lee, E W, Yoo, S H, Kwon, Y W 1968 *The Efficiency of Various Nitrogen Sources and Their Effect on the Utilization of Superphosphate as Affected by the Method of Nitrogen Application in the Paddy Rice Using N^{15} and P^{32} Labeled Material* Soul Taehakkyo Nonmunjip, Chayon Kwahak, Saengnongge 19 10 18 (Korean)

Field experiments using N^{15} and P^{32} labeled materials were carried out to compare the efficiency of various sources of N to the lowland rice as affected by the method of N application, and to determine the efficiency of P utilization from superphosphate as affected by the source and the method of N application Ammonium sulfate and urea resulted in almost the same efficiency and were more efficient than nitrate for rice cultivation Ammonium nitrate was slightly higher in the case of late application but not as efficient as the first two Sodium nitrate was extremely inefficient The method of application was unimportant and interaction between the source and application method was not observed The utilization of P from superphosphate applied on the surface at transplanting was not significantly affected by the nature of the N source and its method of application

464 Lee, E W Kwon Y W Lee, J H 1968 *Studies on the Applicability of Urea Foliar Application to Paddy Rice* Nongsa Sihom Yon'gu Pogo 11(1) 15 21 (Korean) (Coll Agr, Seoul Nat Univ Suwon)

In 1967, plants of swamp rice grown under different fertilizer regimes and on soils of varying fertility received foliar applications of 1 5%-3% urea solutions at 1000 l /ha 18 and 15 days before heading Urea application increased grain yields by an average of 10% Highest yields were obtained where the N or the leafblade was <2 2% 18 days before heading, total soil applications of N were not more than 100 120 kg/ha and where the N content of plants did not exceed 12 g/m^2 A urea solution containing 0 5%-1 0% N sprayed at 1000 l /ha was the most effective rate (FCA 23 285)

465 Oh, W K 1964 *Effect of Compost and Fresh Rice Straw on the Production of Paddy Rice I Effect on the Yield of Paddy and Some of the Physical Properties of Paddy Soil* Nongsa Sihom Yon'gu Pogo 7(1) 1 15 (Korean) (Inst Plant Environ, Suwon)

Experiments in Korea since 1919 are reviewed It is concluded that compost can supplement a shortage of commercial fertilizers, and that fresh rice straw (plowed in) is at least as good as compost for rice yields when a reasonable quantity of fertilizers (e g, 80 kg each of N, P_2O_5, and K_2O/ha) is applied (FCA 19 192)

466 Oh, W K 1968 *Requirement of Rice for Nitrogen When Red Earth is Added to Sandy Permeable Paddy Fields* Nongsa Sihom Yon'gu Pogo 11(3) 9 12 (Eng) (Inst Plant Environ, Suwon)

Field experiments were used to determine the quantity of nitrogenous fertilizer to be applied when different quantities

of red earth are added to a sandy textured paddy field A procedure is given for determining the quantities of red earth and fertilizer required for production of high yield (CA 71 90359s)

467 Park, C S, Kim, B J, Kim, M K, Kim, Y S, Lee, J H 1968 *Causes of Decreased Rice Yield on Irrigation with Saline Water* Nongsa Sihom Yon gu Pogo 11(3) 21 8 (Korean) (Inst Plant Environ, Suwon)

Saline water irrigation decreased rice yield because of decreased absorption of K during the growth periods of the rice plant The decreased absorption of K caused a decrease in numbers of grains per head, rate of grain formation, and weight of 1000 grains (CA 71 90360k)

468 Park, J K 1967 *Varietal Differences in Physiological Characteristics of the Rice Plant I Varietal Differences in the Physiological Activity of the Root and Its Correlation With the Top Part of Rice Plant* Nippon Sakumotsu Gakkai Kiji 36(4) 377 83 (Jap) (Inst Plant Environ Suwon)

A Japanese variety Norin No 29 and a Korean variety Nongkwang were cultured in normal soil (Konosu), humus rich soil (Matsuo), and poor sandy soil (Oami) which were mixed with a granular fertilizer (N 80%, P_2O_5 8% and K_2O 5%) Varietal differences found under low humus soil conditions were (1) at the tillering stage the physiological root activity of the Norin No 29 was higher than that of the Nongkwang but at the ear formation stage the latter showed higher root activity than the former, (2) the formation of silicated epidermal cell of top leaf blade tended to be more influenced by soil fertility rather than by the content of available silica of soils, and the cell number of the Nongkwang was larger than that of the Norin No 29, and (3) a tendency for nonfertilization of spikelets was found and the decrease of spikelet number of Norin No 29 was higher than that of Nongkwang (CA 73 24380g)

469 Park, J K 1967 *Varietal Differences in Physiological Characteristics of the Rice Plant II Varietal Differences in Nutrient Absorption by the Rice Plant* Nippon Sakumotsu Gakkai Kiji 36(4) 384 88 (Jap) (Inst Plant Environ, Suwon)

A Japanese variety Norin No 29 and a Korean variety Nongkwang were cultured in normal (Konosu) humus rich (Matsuo), and poor sandy soils (Oami) to determine the nutrient absorption in the aerial parts (leaf blade, leaf sheath, and stem) No varietal differences were observed in N and P absorption However, there was a difference in the nutrient absorption between varieties when planted in humus rich soil under reducing conditions, and the K and silica contents in Nongkwang variety were higher than that in Norin No 29 (CA 73 24381h)

470 Park, Y D 1967 *The Effect of Silica on the Growth of Rice Plant* Nongsa Sihom Yon'gu Pogo 10(3) 55 61 (Korean) (Inst Plant Environ, Suwon)

In experiments in which rice plants were grown in nutrient culture containing SiO_2 at 0 400 ppm, increasing concentration increased the uptake of SiO_2, but decreased the uptake of other nutrients, particularly P, Fe, and Mn There was evidence of strong absorption of SiO_2 by the roots Plants grown in low concentrations of SiO_2 absorbed it more strongly than those grown in high concentrations SiO_2 had little effect on the dry matter and grain yield when the plant SiO_2 content was <0 3% Plants supplied with SiO_2 were not attacked by leaf mites, whereas those not given SiO_2 were heavily attacked (FCA 21 2527)

471 Park, Y D 1967 *Studies on the Nutrio Physiology of Rice Plant Grown on an Akiochi Soil* Nongsa Sihom Yon gu Pogo 10(3) 23 35 (Korean) (Inst Plant Environ, Suwon)

Rice plants grown on this sandy loam soil (in which Akiochi disease is liable to occur) had lower contents of SiO_2, Mg, and K than those grown on (nondisease inducing) soil, but had higher contents of P, Fe, and S The Fe content in above ground plant parts 3 weeks after transplanting was 500 ppm and Fe toxicity was induced Application of slag decreased the plant contents of P, Fe, Mn, and S, and increased the SiO_2 content Slag decreased plant dry weight in the initial growth stages but markedly increased it during later stages (FCA 21 2528)

472 Park Y D, Kim Y S Kwon H K Park, J Y 1968 *Effect of Inorganic Nutrients (Silicon Dioxide, Calcium, Magnesium Manganese) and Rice Varieties on Grain Yield in an Akiochi Soil* Nongsa Sihom Yon'gu Pogo 11(3) 29 34 (Korean) (Inst Plant Environ Suwon)

In a pot experiment with an Akiochi soil grain yield was increased by a combined application of $SiO_2(K_2SiO_3)$, Ca, Mg, and Mn Omitting Ca gave a slight decrease in yield The application of these materials reduced the damage from *Helminthosporium* leaf spot very clearly In a field experiment with an Akiochi soil grain yield was increased by application of silicate slag and fused phosphate Grain yield of Nong Lim 6 (Akiochi resistant) was higher than that of the Jin Heung in an Akiochi soil Damage by leaf spot of Nong Lim 6 was lower than Jin Heung and Nong Lim 6 had higher Mn content than Jin Heung (CA 71 90361m)

MALAYSIA

473 Dunsmore, J R 1970 *Experiments on the Fertilization of Dry Rice (Hill Padi) in Sarawak Malaysia* Exp Agr 6(3) 239 44 (Eng)

Shifting cultivation of dry rice on steep hillsides continues to be widely practiced in Sarawak Malaysia Fertilizer experiments have shown that economic increases in yield can be obtained by mixing 0 9 kg (2 lb) of monoammonium phosphate pellets (11% N, 21% P) with 2 4 kg (5 3 lb) of seed just before dibbling In certain areas additional increases might be gained by further increasing the rate of application of P, from the use of K, and from topdressing with N Closer spacing (30 5 cm or 12 in^2) than that traditionally used should also increase yields per unit area

PAKISTAN

474 Anon 1969 *Increasing Yields of Paddy by NPK in East Pakistan* Better Crops Plant Food No 3, 13 (Eng)

Two hundred and eight fertilizer experiments conducted on paddy in various regions of East Pakistan were evaluated and

statistically analyzed They were carried out during the "Aman" season 1966 (transplanting in August September) representing the major part of paddy grown in East Pakistan N, P, and K were tested at the following levels 30, 40, and 60 lb/acre N, 60 lb/acre P_2O_5, and 40 lb/acre K_2O In almost all cases NPK at the rate of 60 60 40 produced the highest yields Based on these results, it can be expected that the official fertilizer recommendations for paddy of 40 40 20 will be changed to 60 60 40

475 Ahmed, S Azmi, A R, Malik, M B 1968 *Uptake of Fertilizer Phosphorus and Nitrogen by Lowland Rice in West Pakistan Under Different Methods and Times of Application* IN 'Isotop Radiat Soil Plant Nutr Stud' Proc Symp, Ankara, 1965 449 69 (Eng) (At Energy Agr Res Cent, Tandojam)

Field experiments were conducted to determine the effect of method of application (broadcast on the surface, hoed into the top 5 cm of soil or placed at 10 and 20 cm depths) of 100 kg/ha P_2O_5 on P uptake by rice, the effect of 0, 60, and 300 kg/ha P_2O_5, applied in the nursery, on uptake of P applied at different times in the field and the effect of time of application of 0-120 kg/ha N on uptake of P and N P uptake was greatest when applied broadcast or hoed into the top few cm, and was poor from P placed at 10 and 20 cm Nursery applied P had no influence on uptake of field applied P, grain yields, or dry matter Uptake of P applied at transplanting was unaffected by time of N application The greatest utilization of N was obtained when it was applied as a single dressing halfway between transplanting and 2 weeks before primordial initiation (SF 32 3193)

476 Alam, S M, Karim, A Q M B, Khan, A B, Habibullah, A K M 1966 *Study of the Interaction of Iron and Manganese and Their Effects on the Uptake of Phosphorus in Rice Plants by Radioisotope Technique* Proc Agr Symp, Dacca, Pakistan, A L C, pp 82 90 (U S AEC 1966, CONF 660564) (Eng) (At Energy Cent, Dacca)

Solutions containing various contents and ratios of ^{59}Fe, ^{54}Mn, and ^{32}P were added to rice culture media Five week seedlings were then allowed to grow for 2, 4, and 8 days after transplantation Each treatment was replicated three times Plant samples were collected from three pots of similar treatment after 2, 4 and 8 days' growth In dry plant material as obtained earlier, the radioactive Fe and Mn were determined by γ scintillation counter while the absorption of ^{32}P was determined by G M liquid counter The data were studied to observe the effects of Mn on the uptake of ^{59}Fe, the effects of Fe on the uptake of ^{54}Mn, and the effects of Fe and Mn on the uptake of ^{32}P Mn, when applied at increasing rates to culture solutions containing different levels of ^{59}Fe, decreased the uptake of ^{59}Fe progressively except in the case of 5 ppm of Mn, where a slight increase in the absorption of ^{59}Fe was recorded Secondly, when Fe at an increasing rate was added to nutrient solutions containing different levels of ^{54}Mn, it reduced the Mn content of the rice plants (CA 69 105436z)

477 Alam, S M, Kahn, A B 1966 *Interaction of Iron and Manganese on the Uptake of Iron and Yield of Rice Plants* Proc Agr Symp, Dacca, Pakistan, A E C, pp 95 9 (U S AEC 1966, CONF 660564) (Eng) (At Energy Cent, Dacca)

Plant samples were collected by cutting after 20 and 40 days and these were weighed after drying in an oven at 70° C From the dry plant materials the radioactive Fe was determined by direct counting in a scintillation counter From an analysis of the data, it was noticed that Mn, when applied at increasing rates to the nutrient culture solution containing different levels of ^{55}Fe, progressively decreased the uptake of ^{55}Fe The lowest yield was recorded with a dose of 5 ppm of Mn along with the same dose (5 ppm) of ^{55}Fe On the other hand the highest yield was recorded at a dose of 10 ppm of ^{55}Fe in the absence of Mn As a result of the decrease in the uptake of ^{55}Fe due to increased Mn the growth of the rice plant was adversely affected It was further observed that the uptake of radioactive Fe by the rice plants increased with the increased growth period (FA 2 276)

478 Azeez, M A 1964 *Green Manuring for Increased Rice Production* Pak J Sci 16(2) 56 63 (Eng)

Sesbania aculeata is the best green manure plant for irrigated rice in West Pakistan In a experiment conducted on an alkaline soil during 16 years, green manuring with *S aculeata* in the long run increased the rice yield by about 25%, only slightly less than did annual applications of 22 tons farmyard manure/ha Another trial demonstrated that addition of ammonium sulfate at a rate of 30 kg N/ha increased its effect Experience has shown that *S aculeata* should be sown in March and plowed in in June July, some 15 20 days before rice is transplanted to the field In order to promote the general use of this green manure in rice fields, irrigation water should be made available in March April Seed can be obtained by growing *S aculeata* as a windbreak around fields of rice and fodder crops, the plant flowers in October irrespective of the time of sowing (Trop Abstr 20 1490)

479 Bashir, M, Sandhu, M S, Karim, M 1968 *Evaluation of the Response of Rice Plants to the Application of Sugar Mill Waste (Press Mud) I As a Source of Nitrogen and Organic Matter* Dacca, East Pakistan, Atomic Energy Centre, 19 pp (Eng)

The response of rice plants to the application of sugar mill waste (press mud) in respect to N and P uptake was evaluated Press mud may not compete with ammonium sulfate or urea for the immediate supply of N but may have residual effects Application of fully decomposed press mud or that of undecomposed press mud to a soil having ideal conditions for quick decomposition, may improve the N supply because of its reasonably high N content Due to its high content of P, the press mud contributes available P and its decomposition increases the availability of soil P

480 Islam, A, Rahman, S 1966 *The Effect of Associated Salts on the Availability of Soil Phosphorus and Its Uptake by Rice Plants* Pak J Biol Agr Sci 9(2) 11 16 (Eng) (Univ Dacca, Dacca)

The effects of application of $(NH_4)_2SO_4$, K_2SO_4, $CaSO_4$, $MgSO_4$, $FeSO_4$, and $Al_2(SO_4)_3$ on the availability of soil P and its uptake by rice plants under waterlogged conditions were studied The availability of soil P was increased by the application of $(NH_4)_2SO_4$, $CaSO_4$, and $MgSO_4$ while $FeSO_4$, $Al_2(SO_4)_3$, and K_2SO_4 decreased it The absorption of P by rice plants was increased by the addition of $(NH_4)_2SO_4$,

$CaSO_4$, $MgSO_4$, K_2SO_4, and decreased by the introduction of $FeSO_4$ and $Al_2(SO_4)_3$ (FA 2 100)

481 Islam, A , Saha, R C 1969 *Effects of Silicon on the Chemical Composition of Rice Plants* Plant Soil 30(3) 446 58 (Eng) (Univ Dacca, Dacca)

Rice plants were grown in nutrient culture solutions Si was supplied to these plants at different rates The plant samples of early vegetative, vegetative, and flowering stages were analyzed for N, P, K, Ca, Mg, Fe, Mn, Si, protein, and carbohydrate contents The application of Si generally decreased the N, protein, and K contents of rice plants Its application also decreased the Fe and Mn contents The use of Si resulted in an increase in P, Ca, Mg, Si, and carbohydrate contents of rice plants (CA 71 37981n)

482 Karim, A , Idris, M 1965 *Studies on the Effect of NPK Balance of Soil on the Growth and Yield of Rice Plants* Pak J Soil Sci 1(2) 29 36 (Eng) (Agr Univ , Mymensingh)

In trials with 790 lb/acre $(NH_4)_2SO_4$, 515 1105 lb super and 0 536 lb KCl to paddy, a 1 2 2 ratio of NPK in soil after fertilizing caused a sixfold increase in yields as compared to controls without fertilizing Data on growth, yield, and protein and carbohydrate contents of rice (Aus paddy) under different NPK ratios from 1 1 5 1 5 to 1 3 3 are given (SF 29 3550)

483 Khan, D H , Eaqub, M 1968 *Removal of Nutrients by Transplanted Autumn Rice Grown in a Sub Tropical Soil of East Pakistan* Int Rice Comm Newsl 17(3) 40-4 (Eng) (Agr Univ , Mymensingh)

Rice straw removed about three times as much K and seven times as much P as N, but rice grain removed appreciably more N than P and K N application increased the removal of N, P, K, Ca, Mg, and S by straw and grain P application increased the removal of P and K by straw, but K application increased only K removal Overall, N showed greatest removal followed by P, K, and alkaline earths From applied fertilizers recoveries were greater from N than from P and K N recovery by straw increased, and by grain decreased, with increasing N P recovery by straw and grain decreased at higher rates of P Little K accumulated in the grain due to K fertilizing, although an appreciable amount accumulated in the straw (SF 33 683)

484 Vermaat, J G 1964 *Report to the Government of Pakistan on Soil Fertility Investigations* Exp Tech Assis Progr , FAO Rep 1887, pp 1 100 (Eng)

The purpose of the "rapid soil fertility survey scheme" was to establish soil fertility levels throughout Pakistan and to examine to what extent yields could be increased by the efficient use of fertilizers The main results of nearly 9000 fertilizer trials on cultivators' fields are presented In West Pakistan yield increases of 50%-100% were obtained through combined application of ammonium sulfate and single superphosphate on both wheat and rice, the use of fertilizers on millet and sorghum was not economic, in East Pakistan rice yields were increased by 50%-64% through combined N and P, and by 62%-92% through combined N, P, and K The application of fertilizers gave much higher yield increases with selected wheat varieties than with local varieties (Trop Abstr 21 1626)

PHILIPPINES

485 Anon 1967 *The Economics of IR 8* IRRI Reptr 3(4) 1 3 (Eng)

In six varietal trials conducted in the Philippines during the dry season on a fertile soil but without fertilizer application, the new rice variety IR 8 gave an average yield of 5 3 tons/ha, whereas the average yield of the highest yielding tall variety in each trial was only 4 5 tons/ha Corresponding yields of wet season trials were 4 4 and 3 9 tons/ha, respectively This indicates that even peasant farmers unable to purchase fertilizer should switch over from the traditional varieties to IR 8 However, IR 8 responds much better to N fertilizer than do the old tall varieties, its high yield potential can only be realized with good management including heavy fertilizer applications These applications are highly profitably in terms of cash income (FA 1 1086)

486 Anon 1965 *Nitrogen Increases Rice Yields in Cooperative Experiment* IRRI Reptr 1(4) 1 (Eng)

This note presents results in a dry season fertilizer trail with rice, conducted at the Maligaya Experiment Station in the Philippines Plots received 160 kg N, 30 kg P_2O_5, and 30 kg K_2O/ha, alone or in combinations, N was applied in two dressings 100 kg was worked in before planting and 60 kg was topdressed at panicle initiation With N alone, varieties PI 215936 and No 6993 yielded 6945 kg and 6001 kg/ha, respectively, against 1959 and 2272 kg/ha without N With N and P, they yielded 7164 and 6316 kg grain/ha, respectively P or K, whether applied alone or in combination with N did not significantly affect grain production of either variety (Trop Abstr 21 52)

487 Anon 1967 *Rice –Plant Physiology* Ann Rep Int Rice Res Inst 1967, 19-42 (Eng)

In Los Banos, Philippines, physiological studies in rice were conducted on carbohydrate accumulation and N response in rice varieties, growth performance of varieties of different tillering ability, photoperiod response, internode elongation, salt tolerance, effects of N, P, and K on tillering, and on Zn deficiency of the rice plant in calcareous soils A close relationship was indicated between the starch content of the plant at a high N level and plant type Erect leaved varieties, such as IR 8, can maintain better light conditions, and are, therefore, more responsive to N applications and have a higher starch content than varieties with droopy leaves (Trop Abstr 24 1720)

488 Anon 1966 *Ten Metric Tons Per Hectare High Dry Season Yields* IRRI Reptr 2(4) 1 2 (Eng)

In several varietal trials with irrigated rice, conducted in the Philippines during the dry season of 1965 66, the selection IR 8 288 3 was consistently superior over the other selections and varieties tested, a yield of over 10 tons/ha was attained in one trial In a variety x N fertilizer trial on a rather fertile soil, where yields of most varieties on control plots were 4 5 tons/ha, the yield of IR 8 288 3 increased with N doses of up to 120 kg/ha, whereas yields of other varieties were depressed if the dose of N exceeded 30 90 kg/ha Selection IR 8 288 3 is a dwarf *indica* type derived from the cross between the tall *indica* variety Peta and a dwarf *indica* variety from Taiwan It

will not be released to farmers because of its susceptibility to bacterial leaf blight and many races of *Pircularia*, and of its poor grain quality (Trop Abstr 22 249)

489 Chandler, R F 1966 *Factors Limiting Crop Production 5 Rice* Span 9(3) 165 68 (Eng)

High yields of rice in the tropics and elsewhere can be obtained by using short, stiff strawed nonlodging varieties responsive to fertilizers and resistant to disease, and by applying good management practices which necessarily include adequate insect water and weed control Fertilizer experiments conducted by the International Rice Research Institute in the Philippines clearly show that the traditional low yielding varieties do not respond to N, on the contrary modern varieties which make maximum use of available sunshine respond quite favorably to N The most important recent advance in insect control for flooded rice is the application of systemic insecticides (including lindane) to the water in place of by foliar sprays (Trop Abstr 22 253)

490 Chandler, R F 1969 *Improving the Rice Plant and Its Culture* Nature 221(5185) 1007 10 (Eng)

A brief description is given of several of the research projects of the International Rice Research Institute in the Philippines The principal objective of the breeding work is to develop rice varieties that are short and stiff strawed, with relatively narrow upright leaves i e plants that resist lodging even when heavily fertilized and intensely managed The most successful cross so far is IR 8 its grain quality however, is inferior, and it lacks resistance to certain diseases Therefore work on breeding is continuing In the field of agronomy, work is conducted on variety fertilizer interactions, the relationship between solar energy and yields, and the chemical control of weeds in flooded transplanted rice Entomological work has shown that diazinon is quite effective in controlling stem borers, leaf hoppers and plant hoppers when applied at 2 kg/ha active ingredients every 20 days (Trop Abstr 24 2194)

491 De Datta, S K Magnaye C P 1969 *A Survey of Forms and Sources of Fertilizer Nitrogen for Flooded Rice* Soils Fert 32(2) 103 9 (Eng) (Int Rice Res Inst, Los Banos Laguna)

The relative merits of various N fertilizers for flooded rice have been investigated extensively Yield response is affected by soil conditions and management practices, particularly time and method of application In most instances, ammonium containing or ammonium producing (urea) fertilizers are about equally effective in terms of grain yield response and serve as an excellent source of N for flooded rice In certain instances urea has been reported to be inferior to ammonium sulfate, but no specific reason has been cited for its low performance, except suggestions of greater mobility prior to hydrolysis and biuret toxicity In certain problem soils which are low in active Fe, urea, ammonium chloride and other non S containing fertilizers are preferred to ammonium sulfate Anhydrous ammonia is is effective as any other ammonium fertilizer for flooded rice With its high analysis (82%), low cost, and ease of manufacture, it should be an ideal choice but the equipment needed and the requirement of deep placement limits its widespread use particularly in tropical Asian countries Green manuring may be agronomically desirable but probably has no economic benefit in the tropics where land occupied by green manure can be used for growing a second crop of rice Organic manure, green manure, etc, are used and may still be useful in areas of subsistence farming where inorganic fertilizers are not available and where the varieties grown have a relatively low N response Nitrate sources are unsatisfactory as preplant treatment because of an almost complete loss of N through denitrification but they may be used for topdressing at later stages of rice growth when the superficial root system is well developed (FA 2 1340)

492 De Datta, S K Magnaye C P Moomaw, J C 1968 *Efficiency of Fertilizer Nitrogen (Nitrogen 15 Labeled) for Flooded Rice* Trans, 9th Int Congr Soil Sci 4 67 76 (Eng) (Int Rice Res Inst Los Banos Laguna)

To measure the efficiency of N applied to flooded soils, experiments were conducted in the greenhouse and the field with ^{15}N labeled urea and $(NH_4)_2SO_4$ applied by three methods With a montmorillonite clay soil in the greenhouse experiment the percentage of the applied N recovered from the grain and straw was greater when the fertilizer was placed at 10 cm depth than when it was incorporated before transplanting or where half was incorporated and the remainder broadcast at panicle initiation On a kaolinite clay soil, no significant differences in ^{15}N recovery were found between methods of application, presumably because of low N losses or low NH_4^+ fixation from this slightly more acid soil Alternatively, the interchange of fertilizer ^{15}N with the organic N fraction may have been greater in the kaolinitic clay since this soil had a greater organic matter content The field experiment conducted only on the montmorillonitic clay also demonstrated better N fertilizer utilization if the fertilizer was placed at 10 cm This method resulted in greater efficiency of applied N when expressed as kg rough rice produced per kg N applied In terms of grain yield urea and $(NH_4)_2SO_4$ were equally effective but slightly less N was recovered by the crop fertilized with urea Source of N and method of application did not influence the amount of mineral N remaining in the soil after harvest and the indications were that even with deep placement of fertilizer there was no residual effect of applied N in the form of mineral N Part of this mineral N may be immobilized temporarily in the organic fraction in the soil and may be released with time if kept continuously flooded (CA 72 21017n)

493 De Datta, S K, Moomaw J C, Racho, V V, Simsiman G v 1966 *Phosphorus Supplying Capacity of Lowland Rice Soils* Soil Sci Soc Amer Proc 30(5) 613 17 (Eng) (Int Rice Res Inst Los Banos, Laguna)

In a glasshouse trial rice grown in four soils containing 2 20 ppm extractable P was given 0, 15, 30 or 45 ppm N and 0 or 6 ppm P labeled with ^{32}P Percentages of plant P derived from applied P ranged from 8% to 27% and were generally unaffected by rate of applied N (FCA 20 986)

494 De Datta, S K Tauro, A C, Balaoing S N 1968 *Effect of Plant Type and Nitrogen Level on the Growth Characteristics and Grain Yield of Indica Rice in the Tropics* Agron J 60(6) 643 47 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

In field trials in 1966, six tall *indica* cv and two dwarf

indica cv received N at 0 120 kg/ha (30 kg intervals) in the dry season (January May) and N at 0-80 kg/ha (20 kg intervals) in the wet season (July November) In the dry season the tall cv lodged at certain growth stages and gave highest yields at 30 60 kg N/ha Yields from the dwarf cv Taichung 1 were highest at 90 kg N and those of dwarf cv IR 8 increased with increase in N up to 120 kg N, the highest grain yield being 9477 kg/ha IR 8 showed the highest efficiency in grain production and in total dry matter production The dwarf cv had higher N contents than the tall cv at tillering, panicle initiation, and at harvest During the wet season, IR 8 gave rough rice yields 3474 kg higher than those of the tall, weak strawed cv Peta Two crop yields from IR 8 Taichung 1 and Peta were 15,507, 11,708, and 7998 kg/ha, respectively (FCA 22 2726)

495 Duangpatra, P De Datta S K 1969 *Urea Ammonium Phosphate and Other Phosphorus Sources for Flooded Tropical Rice* Int Rice Comm Newsl 18(4) 1 9 (Eng)

All tested forms of urea ammonium phosphates (29 29 0 25 35 0 and 34 17 0) were as effective as super PO_4 as evidenced by their influence on all the growth characteristics and nutrient uptake of the plant and on the yield components and the grain yield of rice Florida ground rock phosphate was a poor source of P causing a high percentage of unfilled grain and a low grain yield of rice If the cost per unit of P is attractive, urea ammonium phosphate fertilizers may be used as an excellent P fertilizer for flooded tropical rice

496 Kampfer M Zehler E 1967 *The Importance of the Sulfate Fertilizers for Raising the Yield and Improving the Quality of Agricultural Horticultural and Silvicultural Crops* Potash Rev 24(28) 62 (Eng)

After carrying out a 3 year experiment in the Philippines on heavy clay soils with various kinds of rice the largest increase in the yield amounted to 969 kg/ha compared with the untreated from a fertilizer treatment with $(NH_4)_2SO_4$, super PO_4, and KSO_4 The phosphate uptake in rice is intensified by the presence of sulfate with a simultaneous increase of the yield of grain and straw

497 Kawano, K, Tanaka, A 1968 *Growth Duration in Relation to Yield and Nitrogen Responses in the Rice Plant* Jap J Breed 18(1) 46 52 (Eng) (Hokkaido Univ, Sapporo)

In trials in the Philippines during 1963 64 18 rice cv with different growth durations (i e, time from transplanting to flowering) were transplanted at 30 x 30 cm spacing and given various applications of N Plant weight at harvest increased with increasing growth duration but under high N levels it did not increase after 150 days The ratio of total grain weight to total plant weight decreased with growth duration under all N levels, and maximum grain yields were obtained after 120 or 150 160 days growth duration at high and low N levels respectively Under high N levels the maximum photosynthetic rate at flowering was obtained after 120 days and respiratory rates at flowering increased with growth duration under low N levels maximum photosynthetic rates were found at 130 150 days and respiration rates hardly varied with growth duration Low assimilation rates after flowering caused low grain yields in populations of long growth duration at high N levels and thus low N levels are necessary for high yields from such cv (FCA 22 298)

498 Lian, S, Tanaka, A 1967 *Behavior of Photosynthetic Products Associated with Growth and Grain Production in the Rice Plant* Plant Soil 26(2) 333 47 (Eng)

Investigations on rice plants conducted in the Philippines showed that C assimilated at the maximum tiller stage is translocated mostly to the lower leaves, C assimilated at the booting stage is distributed mostly to the spikelet certain leaf sheaths, and culms C assimilated in the leaf sheaths and the culm before flowering is retranslocated to the panicle after flowering However the efficiency of carbohydrates formed in these stages for grain production is not very high because up to 60% may be consumed through respiration The retention percentage of assimilated C decreases as mutual shading increases C assimilated after flowering accumulates mostly and efficiently in the brown rice (Trop Abstr 22 1544)

499 Mabbayad B B 1968 *Further Tests on Minimal Tillage and Rates of Nitrogen Application on Transplanted Rice* Philipp Agr 52(4) 200 10 (Eng)

An experiment in the Philippines, showed that net returns for tillage costs (costs of land preparation, weeding, and of herbicide) were higher from rotovated rice fields than from unplowed, or plowed and harrowed fields (Trop Abstr 25 2060)

500 MacRae, I C, Castro, T F 1967 *Nitrogen Fixation in Some Tropical Rice Soils* Soil Sci 103(4) 277 80 (Eng)

In laboratory studies conducted in the Philippines with three types of submerged rice soils significant fixation of atmospheric N was observed when the soils were incubated at 25° C for 28 days in the light, in two of the soils there was increased fixation on addition of rice straw and roots at crop residue levels Significant N fixation was however, also obtained with incubation in the dark though to a less extent than in the light On the basis of the results of comparative experiments it is suggested that the heterotrophic N fixing microorganisms fixed more N in these soils than the photosynthetic species Soil inoculation with a blue green alga led to increased fixation in two of the soils while inoculation with a N fixing *Clostridium* had no effect (Trop Abstr 22 1553)

501 Marfori, R T 1969 *The Fertilizer Requirements of Rice in Philippine Soils* Araneta J Agr 16(1) 1 87 (Eng) (Araneta Univ, Rizal)

Thirty eight fertilizer requirement maps representing 46 provinces are included Six fertilizer mixtures and two single element fertilizers were recommended for the soils surveyed (SF 33 4078)

502 Marfori, R T 1965 *The Present Situation and Outlook of Soil Classification and Fertilizer Requirements with Emphasis on Their Implications on the Present Rice Problem of the Country* Araneta J Agr 12(3) 178 88 (Eng)

Tables show average results of 36 N x P x K fertilizer trials with lowland rice and 11 trials with upland rice in the Philippines grouped according to soil texture nutrient requirements and yield increases obtainable by applying fertilizers are indicated for each texture class Cost calculations

show that application of fertilizers to good rice soils is highly profitable Maps of the different provinces showing areas for which certain fertilizer formulations are recommended have been prepared on the basis of soil surveys, analysis of 180,000 soil samples, 269 field trials, and pot experiments For large parts of the area no standard recommendations are possible, but farmers may obtain advice by submitting soil samples to 1 of the 16 soil testing laboratories in the country (Trop Abstr 22 891)

503 Nangju, D , De Datta, S K 1970 *Effect of Time of Harvest and Nitrogen Level on Yield and Grain Breakage in Transplanted Rice* Agron J 62(4) 468 74 (Eng)

An application of up to 120 kg/ha of N fertilizer in the dry season improved the milling quality of the chalky varieties 'IR 8', 'IR 5' and Sigadis' but not that of the nonchalky variety 'C 4 63 An application of up to 60 kg/ha of N increased the protein content of brown rice of the four varieties but increased the head rice yield of only Sigadis, the most chalky of the four varieties, the head rice yield of the other three varieties remained unchanged Irrespective of variety and N level, the optimum time of harvest of transplanted rice for obtaining maximum grain and head rice yields and highest germination percentage was between 28 and 34 days after heading in the dry season and between 32 and 38 days in the wet season These heading periods correspond to moisture contents of between 22% and 19% and between 21% and 18% respectively Lodging increased grain yield losses in both seasons with the losses being greater when harvested late, therefore lodging susceptible varieties should be harvested earlier than lodging resistant varieties N fertilization in the dry season delayed by 2 4 days the optimum time of harvest of the improved varieties IR 8 IR 5, and C 4 63

504 Navasero S A 1969 *Rice Nutrition on Bohol Coralline Calcareous Soil* Potash Rev 9(18) 1 9 (Eng)

Field trials conducted in the Philippines on the coralline calcareous soils showed that stunted growth and poor development of newly introduced irrigated short straw rice varieties suffered from noninduced K deficiency The phenomenon could be attributed to low exchangeable K in the soil Organic acids aggravated the condition, whereas the high Ca level of the soil did not adversely influence K uptake A dressing of 200 kg K_2O/ha increased yield and leaf K by 50% 100%, irrespective of the type of fertilizer Observed low Fe reserves in the soil appeared adequate to satisfy requirements in the presence of high organic matter contents (Trop Abstr 25 1559)

505 Nhung, M T M Ponnamperuma, F N 1966 *Effects of Calcium Carbonate Manganese Dioxide Ferric Hydroxide, and Prolonged Flooding on Chemical and Electrochemical Changes and Growth of Rice in a Flooded Acid Sulfate Soil* Soil Sci 102(1) 29 41 (Eng) (Int Rice Res Inst , Los Banos, Laguna)

On the basis of glasshouse trials the following provisional proposals are made for reclaiming acid sulfate soils for rice production (a) leach the soil with fresh water to lower the concentration of salts, chiefly sulfates, (b) lime to an aerobic soil pH of 4 7 to prevent Al toxicity and to decrease Fe toxicity, (c) apply MnO_2 to counteract Fe toxicity, (d) add Fe_2O_3 (red earth) to counteract H_2S toxicity in soils low in active Fe, (e) maintain continuous flooding (FCA 20 1026)

506 Ponnamperuma, F N , Yuan, W L 1966 *Toxicity of Boron to Rice* Nature 211 780 81 (Eng) (Int Rice Res Inst , Los Banos, Laguna)

Chemical retardation of soil reduction was studied as a remedy for physiological disorders of the rice plant $Ca(NO_3)_2$ and MnO_2 despite their retarding effect did not suppress foliar symptoms on a Taiwan coastal saline silt loam of pH 8 1 Soil solutions of the flooded soil contained 9 1 ppm B as against 1 ppm B for two normal Philippine lowland rice soils The symptoms were intervenal chlorosis of upper margins of older leaves and later large, dark brown elliptical spots in the affected parts which ultimately turned light brown dried, and rolled up The B content of the straw at harvest was 80 ppm as compared with 26 30 ppm for normal plants When the same rice variety was grown on two lowland clay soils treated with various levels of B, the described foliar symptoms were found on Luisiana clay (pH 4 6, organic matter 4 1%) to which 20 ppm B or 6 7 ppm water soluble B was added As coastal soils from marine sediments may contain 10 50 times as much B as inland soils, B poisoning may be a hitherto unsuspected factor limiting rice production on such soils (SF 30 649)

507 Ponnamperuma F N Yuan, W L Nhung M M 1965 *Manganese Dioxide as a Remedy for a Physiological Disease of Rice Associated with Reduction of the Soil* Nature 207(5001) 1103 104 (Eng) (Int Rice Res Inst)

In pot experiments, MnO_2 corrected 'suffocation disease', a physiological disorder of rice which occurs in Northeast Taiwan (FCA 19 205)

508 Racho, V V , De Datta S K 1968 *Nitrogen Economy of Cropped and Uncropped Flooded Rice Soils Under Field Conditions* Soil Sci 105(6) 419 27 (Eng) (Int Rice Res Inst , Los Banos, Laguna)

Ammonium sulfate up to 150 kg/ha of N was applied to two rice varieties and to uncropped flooded Maahas clay Changes in soil N content were measured periodically for the two cropping seasons in 1965 Fertilization did not alter total N (organic + mineral) content of the soil Mineral N occurred mostly as NH_4^+ with the amount present at transplanting time closely related to rate of application At harvest time mineral N was similar on all plots but this similarity could not be accounted for through variations in crop removal Thus, considerable quantities of N could not be accounted for at harvest time and the amount increased with rate of N application (FA I 1184, SF 30 4507)

509 Samonte, H P , Mamaril, C P 1966 *Evaluation and Correlation Studies on Selected Phosphorus Soil Test Methods for Paddy Soils* Philipp Agr 49(8) 589 602 (Eng)

In the Philippines six P soil test methods were evaluated on five soils used in pot trials with rice grown at four P fertilizer levels The Bray No 2 method, giving the highest correlation for available P with grain yield appeared best suited The Olsen, Peech, and Ayres Hagihara methods, with highly significant values of the correlation coefficient, were also considered reliable tests The suitability of the Bray No 1 and Morgan methods appeared doubtful because they yielded

available P values that did not correlate with grain yields With respect to P yield, however, the Olsen method was best correlated, followed by the Peech and Bray No 2 methods Of the five phosphate fractions determined, Al, Ca, and Fe phosphates were consistently correlated with available P extracted while reductant soluble Fe phosphate was poorly correlated (Trop Abstr 22 1105)

510 Simsiman, G V 1966 *Effects of Nitrogen Forms and Methods of Application for Lowland Rice* Thesis–College of Agriculture, University of the Philippines in Partial Fulfillment of the Requirements for the Degree of MS in Soils 139 pp (Eng)

N content in the plant increased with the addition of N in all forms, coated and liquid N fertilizers as well as standard N fertilizers In both wet and dry seasons, the N concentration in the plant with deep placement was consistently higher at all stages of growth than with the broadcast and incorporated treatments

511 Simsiman, G V, De Datta, S K, Moomaw, J C 1967 *Sources of Nitrogen and Methods of Application for Flooded Rice I Comparison of Two Methods of Applying Slow-Release and Standard Fertilizer Materials* J Agr Sci 69(2) 189 96 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

Field experiments with rice were conducted on a flooded soil comparing two standard fertilizers (ammonium sulfate and urea) with N fertilizers with various release rates The controlled release fertilizers were ureaform and mixtures of emulsified asphalt, paraffin, and ammonium sulfate or urea For each of these fertilizer materials two methods of application were compared broadcast and incorporated, and placement at 15 cm depth The slow release materials resulted in a lower grain yield than did fast or medium release rate or standard fertilizer materials They released N too slowly during the early growth of rice to permit optimum plant growth and development Placement of 80 kg/ha N at 15 cm depth increased the plant N content at all stages of growth and significantly increased the grain yield compared with the broadcast and incorporated fertilizer treatment The highest grain yield in the experiment (7701 kg/ha rough rice) was obtained from a medium release material, which was 88% more efficient in increasing grain yield per unit of N when placed at 15 cm than when broadcast and incorporated The recovery of fertilizer N was 68% when deeply placed and 38% when broadcast and incorporated Deep placement of N not only increased the recovery of fertilizer N, grain yield, and total dry matter production, but also maintained a greater reserve of mineral N in the flooded soil at all stages of plant growth Data suggest that the ammoniacal fertilizers either of standard or regulated release type when placed in the reduced zone of the soil, persist for a long time and are gradually utilized by the plant Differences of the magnitude measured here can probably be obtained only with lodging resistant varieties and with relatively large amounts of sunlight during the ripening period of the crop The data indicated no particular advantage for the regulated release type (FA 2 276)

512 Tanaka, A 1966 *Mutual Shading as a Factor Limiting the Yield Response of Rice to Application of Nitrogen Phosphorus, and Potassium Fertilizers* Plant Soil 25(2) 201 10 (Eng)

Pot trials with the rice variety Peta conducted in the Philippines showed that, when other nutrients were kept at a constant level, yields increased with N levels up to 40 ppm and then declined, increased with P levels up to 2 ppm and then remained constant and increased with K levels up to at least 200 ppm A higher optimum level of N and higher yields were obtained with high levels of P and K Plants at the outside of a group of pots showed a stronger response to N than did plants surrounded on all sides a similar difference was observed between plants at a wide and a narrow spacing The results indicate that under field conditions mutual shading limits grain yield and may induce a negative response to N fertilizer largely irrespective of the supply of P and K fertilizers (Trop Abstr 22 458)

513 Tanaka, A, Garcia, C V 1965 *Studies of the Relationship Between Tillering and Nitrogen Uptake of the Rice Plant 2 Relation Between Tillering and Nitrogen Metabolism of the Plant* Soil Sci Plant Nutr 11(3) 31 7 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

During the tillering stage of cv Peta, an increase in the N content of the culm above 2% led to an increase in the number of tillers 5 and 10 days later The carbohydrates required by a developing tiller appeared to be provided by the internode immediately above its node of origin (FCA 19 215)

514 Tanaka, A, Kawano, K 1966 *Effect of Mutual Shading on Dry Matter Production in the Tropical Rice Plant* Plant Soil 24(1) 128 44 (Eng)

Field studies on the relationship between dry matter production and mutual shading in six rice varieties were conducted at the International Rice Research Institute in the Philippines The varieties Taiman 3, Peta, Bbt x PI, Taichung Native 1, Hung, and 81 B 25, were of different types Under conditions of heavy mutual shading resulting from a high total area of leaves per unit area of land surface which can be a varietal property or the effect of a high level of N, the lower leaves experience a net loss of carbohydrates and grain yield is reduced Peta had a maximum leaf area index of 7 04 compared to one of 5 06 for 81 B 25 when 150 kg/ha N was applied Peta yielded 4 12 tons/ha without N application and 2 79 tons/ha with 150 kg N/ha, whereas 81 B 25 yielded 3 33 and 5 14 tons/ha respectively

515 Tanaka, A, Kawano, K 1965 *Leaf Characters Relating to Nitrogen Response in the Rice Plant* Soil Sci Plant Nutr 11(6) 31 8 (Eng) (Int Rice Res Inst Los Banos Laguna)

Even at high N levels, rice varieties with short narrow leaves do not cause serious shading Such varieties generally have thick and N rich leaves The higher N content of the leaves and the good light penetration make it possible to produce higher grain yields at high soil N levels (SF 29 2832)

516 Tanaka, A, Loe R, Navasero, S A 1966 *Some Mechanisms Involved in the Development of Iron Toxicity Symptoms in the Rice Plant* Soil Sci Plant Nutr 12 32 8 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

Rice leaves containing more than 300 ppm Fe often exhibit Fe toxicity symptoms known as bronzing, tiny brown spots appear first, followed by development of a uniform brown

color The critical Fe content leading to such symptoms differs according to variety and other factors With high Fe concentration in the growth media, Fe is oxidized and deposited on the root surfaces Considerable amounts are also concentrated in the root tips from where it is translocated, and deposited at the internodes At still higher concentrations Fe is translocated to the lower leaves and deposited if the concentration rises above the critical level The susceptibility of plants to Fe toxicity is increased if the roots are cut, as this facilitates entry of Fe into the plant The critical concentration of Fe in the culture solutions for bronzing to occur was 100 ppm at pH 3 7, but it was frequently over 500 ppm Growth is inhibited in young plants at much lower concentrations (SF 30 3032)

517 Tanaka, A Navasero, S A 1966 *Aluminum Toxicity of the Rice Plant Under Water Culture Conditions* Soil Sci Plant Nutr 12(2) 9 14 (Lng) (Int Rice Res Inst, Los Banos, Laguna)

In water cultures the critical concentration of Al^{+++} was about 25 ppm for plants receiving normal supplies of other nutrients Above 300 ppm Al in the shoot, Al toxicity symptoms often developed These critical levels varied with P status of the plant and with Fe concentration and pH of the culture Al content was much greater in the roots than in other organs, the root content, at least partly, appeared to be in the form of Al phosphate At high Fe level in the culture solution, Al uptake was reduced Al toxicity may develop on acid soils under upland conditions but under lowland conditions there may be little Al toxicity (SF 29 4339)

518 Tanaka A Navasero, S A 1966 *Growth of the Rice Plant on Acid Sulfate Soils* Soil Sci Plant Nutr 12(3) 23 30 (Lng) (Int Rice Res Inst, Los Banos, Laguna)

Rice seedlings showed Al toxicity under upland conditions but not under lowland conditions because of decrease in the Al content of the soil solution following flooding As Mn content of the soil solution decreases after flooding and Mn uptake by the rice plant is inhibited by low pH, toxicity is no problem under lowland conditions Poor growth of lowland rice is due mainly to Fe toxicity, which is eliminated by applying $CaCO_3$ or large amounts of P The soils are P deficient, but if small amounts of P are applied under flooded conditions the Fe concentration of the soil solution may be increased and thus aggravate Fe toxicity The Fe content of the soil solution under flooded conditions can be lowered by applying $CaCO_3$ Normal growth on these soils is achieved by applying adequate P and $CaCO_3$ (SF 30 2233)

519 Tanaka, A, Navasero S A 1966 *Manganese Content of the Rice Plant Under Water Culture Conditions* Soil Sci Plant Nutr 12(2) 21 6 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

Mn content of the plant increased with increasing Mn level and pH in the culture solutions and was greater with NO_3 than with NH_4 When insufficient Mn was supplied, absorbed Mn was translocated to the growing leaves and from lower leaves to upper leaves Deficiency symptoms often develop below 20 ppm Mn and toxicity above 2500 ppm Mn in the shoot The critical upper limit for a single leaf is 4000 8000 ppm Mn A level of 0 01 ppm Mn in the culture is low enough to produce Mn deficiency and 25 ppm is high enough to produce toxicity although pH and N source interact with the critical level (SF 29 4332)

520 Yoshida, S, Ahn, S B 1968 *The Accumulation Process of Carbohydrate in Rice Varieties in Relation to Their Response to Nitrogen in the Tropics* Soil Sci Plant Nutr 14(4) 153 61 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

The carbohydrate metabolism of low and high N responsive varieties was studied at low and high N levels and in the wet and dry season The starch content of the rice plant was much lower in the wet season than in the dry season A heavy application of N markedly lowered the starch content of droopy, low N responsive varieties The high N responsive variety with erect leaves maintained a relatively high starch content even when heavily fertilized with N The high starch content at a high N level may be used as a biochemical parameter for the high N responsiveness of rice varieties The apparent contribution of accumulated carbohydrate to grain carbohydrate was much lower in the wet season than in the dry season and for early maturing varieties than for late maturing ones Total sugar was as important as or even more important than starch in carbohydrate balance between flowering and harvest (FA 2 231)

521 Yoshida, S, Castaneda, L 1969 *Partial Peplacement of Potassium by Sodium in the Rice Plant Under Weakly Saline Conditions* Soil Sci Plant Nutr 15(4) 183 86 (Eng)

The application of NaCl changed the leaf habit of K deficient plants from "droopy' to "erect" Within the deficiency range, higher dry weights were obtained at the same K content in the presence of NaCl, suggesting a partial replacement of K by Na A decreasing effect of NaCl on the K content of the plant was observed at a high, but not at a low, supply of K The overall effects of NaCl can be beneficial to rice growth under weakly saline conditions

522 Yoshida, S, Navasero, S A, Ramirez, E A 1969 *Effects of Silica and Nitrogen Supply on Some Leaf Characters of the Rice Plants* Plant Soil 31(1) 48 56 (Eng)

While the degree of leaf erectness of the rice plant is a varietal characteristic, it can be changed greatly by silica and N nutrition N tends to make rice leaves more droopy and Si keeps them more erect This effect of Si on leaf erectness is marked when the Si content of leaves is low Leaf openness is well correlated with the light extinction coefficient of rice populations Leaf thickness increases with increasing supply of silica whereas it decreases with increasing amounts of N Increased N supply markedly increases leaf length, width, and area Si has little effect on these characteristics

523 Yoshida, S, Tanaka, A 1969 *Zinc Deficiency of the Rice Plant in Calcareous Soils* Soil Sci Plant Nutr 15(2) 75 80 (Eng) (Int Rice Res Inst Los Banos, Laguna)

The present work was conducted to obtain field observations and greenhouse results from a series of experiments on the occurrence of Zn deficiency in rice plants in calcareous soils from Pant Nagar, U P, India, and Kala Shah Kaku, West Pakistan It was found that Khaira disease in India and Hadda in West Pakistan were both due to Zn deficiency The appearance of Zn deficiency was associated with high pH

or calcareous soil or both The plant Zn content was not related to total soil Zn content, but was closely related to soil pH Addition of cellulose to the soil aggravated Zn deficiency, suggesting that soil reduction was one of the factors responsible for decreased availability of Zn in submerged soils Zn deficiency was corrected by Zn application to the nursery bed, main pot applications, and dipping the young plants into a Zn suspension It was found that total Zn content of soil was not related to plant Zn content since soil contained adequate Zn Study of pH showed that the higher the soil pH, the lower the Zn uptake However, since submersion tended to equalize pH, there was the possibility that high Ca or other factors associated with high pH might be the cause of reduced Zn uptake (CA 71 60334r)

524 Yuan, W L, Ponnamperuma, F N 1966 *Chemical Retardation of the Reduction of Flooded Soils and the Growth of Rice* Plant Soil 25 347 60 (Eng) (Int Rice Res Inst, Los Banos, Laguna)

Application of MnO_2 at 0 4% by weight retarded the reduction of flooded soil, corrected a physiological disorder of rice, and markedly improved growth and yield of the crop The beneficial effects were associated with a more favorable Fe/Mn ratio and removal of CO_2 as $MnCO_3$ Application of $Ca(NO_3)_2$ at 0 4% by weight had similar effects, but harmed plants in strongly acid soils, $Ca(ClO_3)_2$ at 0 1% also retarded soil reduction, but tended to kill plants or depress yields (SF 30 2231)

TAIWAN

525 Chang, K C 1964 *Effect of 'Astragalus Sinicus on Rice Growth on Poorly Drained Soil* J Agr Assn China 45 59 67 (Chin) (Taiwan Agr Res Inst)

Poorly drained slate alluvial soil was (a) plowed and ridged after harvest of the rice crop or (b) kept submerged after harvest of the second rice crop until transplanting of the third $N P_2O_5 K_2O$ was applied at 80 60-0, 80 60 100, or 40 60 100 kg/ha, and *Astragalus sinicus* vines at 10,000 kg/ha (a) gave better rice yields than (b) Green manuring under (b) produced a rice disease caused perhaps by toxic substances produced during anaerobic decomposition K appears to alleviate the disorder and increases the yield The two indica varieties tested were more tolerant of low redox potential of the soil than were the three japonica varieties (SF 28 570)

526 Chang, S G 1966 *Application of Phosphorus Fractionation to the Study of the Chemistry of Available Soil Phosphorus* Soils Fert Taiwan 13 1 15 (Chin)

Studies on inorganic P compounds in Taiwan rice soils showed that Fe phosphates predominate in latosols, Ca and Fe phosphates in acidic alluvial soils, and Ca phosphates in calcareous and saline alluvial soils Rice on flooded soils absorbs most of its P from Fe phosphates, less from Al phosphates, still less from Ca phosphates, whereas Al phosphate is the main P source for upland rice A test for available P should dissolve P compounds according to a pattern similar to that of the crop Pot trials demonstrated that for the latosols all standard tests used gave a good correlation with rice grain yields, whereas methods using an alkaline or weakly acid extractant were most suitable for soils with a high proportion of Ca phosphates (Trop Abstr 23 1796)

527 Chang, W L, Yang, S C 1965 *Effect of Growing Conditions on Yield and Components of Yield in Rice* Nung Yeh Yen Chiu 14(2) 23 30 (Chin) (Chiayi Agr Exp Sta)

On well drained clay loam of pH 5 3 5 6 with 1 60%-1 75% organic matter and 40 65 kg/ha available P grain yields in the second crop of 1963 and first crop of 1964 were not increased significantly with increasing NPK Increased planting density increased yields significantly only for the first crop Number of panicles per hill increased slightly with fertilizing and decreased significantly with increasing planting density Number of grains per panicle decreased slightly with fertilizing and significantly with increasing planting density (SF 29 3548)

528 Chang, W L, Yang, S C 1964 *Effects of Split Application of Fertilizer and Planting Density on Yield, Components of Yield and Other Agronomic Characters of Rice* Nung Yeh Yen Chiu 13 16 26 (Chin) (Chiayi Agr Exp Sta)

For a second rice crop on clay loam of pH 5 3 5 6 with 1 60% 1 75% organic matter and 40 65 kg/ha available P, 80-40 40 kg/ha NPK was either applied conventionally (*A*) as all PK and one half N basally the balance of N as topdressing at second weeding or 20 days after transplanting or (*B*) a split application was made in which all P two thirds K and one fifth N was applied as basal dressing, and two fifths of N as second topdressing 42 days after transplanting B gave higher grain yield than did A Grain yields were increased by increasing the planting density from 64 to 96 hills/pen (3 3 m^2) Weight and length of panicles were significantly increased by B but generally decreased with increasing planting density Heading date and plant height were unaffected by A or B The first internode was significantly longer and the rest of the internodes shorter with B than with A A long first internode was related to high grain yield Lodging was significantly reduced by B but unaffected by planting density On high density plots, split applications appear to increase yields and reduce lodging (SF 28 1321)

529 Chang, W L, Yang, S C 1966 *Effects of Split Application of Fertilizer and Planting Density on Yield, Components of Yield and Other Agronomic Characters of Rice (3)* Nung Yeh Yen Chiu 15(1) 1 7 (Chin) (Chiayi Agr Exp Sta Tai)

Rice cv Chainung 242 was planted at densities of 64 or 96 hills/3 3 m^2 and received four fertilizer treatments during 1964 65 Split applications of NPK fertilizer increased grain yields by 5% 6%/ha Grain yields were also increased by close spacing, which increased panicle number per unit area Panicle weight and length were significantly increased by split fertilizer application compared with the nonfertilizer controls, but decreased by close spacing Split fertilizer application did not affect heading date or plant height, but plants were smaller and headed earlier at high densities Split fertilization increased length of the first and second internodes but decreased the length of the next three internodes of the culm, all internodes were shorter in high density plots Lodging was light in all cases (FCA 23 2720)

530 Chang, W L, Yang, S C, Chao, J N 1967 *Effect of Split Application of Fertilizer on Yield, Components of Yield, and Other Agronomic Characters of Rice (4)* Nung Yeh Yen Chiu 16(2) 22 34 (Chin) (Chiayi Agr Exp Sta)

Application of N to rice on a silty clay loam at 25 kg/ha on the day before transplanting with 75 kg topdressed at maximum tillering stage, or at 25 kg before transplanting, with 40 + 25 + 10 kg topdressed between maximum tillering stage and heading, produced the highest yields, responses were associated with increased numbers of panicles per hill Early application of N generally produced more tillers and larger leaf area in the first crop, while late application promoted growth of the second crop Tall and late heading plants were high yielding (SF 30 2865)

531 Chen, T T 1968 *Effect of Aluminum Ion on Rice Growth* Soil Fert Taiwan 65 (Chin) (Nat Taiwan Univ, Taipei)

Growth of rice and barley was impaired and leaf stem and root yields gradually decreased when Al^{3+} concentrations in the medium exceeded 2 ppm Al contents in leaves, stems, and roots of rice and in leaves and stems of barley increased In roots of rice and barley the Al content of the roots was 2 7 4 6 and 3 7 9 9 times higher respectively than in stems and leaves In cultures with excised roots, the pH of the medium significantly affected Al uptake, Al uptake from solutions of higher concentration was greater in rice roots than in barley roots These findings are relevant to the greater adaptability of rice on acid soils (SF 33 4089)

532 Chen, T T 1968 *The Liming of an Acid Paddy Soil* J Agr Assn China 63 35 45 (Chin) (Nat Taiwan Univ, Taipei)

The base saturation percentage of a paddy soil could be estimated from the corrected lime potential, or 1/3pAl 1/2p(Ca + Mg) A close relationship existed between rice growth and base saturation percentage of the soil Maximum rice growth occurred when exchangeable Ca was 8%-20% of the exchange capacity of the soil The proposed "lime requirement' is the amount of lime needed to raise the degree of base saturation of the soil to the experimentally determined optimum value for the series (SF 32 3198)

533 Chen, T T, Huang, H K 1968 *Measurement of Base Saturation Degree of Paddy Latosols and Its Significance to Rice Growth* Trans, 9th Int Congr Soil Sci 4 95 102 (Eng) (Nat Taiwan Univ, Taipei)

The lime potential corrected for ionic product $(Al)(OH)^3$ and 1/3pAl 1/2p(Ca + Mg) were effective measures indicating the degree of base saturation of latosols and were applicable under upland and flooded state Exchangeable Ca or Mg of the soils increased almost proportionally when CaO or MgO was added, respectively, in the two acid washed soils, but exchangeable Ca decreased when MgO was applied Where both CaO and MgO were applied, both exchangeable Ca and Mg contents were increased, but the rate of increase of exchangeable Ca was greater than that of Mg Pot experiments indicated maximum yields of rice were obtained when the levels of exchangeable Ca were 8%-20% of the total exchange capacity Significant correlations between exchange acidity and base saturation percentage, and also between exchange acidity and lime potential were observed for these acid washed soils Ca saturation percentage or base saturation percentage of a latosolic paddy soil is a critical index in determining its lime requirement (CA 72 21018p)

534 Cheng, J S, Su, T M, Lee, C W 1968 *Experiment on the Amount of Nitrogen Required by Indica Varieties of Rice* Taiwan Agr Quart 4(1) 12 20 (Chin)

Kaohsiung shen No 4 performed the best of the three tested varieties Taichung Native 1 and IR 9 60 shared a similar lesser result N application rates of 80 kg/ha and 110 kg/ha showed similar results in increasing grain yields and were significantly higher than fertilization of 50 kg/ha The ideal amount of N for indica rice would be 80 kg/ha

535 Chiang, C T 1968 *Studies on the Availability and Forms of Phosphorus in Paddy Soils Part 4 Availability of Inorganic and Organic Phosphorus Part 5 Factors Influencing the Solubility of Soil Phosphorus* Taiwan Fert Co, Tech Bull 30, 37 pp (Chin)

The availability of different forms of P depends on soil type In acid soils, Ca P is more readily available, while in neutral or alkaline soils Fe P and Al P are more available In acid soils organic P is less readily available than it is in neutral soils It is important to supply P in a form which is deficient in the soil In flooded soils, the solubility of soil P increases when pH increases and Eh is lowered, as the development of soil metabolism results in the decomposition of organic matter, production of organic acids, and generation of gases, especially CO_2 and CH_4

536 Chiang, C T, Yang, C C 1968 *The Relation Between Fertilizer Elements and Soil Metabolism Part 1 Studies on the Solubility of Phosphorus and the Soil Metabolism in Paddy Soils* Taiwan Fert Co Tech Bull 31, 42 pp (Chin)

The addition of calcium phosphate increased the production of NH_4 N in the soil, as well as the amount of soil carbohydrates As the amount of carbohydrates in the soil was directly correlated with soil organic matter, it was assumed that phosphate improved microbial activity and organic matter decomposition The addition of phosphate hastened the production and decomposition of organic acids in soil, while the increase in organic acids increased the water solubility of soil P In general, the amount of soluble P increases in paddy soils as pH increases and Eh lowers Only in soils with a low degree of soil metabolism or with strong P fixation can significant effects be expected from P fertilizer addition

537 Chiang, C T, Yang, C C 1969 *The Relation Between Fertilizer Elements and Soil Metabolism Part 2 The Roles of Nitrogen, Phosphorus and Potassium in the Metabolism of Flooded Paddy Soils* Taiwan Fert Co, Tech Bull 31, 54 pp (Chin)

The addition of fertilizer, especially N, lowered the oxidation reduction potential of the soil and increased the amount of Fe^{2+} in the early stage of flooding N and K resulted in an increase of water soluble carbohydrates in the soil, while P hastened the decomposition of acid soluble carbohydrates Fertilizers, expecially P, hastened soil metabolic changes, including the production and decomposition of organic acids Production of NH_4 N was negatively correlated with the amount of organic acids The

effect of fertilizer elements on the production and changes in soil metabolites can be arranged in the order NPK>NP>PK≥P>N>K

538 Chiu, T F 1966 *Iron and Manganese Absorption by Rice Plants* Soils Fert Taiwan, 1 6 (Eng) (Taiwan Agr Res Inst)

In pot experiments with rice, the Mn uptake was greater and the Fe uptake lower on slate alluvial soil (SA) than on sandstone and shale alluvial soil (SSA) In field experiments greater Fe and Mn uptake in second crops than in first crops was attributed partly to higher temperatures causing more reductive conditions In general, Mn uptake exceeded Fe uptake Laboratory experiments confirmed that available Mn exceeded available Fe during initial stages of flooding, availability in soil followed the order SSA>latosol>SA for Fe, and SA>SSA>latosol for Mn Plants continuously supplied with Fe showed toxicity symptoms about 4 days earlier than those grown alternately in $FeSO_4$ solution and complete nutrient solution No symptoms appeared on plants when a split root technique using $FeSO_4$ solution and complete nutrient solution was applied In another experiment chlorosis first appeared 10 days after transferring the plants to Fe deficient solution, chlorotic plants had higher N, P, K, Mn, and soluble N (amides + NH_4) contents and lower sugar contents than Fe supplied plants Plants showing symptoms of "suffocating disease" ("cold acid paddy") associated with poor drainage and reductive soil conditions, contained more than three times as much Fe and about twice as much Mn as normal plants (SF 32 1561)

539 Chiu, T F 1968 *Nutrient Removal of Rice Plants in Taiwan* Soils Fert Taiwan, 20 6 (Eng) (Taiwan Agr Res Inst)

The effect of growth stage and temperature on nutrient uptake of first and second crops and varietal differences in uptake are discussed (SF 33 4083)

540 Chu, C 1968 *The Influence of Growth Regulators on the Effect of Foliar Applied ^{32}P Phosphate and ^{14}C Urea in Rice* J Agr Assn China, No 62, 69 73 (Chin) (Nat Taiwan Univ)

Studies were made on the effects of plant growth regulators on the utilization of urea and absorption translocation of ^{32}P phosphate which was sprayed on foliage as fertilizer Plant growth regulators applied in combination with ^{14}C urea on rice leaves inhibited the amount of $^{14}CO_2$ released If the amount of $^{14}CO_2$ release was 100% in the check treatment, the treatments of NAA, G A, 2,4 D, and IAA were in the order of 47%, 54%, 56%, and 80%, respectively Little difference was found in the behavior of absorption and translocation of the foliar applied phosphate to rice when various kinds of plant growth regulators were applied (FA 1 1810)

541 Chu, C, Ku, Y L 1966 *The Absorption and Translocation of Foliar Applied P^{32} Phosphate and Its Effect as Fertilizer When in Combination With C^{14} Urea on Rice Damaged by Salinity* J Agr Assn China 54 25 39 (Chin)

P^{32} was rapidly absorbed after application to the rice leaf and some P^{32} was translocated to all plant parts 6 hours after treatment Greater amounts were distributed to organs where metabolism was most active (young leaves and roots) P^{32} retention in the treated leaves increased with increasing pH of the applied solution The absorption of foliar applied P^{32} was greater in rice seedlings grown in synthetic sea water of 6 and 8 mmhos conductance than in those grown in untreated water, probably due to less P uptake by the roots Absorption of P^{32} or C^{14} urea decreased when the salinity level increased from 8 12 mmhos When P and urea were foliar applied in combination, the utilization of C^{14} urea was not as good as when it was applied singly (SF 30 1398)

542 Feng, M P 1968 *Method of Potash Application on Paddy Rice in Taiwan* Fertilite, No 31, 27 41 (Eng) (T P R F, Taichung)

In Taiwan soils, split K applications gave better results than a single basal dressing for the first and second rice crops The recommended methods are to apply 40% of the K at the first weeding and 60% at the second weeding, or 40% at the first weeding, 40% at the second weeding and 20% at the panicle formation stage (SF 32 747)

543 Feng, M P 1967 *Study on the Methods of Potash Application on Paddy Rice in Taiwan* Potash Rev 16(37) 5 pp (Eng)

On slate alluvial soil low in K holding capacity, which received 80 kg/ha N and 60 kg/ha P_2O_5, application of 60 kg/ha K_2O increased grain and straw yields of rice significantly Splitting the application into three portions according to the physiological needs of the plant increased the grain yield by 15 3% (617 kg/ha) over the no K check plot, whereas a single basal K dressing increased the yield by 4 6% (186 kg/ha) K applied 50 days before heading was important for increasing grain yields (SF 30 3027)

544 Houng, K H, Chen, T T, Liu T P 1967 *Effect of Liming on the Nutrient Uptake of Rice Plants* Chung Kuo Nung Yeh Hua Hsueh Hui Chih, Spec Issue 1 11 (Eng) (Nat Taiwan Univ, Taipei)

Latosol soil samples from paddy fields in Pinchen and Chungli were leached with 0 1*N* HCl to adjust the pH to ~2 0, and then freed from Cl by leaching with H_2O Their exchange acidities were 4 67 and 4 20 meq/100 g, respectively Their cation exchange capacities were 8 5 and 8 3 meq/100 g, respectively After neutralizing the samples with CaO and/or MgO to various percentages of exchange acidity and adding fertilizer and 0 3 g each of N, P_2O_5, and K_2O per sample, rice plants were grown for 8 weeks Rice yield was controlled chiefly by the amount of exchangeable Ca in the soil, 10% being optimal for both soils Increasing CaO and/or MgO reduced plant uptake of N and Fe, K uptake was unaffected Application of Ca increased Mg uptake, but Mg application reduced Ca uptake Application of Mg without Ca produced severe stunting (CA 70 28053p)

545 Hsieh, C F, Kao, S, Chiang, C 1966 *Effects of Planting Densities Amounts of Fertilizer Application and Planting Forms on the Yield of Rice* Nung Yeh Yen Chiu 15(4) 7 22 (Chin) (Taiwan Agr Res Inst)

Four crops of *japonica* rice cv Tainung No 38, Chianung No 242, and Taichung No 65 were planted in squares,

rectangles, or close spaced squares at 8, 36, 54, or 108 hills/m² and received normal, 1 5, or 2 times normal applications of fertilizer during 1960 63 Plant height and panicle number increased with increasing rates of fertilizer and Chianung 242 was tallest Tiller and panicle numbers were highest in the square planted plots At the lowest and highest planting densities respectively, panicle numbers per hill were 16 2 and 3 5 in the first crop and total panicle number per m² 290 and 380, respectively Individual panicle weights were greater in second crops and were unaffected by planting density Total grain yields, 1000 grain weight and total grain number per unit area increased, but grain number per panicle decreased as planting density increased Yield increases resulting from close planting were considered to be due to increases in panicle number, grain number, and total panicle weight Taimung No 38 was recommended for close planting Square planting was best for the first crop, rectangular for the second (FCA 22 2711)

546 Hsu, S C , Lin, M F , Chiu, T F , Lee, L T , Huang, W L 1967 *Leaching Loss of Plant Nutrients in Paddy Soils of Taiwan 1 Comparison of the Effec of Ammonium Sulfate and Urea on Paddy Rice and Leaching Loss of Plant Nutrients in Paddy Soils of Taiwan* Nung Yeh Yen Chiu 16 33 43 (Chin)

In a lysimeter experiment with two silt loams (one acid, one neutral) and two silty clay loams (one acid, one neutral), $(NH_4)_2SO_4$ gave greater grain and straw yields and greater N uptake than urea This was not due to greater leaching losses of N with urea than with $(NH_4)_2SO_4$ Leaching losses, particularly of N and K, were greater in acid soils than in neutral soils In general, leaching losses followed the order Ca>Mg>K>N>P (SF 30 2864)

547 Huang W L , Lee, L T 1966 *A Comparative Study of Some Rice Varieties of Taiwan with Regard to Fertilizer Response and Nutrient Uptake II* Nung Yeh Yen Chiu 15(4) 41 8 (Chin)

Five rice varieties were selected for comparison of the response to N, P, K fertilizers and nutrient uptake Application of N gives a substantial increase in the yield of each variety The effect is greater in the first crop than in the second crop The response of the varieties to P and K fertilizers was not significant, nor is there significant difference in the N, P, and K contents of straw The high yielding varieties tend to contain higher N, P, and K contents in grain (CA 68 94943p)

548 Lee C C 1966 *A Study of Fertilizer Application on the Farm Soils of Tidal Land in Taiwan II The Use of (Chemical) Nitrogenous Fertilizers on the Paddy Field of Tidal Land* Res Bull Taiwan Fert Co 25 40 1 (Chin) (Taiwan Fert Co)

For rice receiving between 0 and 105 kg N, plus 36 kg P and 30 kg/Kha, plant height increased with increasing N rates, and maximum height was given with two topdressings of $(NH_4)_2SO_4$ during early growth Rice grown as a second crop produced more primary than secondary tillers, but grown as a first crop produced equal numbers Since panicle weights of primary tillers were greater than of secondary, controlled tillering and fertilizer treatments are recommended For rice as a first crop four topdressings of urea (total 105 kg N/ha) and for rice as a second crop two topdressings of $(NH_4)_2SO_4$ (total 90 kg/ha) (SF 33 2384)

549 Lin, H C 1968 *Uptake and Distribution of Phosphorus by Rice Plants* Soils Fert Taiwan, 27 31 (Chin)

Experiments with ^{32}P showed that in mature leaves newly absorbed P ions replaced those already present, the latter were then translocated to meristematic areas or storage tissues (SF 33 4084)

550 Lin, K C , Wen, H P , Wang, C Y 1964 *Experiment on the Availability of PCP Calcium Cyanamide for Paddy Rice and Its Effect on Weeding* Nung Yeh Yen Chiu 13(1) 32 6 (Chin)

Field experiments for two crops of paddy rice in 1962 indicated that the availability of Na pentachlorophenolate (PCP) Ca cyanamide as a N fertilizer corresponded to that of $(NH_4)_2SO_4$ in the first crop and was even superior in the second crop Although the early growth of paddy was slightly affected by the toxicity of PCP, it soon recovered and the growth became even better than that of the check [$(NH_4)_2SO_4$ plot] later The herbicidal effect was also high due to the degree of availability (CA 62 7061g)

551 Tsai, W F 1967 *Nitrogen and Potash Requirements in the Panicle Formation and Fruiting Stages of Rice* J Agr Assn China 57 72 8 (Chin) (Taiwan Univ)

Nine treatment combinations respectively of N and K were given, three levels (5, 15, and 25 ppm) at the panicle formation stage combined with three levels at the fruiting stage The best N level at both stages was 15 ppm Rice yields increased with increasing K at the panicle formation stage but there was no response to K at the fruiting stage (SF 30 4577)

552 Tsai, W F , Chen, C S , Lin, C I 1965 *Effect of Late Application of Nitrogen Fertilizer on Grain Yield and Some Other Characters of Paddy Rice (Preliminary Report)* J Agr Assn China 49 65 72 (Chin) (Nat Taiwan Univ)

Application of part of the N at heading gave better yields than the traditional application of all the N before second weeding and intertillage N supplied at the beginning of primordia differentiation of the second rice crop increased the number of grains per ear The N content (or crude protein content) of brown rice and milled rice also increased about 10%-15% when N was applied at heading (SF 28 4177)

553 Wen, H P 1967 *Experiment on the Availability of Sodium Pentachlorophenolate Urea for Paddy Rice and Its Effect on Weeding* Nung Yeh Yen Chiu 16(1) 69 75 (Chin)

Field experiments were conducted at Taoyuan and Taipei areas to compare the fertilizer effect of pentachlorophenolate urea (A) with that of urea The nitrification inhibition effect of (A) was also tested in the laboratory With the same rate of N applied (A) favors the growth of rice under waterlogged condition Ammonification of urea is also affected by (A) Rice plants were injured by (A) when applied at a rate higher than 10 kg/ha (FA 1 1188)

554 Yang, S C 1966 *Experiment on the Timing of Urea Application in Rice* Soils Fert Taiwan, 99 (Chin)

In a fertilizer trial conducted in Taiwan, the first crop of rice variety Chianung 242 received a basal dressing of P and K fertilizers plus split applications of 80 kg N/ha in the forms of ammonium sulfate (50% at transplanting and 50% after 30 days) and urea (five methods) The best yield resulted from three applications of urea after 7 days (50%), 30 days (25%), and 60 days (25%), the lowest yield from applications of ammonium sulfate The second rice crop received 100 kg N/ha and later applications were given somewhat earlier, the highest yield resulted from equal doses of urea applied after 7 and 25 days, the lowest yield from applications of ammonium sulfate (Trop Abstr 23 1805)

555 Young, F P, Chen, Y C 1965 *Studies on the Varietal Difference of Nitrogen Fertilizer Response to the Yield of Rice* Nung Yeh Yen Chiu 14(2) 43 8 (Chin)

Grain yields with application of 80, 120, or 160 kg/ha N varied with variety, but varietal differences in fertilizer response were small because of insignificant interaction between variety and fertilizer level Yield response to N in a particular variety was greater in the first crop than in the second Increasing the application up to 160 kg did not increase the yield of the first crop but was effective for the second (SF 29 3562)

556 Young, F P, Teng, Y C, Hsu, T H 1967 *Comparative Studies on the Effect of Selection in Hybrid Population of Rice Under Different Fertilizer Levels* Nung Yeh Yen Chiu 16(1) 35 41 (Chin)

Two hybrid rice varieties, crosses of Chianung No 242 X Colusa and Hsinchu No 56 X Indidsol Dinoj, were used in studies of their successive generations on the response to fertilizer application Starting from F_2, seeds were planted separate in (1) ordinary (80 kg N/acre) and (2) heavy (160 kg N/acre) fertilization plots From F_7, selected seedlings were again planted in (1), moderate (120 kg N/acre), and (2) plots to compare their yield, panicle length and weight, and ripening time in days The number of panicles per hill in (2) was more than that in (1) Panicle weight in (1) was greater than in (2) Since there was no significant difference in panicle length between (1) and (2), less panicle weight may be due to insufficient grain filling, as indicated by number of days for ripening In (1) plots the yield of rice which was selected from rice previously planted in (1) was higher than that selected from (2) plots Under 120 kg N/acre conditions there was no difference in yield between lines The yield was higher in those lines which were planted in (2) plots than those in (1) The difference in yield between lines was statistically significant (FA 1 1180)

THAILAND

557 Anon 1967 *Methods of Fertilizer Application in Paddy Field* Proc Conf Tech Staff Rice Dep Thailand, 538 44 (Thai)

558 Anon 1967 *Study on Duration and Rate of Application of Ammonium Sulfate and Superphosphate Mixture in Paddy Field* Proc Conf Tech Staff Rice Dep Thailand, 335 52 (Thai)

559 Anon 1967 *A Study on Efficiency of Fertilizer Nitrogen and Phosphorus as Affected by Time and Rate of Their Combined Application* Proc Conf Tech Staff Rice Dep Thailand, 400 14 (Eng)

N^{15} labeled ammonium sulfate and P^{32} labeled superphosphate were applied at rates of 20 20 (kg nutrient/ha), 30 30, and 60 60 at transplanting, half way between transplanting and 2 weeks before inflorescence initiation P uptake was about the same when P was applied at the rate of 60 kg at the first or second stages, it was slightly higher when 30 kg was applied at the second and third stages Maximum N uptake followed the 30 30 application at the second and third stages

560 Bond, B, Kelso, T, Woodward, R 1966 *A Report on the Thailand Fertilizer Situation and Potential* (Prepared for the Agency for International Development), pp 105 17 (Eng)

The value of the added yield of rice is only slightly higher than the cost of the fertilizer due to the low price the farmer receives for his rice crop There are three ways to make the use of fertilizer more profitable (1) lower the cost of fertilizer, (2) raise the price of rice, and (3) a combination of (1) and (2) Under active consideration by the RTG is a proposal to subsidize fertilizers thus raising the present low level of use

561 Lusanandana, B, Sanitwongse, P, Suwanawaong, S 1967 *A Study on the Efficiency of Nitrogen Utilization from Ammonium Sulfate in Different Placement Methods and Its Interaction With Utilization of Superphosphate* Proc Conf Tech Staff Rice Dep Thailand, 415 31 (Eng)

N added as ammonium sulfate applied either broadcast or in rows on the soil surface at transplanting, appeared to be taken up more quickly by rice seedlings than N from the same source placed at different depths in the soil At later stages of growth, deeper placements were more effective All subsurface placement resulted in significantly better growth and higher grain yields than surface application The lower effect of surface placement of ammonium sulfate probably resulted from loss of fertilizer N through such factors as nitrification denitrification and also utilization by weeds

562 Lusanandana, B, Suwanawaong, S 1967 *A Study on Time and Rate of Superphosphate Application in Rice Cultivation and the Residual Effects of Superphosphate from Various Methods of Placement* Proc Conf Tech Staff Rice Dep Thailand, 309 34 (Eng)

The degree of tillering observed at 30 days after transplanting increased with rate of phosphate fertilizer applied At 80 days after transplanting the rice receiving the highest rate of phosphate fertilizer as basal dressing produced the highest number of tillers, the plants with the latest application of the same rate produced the lowest number of tillers There was a good relationship between yield of rice and these tillering effects Plants receiving full or split application earliest seemed to have the highest percentage of P uptake derived from fertilizer Split applications appeared to be as effective as full rate at basal dressing provided that the final application was not very late This seemed to indicate that split applications tended to reduce the phosphate fixation in

the soil At early stages of growth (30 days after transplanting), superphosphate hoed in was more effective than that broadcast on he soil surface However, this difference disappeared by 90 days after transplanting Residual effects from an experiment the previous year were highly significant, for all treatments involving subsurface placement, there was less total P uptake but greater fertilizer P uptake as compared with surface treatments It is quite probable that in heavy clay rice soils, greater fixation of P occurs with subsurface placement than with surface or broadcast application

563 Lusanandana, B , Suwanawaong, S , Lampapong, S 1967 *Effects of Ammonium Sulfate N^{15} and Superphosphate P^{32} Application and Their Interaction on Paddy Field* Proc Conf Tech Staff Rice Dep Thailand, 380 99 (Thai)

564 Lusanandana B , Suwanawaong, S , Sanitwongse, P 1967 *A Study on Comparative Efficiency of Different Forms of Fertilizer Nitrogen for R e* Proc Conf Tech Staff Rice Dep Thailand, 432 50 (Eng)

There was practically no difference in the efficiency of urea and ammonium sulfate Ammonium nitrate was less efficient and sodium nitrate was least effective It is highly probable that nitrate N could have been lost through denitrification and/or leaching more easily than the urea and ammonium forms especially when nitrate N was applied early in the planting season When sodium nitrate was applied broadcast as topdressing at the beginning of the reproductive stage of the rice plant its efficiency was comparable with the other three fertilizers

NORTH VIETNAM

565 An Phong 1968 *Use of Powdered Limestone and Dolomite Instead of Lime in Rice Paddies* Jt Publ Res Serv Transl N Vietnam, No 332 77 8 (translated from Khoa Hoc Thuong Thuc 3 1968) (Eng)

The fields in North Vietnam require a quantity of powdered limestone or dolomite 2 2½ times greater than heated lime to cover the same ground Those fields which are acid require greater quantities of powdered limestone and dolomite This must be completely pulverized to be effective but may be spread in relatively large quantities without danger of poisoning the rice plants Powdered limestone may also be spread with animal manure, composted with peat or garbage, or plowed under with green manure to hasten fermentation

566 Can, L 1964 *The Effect of Raw Phosphate on Flooded Rice in the Democratic Republic of Vietnam* Beitr Trop Subtrop Landwirt Tropenveterinaermed 1 45 56 (Ger)

Local raw phosphate (16% P_2O_5) had no effect on rice on soils of pH >5 5, on more acid soils, yields were increased by about 10% to 3000 kg/ha (SF 28 4179)

SOUTH VIETNAM

567 My Nhung, M 1966 *Chemical and Physico Chemical Changes in a Flooded Acid Sulfate Soil and the Growth and Yield of Rice* Directorate of Agricultural Research, 100 pp (Eng) (Saigon, Vietnam)

Includes a review of literature on acid sulfate soils, a summary of experiments conducted, results of experiments and discussion, effects of various chemicals on rice plants, summary, and conclusions

568 Pham Huu Anh 1970 *Results of Fertilizer Experiments in 1962 63* Directorate of Agriculture Research, Soil Fertility Section Publication No Bheb 89, 152 pp (Eng) (Saigon, Vietnam)

After general description of soils at nine experiment stations, detailed results of fertilizer experiments on rice, upland crops, and vegetables are discussed as a source of data for future work

569 Tran Thi Nguyet, Pham Huu Anh 1966 *The Estimation of Fertilizer Requirements in Vietnam for 1967* Saigon, 24 pp

Fertilizer use on Vietnam rice soils will increase if the distribution system can be improved and if prices of fertilizer and agricultural products can be made more favorable to growers Recommended nutrient rates for three major soil groups are given

EUROPE

AUSTRIA

570 Aleksic, Z , Broeshart, H , Middelboe, V 1968 *Shallow Depth Placement of $(NH_4)_2SO_4$ in Submerged Rice Soils as Related to Gaseous Losses of Fertilizer Nitrogen and Fertilizer Efficiency* Plant Soil 29(2) 338 42 (Eng) (IAEA, Vienna)

When N fertilizers are applied to rice, growing under submerged conditions, substantial gaseous losses of fertilizer N have been observed Placement of the fertilizer at shallow depth greatly reduces these losses A balance experiment using six different rice soils was carried out in a greenhouse ^{15}N labeled $(NH_4)_2SO_4$ (atom excess of 10% ^{15}N) was applied on the surface and at a 7 cm depth Analysis of soil, roots, and shoots showed that the difference in utilization of fertilizer N for surface and depth placement in pots could be accounted for by the difference in gaseous loss of fertilizer N (FA 2 233)

571 Broeshart, H , Haunold E , Fried, M 1965 *The Effect of Water Conditions and Oxidation Reduction Status of Rice Soils on the Availability of Soil and Fertilizer Phosphate* Plant Soil 23(3) 305 13 (Eng) (IAEA, Vienna)

A factorial pot experiment with rice comprising four watering treatments and two labeled superphosphate

placements was conducted using nine rice soils The dry matter yield of 8 week old rice varied with the soil type, upland conditions resulted in less dry matter and a lower P content than constant or intermittent flooding Mixing the fertilizer with the soil and surface application resulted in equal yields and P contents of the rice The availability of the fertilizer P was significantly higher under upland than under reduced soil conditions The availability of P in soils free from $CaCO_3$ was higher under the reduced condition of the flooded soils than under the upland conditions, this is due to the reduction of Fe and the solubilization of Fe phosphate Placement of superphosphate on the soil surface resulted in a higher utilization of the P fertilizer than mixing with the soil (Trop Abstr 21 1643)

572 Fried, M , Zsoldos, F , Vose, P B , Shatokhin, I L 1965 *Characterizing the NO_3 and NH_4 Uptake Process of Rice Roots by Use of ^{15}N labeled NH_4NO_3* Physiol Plant 18 313 20 (Eng) (IAEA, Vienna)

Uptake of NO_3 and NH_4^+ even in the presence of one another, could be measured for 2 week old rice roots using salts enriched with N^{15} NH_4^+ was absorbed 5 20 times as fast as NO_3 , depending on pH Since NH_4Cl and NaCl both inhibited NO_3 uptake, about 40% of the inhibition by NH_4Cl was probably not due to NH_4^+ NO_3 did not affect uptake of NH_4^+, Rb, K, and Ca caused less than 30% decrease in uptake despite the tenfold higher concentration of these complementary ions (SF 28 4005)

573 Kumazawa, K , Goler, J A 1969 *Optical Emmission Spectrographic Studies on the Distribution and Accumulation of Nanogram Amounts of ^{15}N in Rice Seedlings* Plant Cell Physiol 10(4) 725 31 (Eng) (IAEA, Seibersdorf Laboratory)

An optical emission spectrographic method was used to study the distribution and accumulation of nanogram quantities of ^{15}N in leaves and roots of individual rice plants Gaseous N that was prepared from plant samples, not weighing more than 100 μg, was trapped in an electrodeless tube The excess ^{15}N was determined by exciting the gas with a high frequency generator, then measuring the light intensities of the molecular bandheads at 2977, 2983, and 2989 A For leaves that contained 4 atom percent ^{15}N the precision obtained was ±1 33% A comparison of emission and mass spectrographic ^{15}N values was obtained with a number of second leaves of rice plants that were grown under similar environmental conditions The ^{15}N contents obtained at a 2 atom percent level by the two methods were in reasonable agreement

BELGIUM

574 Hai, T V , Laudelout, H 1966 *Phosphate Uptake by Intact Rice Plants by the Continuous Flow Method at Low Phosphate Concentrations* Soil Sci 101(5) 408 17 (Eng) (Univ Louvain)

Measurements according to the continuous flow technique of PO_4^{3-} uptake from very dilute solutions by intact rice plants have shown that the flow rate noticeably influences the rate of uptake A theoretical interpretation based on film diffusion effects is presented which provides a partial explanation of the experimental observations It also allows the calculation of a first order rate constant for PO_4^{3-} uptake in the range 0 1 0 5 ppm Passive leakage of PO_4^{3-} from poisoned roots or O uptake is also influenced by the rate at which the nutrient solut on flows past the root surfaces (CA 65 2636)

575 Hai, T V , Laudelout, H 1966 *Phosphate Uptake by Rice Roots* Ann Physiol Veg 8 13 24 (Fr) (Univ Louvain)

Rate of P uptake by excised rice roots is directly proportional to P concentration in the nutrient medium up to about 1 0 ppm, rate of uptake by unit surface area being 5 x 10^{-5} cm sec^{-1} Respiration and rate of P uptake are related to partial oxygen pressure by hyperbolic curve Effect of pH on P uptake at low concentrations (0 5 ppm) is explained by assuming that only H_2PO_4 ions are absorbed There is a well marked point of optimum absorption at pH 5 6 (SF 30 1397)

BULGARIA

576 Gurbuchev, I , Neikova Bocheva, E , Raikov, L 1968 *Effectiveness of Phosphates with Different Levels of Available Phosphorus in Soils* Agrokhimiya, No 8, 44 9 (Russ) (Inst Pochvoved im Pushkarova, Sofia)

Administration of PO_4^{3-} was slightly effective in soils with a sufficient amount of mobile P, even when utilizable N was present P fertilizers were not effective when used in alkalized chernozem or carbonated chernozem or podzol brown forest soil, if the original P_2O_5 concentration was >30 mg/100 g soil The utilization coefficient for administered PO_4^{3-} was 16 9%-20 9% in nonfertilized soils The fertilizers increased rice harvest on chernozem smolnitsa soil (CA 69 85757z)

577 Katzarov, K , Milev, V 1964 *Rice Manuring with Organic and Mineral Fertilizer* Agrochimica 8 349 61 (Eng) (Rice Inst , Plovdiv)

In conjunction with 500 600 kg/ha super spread before sowing, NH_4NO_3 applied at 250 300 kg/ha in two installments at the time of shooting and tillering increased rice yields by 45%, urea applied at 174 kg/na under the same conditions increased yields by 52% as compared to no fertilizing Best results were obtained by simultaneous application of 500 kg super and 200 kg $(NH_4)_2SO_4$ before sowing, followed by NH_4NO_3 and urea split into two equal rates at the time of shooting and tillering (SF 28 1320)

ENGLAND

578 Larsen, S 1967 *Isoionic Exchange of Phosphate in Paddy Soils* Plant Soil 27(3) 401 7 (Eng)

In experiments conducted in England, isoionic exchange of phosphate was studied in aqueous suspensions of two British and four paddy soils under anaerobic and aerobic conditions Linear relationships between the logarithms of the P^{32} concentration in solution and the logarithm of time elapsed after application of P^{32} to the suspensions were observed under the two contrasting conditions Using a rate equation for recrystallization, the calculated reaction orders ranged from 4 0 to 6 6 Based on these values it is believed

that hydroxyapatite was present in at least some of the soils Anaerobic treatment of the soils produced higher pH, P, and Fe in solution, isotopically exchangeable P, and reaction order values than did aerobic treatment (Trop Abstr 23 921)

FRANCE

579 Gouny, P 1967 *Features of Fertilizer Application to Rice Fields* Bull Engrais 495 9 15 (Fr)

A brief review is given of nutrient requirements of the rice plant in relation to its successive stages of development, and of fertilizer requirements of rice fields as they are affected by climate, soil, flooding, transplanting, and other cultural practices The emphasis is on rice in temperate zones, in particular in the Camargue region of southern France Farmers in this region now apply 120 140 kg N/ha as ammonium salts or urea Evapotranspiration of the crop is 750 mm while 3350 mm water are supplied the irrigation water does not appreciably contribute to the mineral nutrition of the crop In temperate zones rice should be abundantly supplied with nutrients in the early stages when temperatures are still low, P requirements are higher for directly sown rice than for transplanted rice (Trop Abstr 22 1785)

580 Rouquerol F 1964 *The Activity of Nitrogen Fixing Organisms in Soils of the Camargue Delta Application of a Method for Measuring Potential Fixing Capacity* Ann Agron 15 599 617 (Fr) (Centre Rech Agron Midi, Montpellier)

Graphs show seasonal variations in the N content and potential fixing capacity (method discussed) in soils under rice, fallow, halophyte vegetation, and grass (SF 28 2906)

HUNGARY

581 Kiss, I S 1965 *Nitrogen and Phosphorus Fertilization of Rice* Novenytermeles 14(1) 1 8 (Hung) (Res Inst Irrig Rice Prod, Szarvas)

On alkali and meadow soils, N increased the yields and dry weight of rice cv Dunghan Shali and the shoot/root ratio, but P did not The N and K contents of the plants were highest at tillering, then decreased, however, the P content was lowest at tillering and increased during flowering Fertilizer affected the contents of N and K, but not that of P (FCA 19 193)

582 Palfi, G 1965 *The Effect of Sodium Salts on the Nitrogen Phosphorus Potassium Sodium and Amino Acid Content of Rice Shoots* Plant Soil 22 127 35 (Eng)

Plants grown in sand rich in Na but with other nutrient levels normal contained less N and P than plants grown with all nutrient levels normal The presence of Na impaired uptake of NH_4 Uptake of PO_4 was antagonized by SO_4 and Cl Thus on Ca free saline soil, the decrease in P uptake by rice is explained by the surplus of antagonistic ions as well as by P fixation Plants grown on high salt media had lower dry weights than plants grown at lower Na levels The N P ratio was 4 2 in the control but 5 2 in the high Na medium Usually the asparagine content of plants indicates the level of plant nutrition but under poor conditions (e g, with excess Na) it may result from impaired protein synthesis, it only indicates better N nutrition if accompanied by an increase in total N and dry matter Changes in asparagine concentration are usually associated with changes in the concentration of the major amino acids

583 Palfi, G 1965 *Nitrogen and Amino Acid Content in Rice Leaves Under Conditions of Abundant Ammonium Sulfate Supply* Fiziol Rast 12(3) 398 404 (Russ) (Szeged Univ)

The rice Dunghan Shali was sown in an acid saline soil with 0, 434, and 695 kg ammonium sulfate/ha Some of the plants given the highest dose formed necrotic brown spots and lodged badly, their growing points rotted The surviving plants in the manured plots had longer leaves tillered less, and flowered 4 5 days later Their leaves had higher contents of dry matter and of K, the N content was raised only slightly The content of amino acids at the time of flowering rose sharply from the lower leaves to the upper, though it was not notably increased by manuring, the content fell for some time after flowering but rose again when the leaves died There was also a reduction of N content at maturity and a positive correlation between N and asparagine contents The behavior of the amino acids suggests that they are, together with amides, the main form of N transport An unidentified substance with properties resembling an amino acid was also found in the leaves in direct proportion to the amount of N Yields equivalent to 41 3 hkg were obtained from the control, 45 6 under moderate manuring, and 32 8 hkg/ha from the high dose (FCA 19 195)

584 Polgar, S 1967 *The Lime Content of Soil and Rice Plants* Novenytermeles 16 15 24 (Hung) (Agrartud Foisk, Debrecen)

Pot experiments indicated the need for a particular Ca/N ratio in the soil to ensure balanced rice nutrition, antagonism between Ca and N was confirmed Low soil and air temperatures caused unbalanced N nutrition, decreased yields, extended the vegetative period, and could severely injure plants grown on lime free soils Liming was therefore particularly beneficial in unfavorable weather Increased Ca content of rice plants was correlated with increased resistance to disease and adverse environmental conditions Applying 10 15 q/ha powdered limestone would ensure higher and more consistent yields on lime deficient soils (SF 30 3024)

585 Szepes, J Kiss, I S 1967 *The Uptake of $P^{32}O_4$ and Its Incorporation into Phosphate Fractions of the Rice Leaf in Response to Various Nitrogen Applications* Novenytermeles 16 73 8 (Hung) (Tudomanyegyet, Budapest)

$P^{32}O_4$ uptake was most significan at tillering, decreased markedly by the time of panicle shedding and flowering but at ripening again approached the value shown at tillering Absorbed P was only slightly incorporated into the organic fractions at tillering but it increased more than 20 fold at panicle shedding flowering and decreased again by the beginning of ripening At tillering, there was little effect of N fertilizing on $P^{32}O_4$ uptake, at panicle shedding flowering, large N dressings markedly increased the incorporation of $P^{32}O_4$ into the leaf protein Yields were highest and ripening earliest in treatments where the inorganic P content was highest and changes in the ratio of organic P to inorganic P in the course of development were lowest (60 kg/ha N basal + 20 kg N topdressing or 100 kg/ha N basal dressing) (SF 30 3026)

586 Vamos, R 1969 *Effect of the Amount of Sunlight on the Utilization of Ammonium Sulfate by Rice Plants* Novenytermeles 18(1) 93 6 (Hung) (Mikrobiol Int , Szeged)

The effect of $(NH_4)_2SO_4$ on solonetz soils and on lime deficient meadows depends on the amount and intensity of sunlight During the generative phase up to stem elongation the synthetic processes of the rice plants are very slow, when there is little sunlight This may result in the reduction of $(NH_4)_2SO_4$ to H_2S and in the degeneration of roots to cause browning of the plants In these cases $(NH_4)_2SO_4$ addition increases the damage At a high sunlight intensity this trend is counteracted and the plant even liberates P from insoluble Fe phosphates, which increases the yield Under such conditions the addition of 400 500 kg $(NH_4)_2SO_4$/ha may double or triple yields (CA 71 60236g)

587 Zsoldos, F 1970 *Influence of pH and Temperature on Potassium Ion Uptake and Exchange by Rice Roots* Bot Kozlem 57(2) 101 5 (Hung) (Jozsef Attila Univ , Szeged)

Excised roots of 8 day old rice plants were studied to determine the uptake and exchange ratio of K^+ and $^{86}Rb^+$ The maximum rate of exchange occurs at pH 6 1 and 1° A sudden decrease in temperature alters cell membrane permeability (CA 74 1124b)

588 Zsoldos, F 1967 *Influence of Low Temperature on the Ion Absorption of Rice Roots* Agrokem Talajt 16(4) 653 58 (Hung) (Jozsef Atilla Univ , Szeged)

The influence of low temperature on the ion absorption of rice roots (*Oryza sativa* var japonica) was studied using radioactive isotopes (^{32}P, ^{86}Rb and ^{82}Br) At low temperature the absorption of various ions in KH_2PO_4 and RbCl solutions of 5 X 10 ^{1} moles concentration varied While the adsorption of PO_4 P and Br anions always decreased with the temperature, in the case of Rb, ion absorption began to increase again below 8° C The unusual result is explained by the cold shock effect which is likely to be caused mainly by sudden temperature changes This effect could be moderated by gradual cooling Under the influence of cold shocks the permeability of the cell membranes and consequently the absorption and the release of materials may considerably change It is likely that in the case of rice roots, too, the permeability of the boundary membranes increases at low temperature and allows a larger quantity of Rb ions to penetrate the cells than under normal conditions Since the difference presented itself only in the Rb absorption it is likely that the shock effect is very specific as regards the various ions It is assumed that ions having a common carrier" behave similarly At 10° 12° C , for example, at the minimum germination temperature of rice seeds no cold shock effect occurs At this temperature, and this may be of interest in practice, a reduced but yet regular ion absorption takes place (FA 2 294)

ITALY

589 Borasio, L 1964 *Fertilization of Rice and Its Practical Application (In Italy)* Riso 13(?) 149 63 (It)

The author deals with the importance of C as a fundamental element supplied to the rice plant not only by the air but also in part with C^{14} through the roots as proved by experiments with C^{14} Next to organic molecular N, the ammoniacal ion NH_4^+ is the best, whereas NO_3 –hardly ever present in Italian soils–is harmful to the plant The organic manures (green manure, stable manure, hoof and horn dried blood, etc) are the most effective ones Among nitrogenous fertilizers the most recommended are $(NH_4)_2SO_4$, CaN(CN) (considered as one of the best forms of N for rice fields), and urea which is coming into use for its high fertilizing value The phosphatic fertilizers most in use are superphosphates, Thomas slag, and the triple superphosphates K is applied under the form of KCl Ca is rarely used, being generally contained in the soil and in the fertilizers (FCA 19 903)

590 Borasio, L , Upadhyaya, S S S 1964 *The Retention Capacity of Rice Soils for Nitrogenous Organic Substances* Riso 13 283 94 (It)

Data show the retention and transformation of active ingredients from solutions of urea, biuret, dicyandiamide, and melamine in columns of different soils (pH 5 1 7) with permeabilities ranging from 0 012 to 9 6 l /hr according to the structure and texture of the soil (sand, and medium sandy or loamy soils) Results indicate that these N fertilizers may be applied to normal soils in rice cultivation without any impairment of their utilization and efficiency (SF 28 2030)

591 De Rege, F 1967 *Variation in Rice Production and Function of Increasing Rate of Single or Complex Fertilizing Elements* Riso 16(3) 213 50 (It)

From statistical analysis of experiments an equation is derived correlating yield with fertilizer use Results of the experiments indicate that N is the most important single element, but best results can be expected from a balance of the different nutritive elements given together

592 De Rege, F , Leonizo, M 1969 *Increase in the Fertile Tillers of Rice by Increasing Rates of Nutrient Elements* Riso 18 263 78 (It) (ENTE Naz Risi, Vercelli)

Rice grown in potted soil (pH 6 3) rich in organic matter and available P and poor in available K, was treated after transplanting with urea, superphosphate, and KCl, singly or in combination, at increasing rates Complete fertilizer was much more effective than single applications of N, P, or K (in this decreasing order of importance), the increase in the number of fertile tillers was related sigmoidally to fertilizer rate (SF 33 3191)

593 Myttenaere, C , Bourdeau, P 1969 *Cesium 137, Stable Cesium, and Potassium in Lowland Rice* Proc Second Nat Symp Radioecology, Ann Arbor, Michigan, May 15 17, 1967, pp 553 55 (Eng)

Stable Cs, K, and ^{137}Cs from fallout were measured in lowland rice grown in 1964 near Vercelli, Italy No correlation was found between the Cs and K contents of various plant parts Flooding enhanced the uptake of stable Cs in the shoots It also increased the specific activity of ^{137}Cs (pCi $^{137}Cs/\mu g$ Cs) in the plant

594 Myttenaere, C , Bourdeau, P , Masset, M 1969 *Indirect Contamination of Lowland Rice with Manganese 54* Proc Second Nat Symp Radioecology, Ann Arbor, Michigan, May 15 17, 1967, pp 561 70 (Eng)

Tracer experiments were carried out to explain field observations showing that indirect contamination was responsible for most of the fallout ^{54}Mn found in lowland rice and that preventing flooding increased this contamination Lowland and upland rice were grown in flooded soil and in soil at field capacity Carrier free ^{54}Mn was applied to the surface of the soil or uniformly mixed with it The lowland variety was found to absorb more of the stable and radioactive Mn than the upland variety Flooded plants absorbed more stable Mn and proportionally even more radiomanganese than plants grown at field capacity regardless of the mode of application of ^{54}Mn Applying ^{54}Mn to the soil surface resulted in greater radiocontamination this effect was particularly enhanced in the flooded lowland rice plants which developed numerous surface roots The specific activity of ^{54}Mn varied considerably within the plants It would seem the availability of ^{54}Mn for plant uptake varies with time, more or less independently of that of native stable Mn and that the element has little mobility within the plant

595 Myttenaere, C , Masset, M 1969 *Availability of Stable Manganese and ^{54}Mn to the Rice Plant in Flooded Soil* Soil Sci 107(4) 296 301 (Eng) (European At Energy Community, Ispra)

Rice was grown in a flooded soil traced with ^{54}Mn and sampled throughout the growing cycle in order to explain variations in the specific activity of this radioelement within the plant and relate them to the availability of stable and radiomanganese in the soil The specific activity of ^{54}Mn in the plant was found to decrease with time together with that of the available Mn fraction of the soil At harvest, the differences observed within the plant were related to the time at which the organs developed and to their function These differences may be explained by the evolution of the isotopes in the soil and by the low mobility of Mn in the plant The values obtained for the total aerial part represent an integral of the conditions prevailing during the whole growing cycle and are consequently higher than the root values (FA 2 1381)

596 Picciurro, G , Piacco, R 1966 *The Efficiency of Nitrogen and Phosphorus Fertilizers on Rice Cultivation* Riso 15(4) 261 68 (It)

Results are presented of a fertilizer placement trial with a recently introduced semi early *japonica* rice variety, conducted in northern Italy Ammonium sulfate at a rate of 60 kg N/ha and superphosphate at 60 kg P_2O_5/ha were either distributed on the surface or placed at a depth of 5 cm before transplanting, K fertilizer at 60 kg K_2O/ha was broadcast on the surface Crop development was below normal because of cold weather The trial indicated that the best utilization of N fertilizer is obtained by placement at a depth of 5 cm, the best utilization of P fertilizer by broadcasting on the surface When both fertilizers were distributed on the surface or placed at a depth of 5 cm, mixing had no appreciable effect on N and P uptake by the crop (Trop Abstr 22 455, SF 30 2237)

597 Picciurro, G , Piacco, R 1969 *Evaluation of the Efficiency of Different Nitrogen Fertilizers in Rice Cultivation* Riso 18(2) 121 34 (It)

In Italy, urea, sulfate of ammonia, ammonium nitrate, and sodium nitrate, applied at 5 cm depth at transplanting of rice, had a significantly positive effect on the height of plants, dry matter, and grain yields, the most effective fertilizers were urea and sulfate of ammonia Plants absorbed a considerably greater quantity of N from ammonium sulfate and urea than from ammonium nitrate and sodium nitrate The absorption of N was greater when applied at 5 cm depth at transplanting, than when applied on the surface 2 weeks before the primordial initiation No marked effect of the different N fertilizers on the P absorption was noted (Trop Abstr 25 555)

598 Tano, F 1967 *Investigations into Root Excretion of Rice Plants ("Oryza sativa" L)* Riso 16(4) 269 308 (It)

In northern Italy, different parts of rice plants of a local variety were analyzed at successive stages of growth in 1964 and 1966, in order to determine the pattern of uptake of the major nutrients and that of dry matter synthesis It was found that dry matter increases up to full maturity whereas uptake of minerals ceases at the milky ripe stage After that, the plant loses 17% 20% of its K, 20%-25% of its Ca, and 25%-30% of its Mg through root excretion, no losses of N and P were observed (Trop Abstr 23 706)

PORTUGAL

599 Patella, J F 1965 *Residual Effect of Phosphorus on Soils of Irrigated Rice* Lav Arroz 19(216) 5 7 (Port)

After 2 years superphosphate applied at 90 kg/ha had the most residual effect, resulting in yield of 5 kg/ha compared with 4 5 kg/ha for control

ROMANIA

600 Maianu, A , Albescu, I 1969 *The Setting and Layout of Rice Paddies in Saline Soils* Stiinta Sol 7(3) 19 26 (Rom) (Inst Cercet Pentru Imbunatatiri Funciare Pedol)

Rice paddies can be initiated in steppes and forest steppes Water with a salinity normally required by rice (up to 5 g/l) cannot be used in saline soils because they increase the salinity The recommended water should have 2 g salts/l and a pH of not over 8 If the pH of the water is higher, the use of gypsum is recommended The soil must contain 3% 5% humus, 0 12% 2% total N, and over 0 1% P_2O_5 If the soil contains under 2% organic matter its reclamation is necessary (CA 72 89384k)

USSR

601 Akhundov, F G 1968 *Application of Fertilizers to Rice in the Lenkoran Region of Azerbaidzhan SSR* Khim Sel' Khoz , No 11, 5 6 (Russ)

Rice grown on marshy loam soil received different combinations of 90 150 kg each of N and P_2O_5, and 70 120 kg K_2O/ha On fertilized plots, grain yields increased to 29 1 42 6 hkg/ha, total N content in the grain to 2 41%-2 97%, soluble N content to 0 22%-0 73%, protein N content to 2 16%-2 21%, and P_2O_5 content to 0 75% 0 96%, compared with 25 hkg, 2 27%, 0 22%, 2 04%, and 0 71%, respectively, for unfertilized

control, the highest increases were given by 150 kg N + 150 kg P_2O_5 + 120 kg K_2O/ha (FCA 22 1873)

602 Akhundov, F G 1969 *Dynamics of Nutrients in Bog Soil Under a Rice Crop in Connection With the Use of Various Forms of Nitrogen Fertilizers* Izv Akad Nauk Azerb SSR, Ser Biol Nauk, No 2, 68 73 (Russ)

The bog soil was low in hydrolyzable N and exchangeable K and was characterized as intermediate in the supply of available P The general fertilization background consisted of 90 kg N/ha in the form of $(NH_4)_2SO_4$, NH_4Cl, NH_4NO_3, urea, KNO_3, NH_4OH, or urea formaldehyde complex fertilizer, 90 kg P/ha in the form of superphosphate, and 60 kg K/ha in the form of KCl The highest content of absorbed NH_4^+ in soil was with $(NH_4)_2SO_4$, 13 69 14 92 mg/kg in the upper horizon and 9 70 12 38 mg/kg in the lower Applications of amide and amine forms of N did not produce significant changes in the absorbed NH_4^+ The lowest content of absorbed NH_4^+ was observed with KNO_3 application 9 31 10 58 mg/kg in the upper horizon and 7 27 9 70 mg/kg in the lower The content of extractable P in the soil samples increased with the application of the various N fertilizers Similarly, the content of exchangeable K in the $(NH_4)_2SO_4$ treated soil samples was 14 22 20 48 mg/kg whereas in the untreated samples the K content was 9 40 15 06 mg/kg (CA 71 111957c)

603 Akhundov, F G 1965 *Effect of Nitrogen Fertilizers on Rice Yield in the Azerbaidzhan SSR* Agrokhimiya, No 12, 13 16 (Russ) (Inst Pochv Agrokhim Akad Nauk Azerb)

In the Lenkoran region, on heavy loamy slightly alkaline soil to which PK was applied, urea or $(NH_4)_2SO_4$ increased yield over a 2 year period NO_3 fertilizers did not increase yield Urea and $(NH_4)_2SO_4$ increased the percentage contents (dry weight basis) of total and protein N in the grain (SF 29 2100)

604 Akhundov, F G 1966 *Effect of Potassium Fertilizers on Rice Yield in the Azerbaidzhan SSR* Agrokhimiya, No 6, 44 8 (Russ)

The experiments were carried out on a marshy, heavily argillaceous soil in the Masally region of the Azerbaidzhan SSR in 1963 65 The soil reaction was mildly alkaline, total humus content in the top layer (horizon) 3 83%, total N 0 24%, readily hydrolyzed N 56 mg/kg, absorbed ammonia 20 8 mg/kg, and water soluble material 3 73 mg/kg, nitrates 1 73 mg/kg, total P 0 28% (32% organic, 55% mineral compounds), P soluble in 1% $(NH_4)_2CO_3$ 20 7 mg/kg Total K 3 61%, and exchangeable K 8 45 mg/100 g Laboratory tests were set up to establish a theoretical basis for fertilizer application to a marshy soil Samples were taken off from an experimental rice field, and mixed with fertilizer in a ratio of 200 g major nutrient to 1 kg of air dry soil Irrigation was carried out by weight to maintain 100% humidity The test was repeated three times Before sampling, the percent of hygroscopic humidity was determined in a thoroughly mixed soil Samples were taken 1, 3, 15, 30, 60, 90, and 150 days after the start One day after KCl application, 59 9% of the introduced K was water soluble When KCl was introduced together with N, and also with N and P, the values were 68 3% and 73 3%, respectively Further composting lowers the amount of water soluble K When K is introduced, part of it is converted to an exchangeable form One day after the start of the test, the content of exchangeable K was 30% and decreased insignificantly in 30 and 60 days Washing out of K was studied on the basis N and P with a test lasting 70 days during which 57% of the total irrigating rate of water was used (irrigating rate = 2000 m^3/ha) The greater part of water soluble K was found in the first fraction (7 days) with a gradual decrease in the subsequent days (14 4%, 6 9%, and 3%) K fertilizing of a rice plantation could well be limited to a two stage application which will provide rice plants with the necessary K nutrition during the total vegetation period The effectiveness of different forms of K diminishes in the order K_2SO_4, KCl, sylvinite The same order applies to the yield of rice straw Fertilization also improves the quality of rice, in particular, by increasing its protein content (CA 65 12815)

605 Basitova, S M , Zasorina, E F , Muladzhanova, B S 1968 *Manganese in the Biosphere of Southwestern Tadzhikistan* Izv Akad Nauk Tadzh SSR, Otd Fiz Mat Geol Khim Nauk, No 1, 73 8 (Russ) (Inst Khim , Dushanbe)

Mn was determined colorimetrically in soils and plants and spectrally in natural waters of southwestern Tadzhikistan The average content in typical mountain brown, mountain brown carbonate gray and gray meadow weakly salinated and saloncha soils was 863, 730, 640, and 500 ppm, respectively averaging 683 ppm for all southwestern Tadzhikistan soils Chemical analysis of 160 plant samples showed that the Mn content was 5 90, average 41 ppm The average normal content of Mn in plants is 80 ppm, therefore the plants in southwestern Tadzhikistan contained much less Mn than normal The average Mn content in surface and subsurface waters of the territory is 0 003 ppm This is lower than the Clarke value of Mn in the hydrosphere (0 004 ppm) The concentration of Mn in various plants depended on its content in soils and on the type of plant The Mn concentrated in rice stems Rice straw contained $\leq$380 ppm Mn This straw is recommended for addition to animal feeds (CA 70 46471c)

606 Dobrunov, L G , Gostenko G P , Tsvetkova, B M 1968 *Responses of Rice Plants to N and P Fertilizers at Different Stages of Growth* Tr Inst Bot , Alma Ata 26 36 48 (Russ)

In plot trials plants of swamp rice cv Dubrovskii 129 were given 0 2 g N/kg soil, and P_2O_5 and K_2O at 0 15 g of each, (a) before sowing, (b) at the 1 2 leaf, (c) the 3 4 leaf, and (d) at the full tillering stages in a further treatment (e) 50% of the fertilizer was given before sowing and 50% at early tillering The greatest number of productive tillers (5 1) was given by treatments applied at (b), highest yields of dry matter (20 5 g/plant) and of grain (4 2 g) at (a), plants receiving no fertilizer yielded only 0 9 g grain/plant Data on contents of chlorophyll, carbohydrates, N, P, and K are also given for plants receiving fertilizer at different times Fertilizers were most effective when applied before sowing (FCA 23 284)

607 Guseinov, R K , Akhundov, F G 1968 *Metabolism, Yield, and Quality of Rice as Influenced by Nitrogen Nutrition* Vestn Sel'skokhoz Nauki (Moscow) 13(11) 10 14 (Russ)

In paddy soils, use of $(^{15}NH_4)_2SO_4$ and $Ca(^{15}NO_3)_2 4H_2O$ showed that the ammoniacal forms of N remain in the soil longer than the nitrates Although P is taken up by the plants readily, its absorption is a slow process The elution of N from NPK fertilizers is rapid if it is in the form of nitrate, and slow if it is ammoniacal The tallest plants, maximum bushy growth, and largest number of grains are obtained with urea and $(NH_4)_2SO_4$ Use of Ca and K nitrates gave poorer plant growth and lower grain yields The maximum quantity of free amino acids in the plant parts was obtained with urea and $(NH_4)_2SO_4$ (394 and 382 mg of free amino acid/100 g of plant part, respectively) Urea and $(NH_4)_2SO_4$ gave a higher protein content in the rice than the nitrates (CA 70 114281t)

608 Ilyaletdinov, A N 1970 *Biological Mobilization of Phosphorus and Nitrogen in Inundated Soils Used Under Rice Crops* Izv Akad Nauk Kaz SSR, Ser Biol 8(2) 19 28 (Russ) (Inst Mikrobiol Virusol , Alma Ata)

Greenhouse experiments were performed on the effect of flooding a marshy grassland carbonate soil 7 45 days before sowing rice Flooding and incubating for 32 instead of 7 days raised the yield of rice from 183 g/100 plants to 308 in an experiment with 2 4 g $(NH_4)_2SO_4$ and 2 8 g phosphorite added per 9 kg soil effects of other amounts of fertilizer were investigated The explanation for this improvement is mobilization of N and P by bacteria under anaerobic conditions Soil + phosphorite wetted for 7 days with a solution containing 2 g/l $(NH_4)_2SO_4$ + 5 g Ca lactate showed an increase in HOAc extractable Fe and sulfide (sulfide was zero initially), and the incubated soil showed black spots of FeS After incubation with grated lucerne roots for 20 days, NH_3 N increased from 2 14 to 4 35 mg/100 g in flooded soil and to 3 48 in soil at 45% saturated moisture Bacterial counts are included (CA 73 97940z)

609 Kandaurov, N S 1967 *Transformation of Iron Forms and the Nitrogen Mobility in the Soil of Rice Fields* Agrochimiya No 4, 103 10 (Russ) (Kubansk Sel'skokhoz Inst , Krasnodar)

Samples (600 g) of slightly depleted meadow chernozem soil from the Krasnodar region of northern Caucasus, with additions of 4 12 g finely divided peas, were submerged for 3 months at 27 30° under a 5 8 cm layer of distilled water Fe_2O_3 and FeO, humus, and the absorbance of the humic acids were determined repeatedly in the samples during the anaerobic process, in 0 1 0 5, and 1 0*N* H_2SO_4 extracts and in 0 2*N* NaOH extract on a photoelectric colorimeter The conversion of Fe_2O_3 into FeO to a limiting equilibrium was established in the experimental soil, and also the transformation of the original humus into a simpler complex with a lower humic/fulvic acid ratio (CA 67 53044g)

610 Krupskii, N K , Rovalivnich, P G , Latyshev, E P 1967 *Oxidation Reduction Potential and Dynamics of Mobile Nitrogen in Rice Field Soil* Agrokhimiya, No 5, 37 42 (Russ) (Ukrainsk N I Inst Pochv , Kharkov)

The study of oxidation reduction potentials in various positions of soil and water of flooded rice fields, as related to flooded soil surface and to distance from growing rice plants, showed that values determined in water 1 cm over soil surface, 1 cm under flooded soil surface at point of tillering, 5 cm under soil surface in rhizosphere, and 1, 5, and 10 cm in depth at a distance 10 cm from rice plants varied from 12 3 to 26 5 *rH* (oxidation reduction potential) units The lowest values were those determined at depths 1, 5, and 10 cm at a distance 10 cm from rice plants Because of reduction under anaerobic conditions corresponding to *rH* values determined and also significant leaching, the nitrates are shown to be almost completely excluded from the N nutrition of rice plants Thus, the main source of N on rice fields is ammonium N (CA 67 90150j)

611 Mamedov, C A 1968 *Influence of Physical Properties and Treatment of Soils on Summer Rice Crops on the West Shirvan Steppes* Uch Zap Azerb Sel'skokhoz Inst , No 2, 62 7 (Azerb) (U S S R)

In gray grassland soils on two farms, raising rice and cotton, effects of the initial flooding were checked to depths of 184 cm for HCO_3^-, Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, and Na^+ content The same assays were made later for the cotton crop On both farms HCO_3^- remained unchanged, other assays showed slight increases or decreases Soil pH, at depths to 125 cm, varied from 7 10 to 8 87 for the rice crop, and from 8 00 to 8 95 later for cotton Fertilizers, organic and inorganic, increased crop yields (CA 73 3111e)

612 Milev, V 1967 *Rice Growing in the Krasnodar District of the U S S R* Riso 16(1) 57 61 (It)

Rice growing in the Krasnodar district of southern Russia started in 1930, at present over 50,000 ha are sown annually and the area is still expanding The mean yield is 3 0 3 2 tons/ha Features of the highly mechanized growing system are flooded fields, in part requiring frequent changes of water to prevent high temperatures and excess salinity application of NPK fertilizers, aerial sowing on part of the area weed control with 2 5 3 kg 2,4 D/ha applied from the air at flowering time when the water temperature is at least 25° C Locally selected blast resistant varieties with a duration of 150 120 days are grown in rotation cycles varying from 3 years with two rice crops to 8 years with five rice crops (Trop Abstr 22 1341)

613 Rozin, S Y 1968 *Fertilization of Rice in the Ukraine* Visn Sil's'kogospod Nauki 4 28 35 (Ukr)

614 Slukhai, S I , Zhabitskii, P F , Nizhko, L V 1968 *Effect of Various Forms of Nitrogen Fertilizers on the Growth and Productivity of Rice in the Southern Ukraine* Fiziol Biokhim Osn Pitan Rast , No 4, 153 59 (Russ) (Inst Fiziol Rast , Kiev)

Pot and field experiments were carried out to determine the effect of NH_4NO_3, $NaNO_3$, $Ca(NO_3)_2$ and urea on the growth and yield of rice grown in southern Ukraine Urea and NH_4NO_3 were much more effective than the other nitrates A higher content of cell fluid in the plants treated with NH_4NO_3 and urea was found compared with the control and with $NaNO_3$ treatment Treatment with NH_4NO_3 and urea produced the highest yield of rice grain containing higher levels of protein and starch, compared with $NaNO_3$ treatment (CA 71 60217b)

615 Tonkonozhenko, E V 1966 *Effects of Trace Elements on the Yields of Agricultural Crops Under the Conditions of the Krasnodar District* Khim Sel' Khoz 4(5) 9 14 (Russ)

During 1963 64 field experiments were carried out with beets, peas, rice, and corn Mg, B, Mo, and Cu were applied in different amounts in different forms The soils of the Krasnodar district were high in trace elements, but no direct correlation existed between the trace element content in soil and that in the crops A favorable influence of these elements, when applied as fertilizers, upon yields and quality of cropped plants was observed Pronounced effects of applied trace elements appeared with beets, peas, and rice, but not with corn (CA 65 9678c)

BOOKS AND REVIEWS

616 Comhaire, M 1965 *Rice Manuring* Centre International d'Information et de Documentation des Producteurs de Phosphate Thomas 197 pp (Eng) (Brussels)

This publication is concerned with the manuring of rice fields in tropical and temperate regions The main parts of the publication deal with the problems of rice manuring, the manuring of rice in the different countries of the world economic aspects and recommendations (FCA 19 1103)

617 de Geus, J G 1967 *Rice* IN Fertilizer Guide for Tropical and Subtropical Farming pp 31 69 (Eng) (Centre d'Etude de l'Azote, Zurich)

618 Doyle, J J 1966 *The Response of Rice to Fertilizer* FAO Agr Stud, No 70 69 pp (Eng) (FAO, Rome)

A review is presented of the response of rice to fertilizer on the basis of field trials carried out in 31 countries The findings are presented under two headings (1) response of rice to fertilizer within individual countries and (2) a summary of response data on a worldwide basis It appears that rice responds to N on nearly all soils at a rate of 12 13 kg of paddy per kg of applied N, at least with moderate rates of application This ratio could be substantially increased through the introduction of improved practices The use of P_2O_5 and K_2O is probably not economic on a worldwide basis but can be highly profitable on particular soils (Trop Abstr 21 2273)

619 Food and Agriculture Organization of the United Nations 1966 *Statistics of Crop Responses to Fertilizers* 112 pp (Eng) (FAO, Rome)

620 Grist, D H 1969 *Cultivation of Rice* World Crops 21(1) 17 21 (Eng)

General aspects of the cultivation of irrigated rice are outlined The need for high yielding disease resistant hybrids is emphasized Brief information is given on drainage and irrigation Response to times and placement of N fertilizers, soil P availability, K shortage, possible deficiencies of Fe, Mn and other trace elements, the effect of silica on peat soils, and the need for organic and inorganic manuring are briefly discussed Operations with respect to mechanization in small holdings and in large scale production, major requisites for double cropping, ratooning, and the favorable effects of rotations are summarized Early weed control with propanil at 3 kg/ha has proved to be effective, paraquat appears promising MCPA or 2,4 D given 15 25 days after transplanting, followed by conventional weeding practices is effective in tropical monsoon Asia A table listing diseases and pests is added (Trop Abstr 24 2206)

621 Grist, D H 1965 *Rice* 4th ed London, Longmans, 548 pp (Eng)

622 International Rice Research Institute 1965 *The Mineral Nutrition of the Rice Plant* Proc Symp Int Rice Res Inst, Los Banos, Philippines, February 1964 Johns Hopkins Press, Baltimore, 494 pp (Eng)

623 Janick, J, Schery, R W, Woods, F W, Ruttan, V W 1969 *Rice* IN Plant Science, San Francisco, Freeman and Company, pp 352 55 (Eng)

General discussion on history of rice, evolution and current methods of rice culture, processing, and products Maps show world's major rice producing areas

624 Kemmler, G 1968 *The Manuring of Paddy Rice–Experiences from South and East Asia* Tropenlandwirt 69 8 26 (Ger)

Based on the evaluation of experiments and practical experience, recommendations have been established for various rice growing districts in different countries In Taiwan, recommendable rates vary between 60 and 120 kg/ha N, 30 80 kg/ha P_2O_5, and 40 90 kg/ha K_2O In India the following rates are recommended for local varieties 17 67 kg/ha N, 11 50 kg/ha P_2O_5, 0 50 kg/ha K_2O Recommendations under the "High Yielding Varieties Program' in India are 67 135 kg/ha N, 34 74 kg/ha P_2O_5, 25 67 kg/ha K_2O Part of the N, the full rate of P, and part or the whole amount of the K_2O dose are applied before transplanting and mixed into the soil with the puddling operation Topdressing with N and sometimes with K is done at the stage of tillering and/or panicle initiation Analyses of long term trends show the close connection between fertilizer rates and yield level

625 Kemmler, G 1969 *Manuring of Rice in Japan* Fertilizer News 14(4) 11 17 (Eng) (Agr Res Sta Buentehof, Hannover, German Federal Republic)

A review with 21 references Uptake of N, P, and K per ton of brown rice does not increase when the yield is doubled Splitting the application of K and applying Ca silicate increases yield (SF 33 4840)

626 Matz, S A 1969 *Rice* IN Cereal Science (Chap 7), Avi Publishing Company, Westport, Conn 172 223 (Eng)

627 Noguchi, Y , Sugawara, T 1966 *Potassium and Japonica Rice, Effects of Potassium on the Growth, Yield, Histological Structure, and Metabolism of Rice Plants* International Potash Institute 102 pp (Eng) (Berne, Switzerland) (CA 66 104436a)

628 Nuttonson, M Y 1965 *Global Agroclimatic Analogues for the Rice Regions of the Continental United States* American Institute of Crop Ecology, 9 pp (Eng) (Washington, D C)

629 Nuttonson, M Y 1965 *Rice Culture and Rice Climate Relationships with Special Reference to the United States Rice Areas and Their Latitudinal and Thermal Analogues in Other Countries* American Institute of Crop Ecology 555 pp (Eng) (Washington, D C)

630 Government Printing Office 1966 *Rice in the United States Varieties and Production* U S D A Agr Handb 289, 124 pp (Eng) (Washington, D C)

This handbook presents a general account of rice growing in the U S A Its 8 chapters have been written by different authors The brief introductory chapter, outlining the economic importance of rice in the U S A is followed by chapters discussing the botany of the rice plant, rice breeding and selection methods, the characteristics and performance of varieties, and seed growing soils and fertilizer application, rotation, land preparation, sowing, irrigation, and drainage, harvesting, drying, and storage of the crop, and weeds, diseases, and pests and their control With the exception of the chapter on botany, the whole publication is concerned only with rice in the U S A (Trop Abstr 22 45)

631 Shiroshita, T 1965 *Theory and Practice in Fertilizer Application* IN Theory and Practice of Growing Rice,(Chap 4) pp 183 227 Fuji Publ Co , Ltd , Tokyo (Eng)

632 Tanaka, A , Yoshida, S 1970 *Nutritional Disorders of the Rice Plant in Asia* IRRI Tech Bull 10, 51 pp (Eng) (Int Rice Res Inst , Los Banos, Philippines)

A report on the "physiological diseases" of rice, descriptions and causes of these disorders are discussed

633 Watabe, T , Kawaguchi, K 1968 *Increasing the Rice Yield in South and Southeast Asia* Asian Survey 8(10) 820 28 (Eng)

Various means of increasing the rice yields in Asia are discussed Output can be increased by increasing the area under cultivation and/or increasing the yield/unit area cropped Apparently it is quite difficult to increase the area cropped Temperature and quality of soil are not serious factors in causing low yields Suggestions are made to improve nursery practices, improve the varieties used, use more fertilizer, and improve irrigation, the latter might be effected by using water reservoirs to store water from rainy to dry seasons (FA 2 133)

634 Yamada, N , Lusanandana, B 1969 *Rice Production in the Asian Development Region* IN Asian Agr Survey (Part I) pp 141 96 (Eng) (Univ of Washington Press, Seattle)

Part I seeks to identify the problem areas involved in rice production in the regions covering member countries of the Asian Development Bank (ADB) While the report is not divided into problems any country in particular may have, it does recognize problem areas typical to the regions, i e , land use, soil conditions, fertilizer use, variety improvement, plant protection, and rice processing

LIST OF PUBLICATIONS

Acta Agron (Budapest) [*Acta Agronomica (Budapest)*]
Acta Bot Sin (*Acta Botanica Sinica, Chih Wu Hsueh Pao*)
Acta Pedol Sin (*Acta Pedologica Sinica*)
Advan Agron (*Advances in Agronomy*)
Agr, Asia (*Agriculture Asia*)
Agr Gaz N S W (*Agricultural Gazette of New South Wales*)
Agr Handb, USDA (*Agricultural Handbook, U S Departmen of Agriculture*)
Agr Nitrogen News (*Agricultural Nitrogen News*)
Agr Pak (*Agriculture Pakistan*)
Agr Res J Kerala (*Agricultural Research Journal of Kerala*)
Agr Res Rev (*Agricultural Research Review*)
Agr Sci, Hong Kong (*Agricultural Science, Hong Kong*)
Agr Tec Mex (*Agricultura Tecnica en Mexico*)
Agr Trop (*Agricultura Tropical*)
Agri Digest
Agrochimica
Agrokem Talajt (*Agrokemia es Talajtan*)
Agrokhimiya
Agron J (*Agronomy Journal*)
Agron Trop [*Agronomie Tropicale (Paris)*]
An Esc Super Agr "Luiz Queiroz," Univ Sao Paulo (*Anais da Escola Superior de Agricultura, "Luiz de Queiroz," Universidade de Sao Paulo*)
Andhra Agr J (*Andhra Agricultural Journal*)
Ann Agr Sci (*Annals of Agricultural Science*)
Ann Agron (*Annales Agronomiques*)
Ann Physiol Veg (*Annanles de Physiologie Vegetale*)
Ann Rep Div Chem Fert Natl Inst Agr Sci (Japan) (*Annual Report of the Division of Chemical Fertilizers, National Institute of Agricultural Sciences, Japan*)
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Arkansas Farm Res (*Arkansas Farm Research*)
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Background papers Workshop on Food sponsored by the National Academy of Sciences–Lembago Ilmu Pengethuan Indonesia Djakarta, May 27 June 1, 1968
Beitr Trop Subtrop Landwirt Tropenveterinaermed (*Beitraege zur Tropischen und Subtropischen Landwirtschaft und Tropenveterinaermedizin*)
Better Crops Plant Food (*Better Crops with Plant Food*)
Bol Tec Pesqu Exp Agropecuar Norte (*Boletim Tecnico do Instituto de Pesquisas e Experimentacao Agropecuarias do Norte*)
Bot Kozlem (*Botanikai Kozlemenyek*)
Bragantia
Bull Engrais (*Bulletin des Engrais*)
Bull Aomori Agr Exp Sta (*Bulletin of the Aomori Agricultural Experiment Station*)
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Bull Kanagawa Agr Exp Sta (*Bulletin of Kanagawa Agricultural Experiment Station*)
Bull Nat Inst Sci India (*Bulletin of the National Institute of Sciences of India*)

Caribbean Farming
Chem Age India (*Chemical Age of India*)
Chika Shigen Chosasho Hokoku (*Report of the Geological Survey of Hokkaido*)
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Chung Kuo Nung Yeh Hua Hsueh Hui Chih, Spec Issue (*Journal of the Chinese Agricultural Chemical Society, Special Issue*)
Curr Sci (*Current Science*)

Diss Abstr (*Dissertation Abstracts*)

Ehime Daigaku Kiyo, Dai 6 Bu (*Memoirs of the Ehime University, Section 6 Agriculture*)
Emp J Exp Agr (*Empire Journal of Experimental Agriculture*)
Exp Agr (*Experimental Agriculture*)
Exp Tech Assis Progr, FAO Rep (*Expanded Technical Assistance Program, Food and Agriculture Organization of the United Nations*)

FAO Agr Stud (*Food and Agriculture Organization of the United Nations Agricultural Studies*)
Farm J (Calcutta) [*Farm Journal (Calcutta)*]
Farming Japan
Fert Soc S Afr J (*Fertilizer Society of South Africa Journal*)
Fertilite
Fertilite (*Paris*)
Fertilizer News
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Indian J Agr Econ (*Indian Journal of Agricultural Economics*)
Indian J Agr Sci (*Indian Journal of Agricultural Science*)
Indian J Sci & Ind (*Indian Journal of Science and Industry*)
Int Rice Comm Newsl (*International Rice Commission News Letter*)
IRRI Reptr (*International Rice Research Institute Reporter*)
IRRI Tech Bull (*International Rice Research Institute Technical Bulletin*)
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J Inst Chem, Calcutta (*Journal of the Institution of Chemists, Calcutta*)
J Post Grad Sch, Indian Agr Res Inst (*Journal of the Post Graduate School, Indian Agricultural Research Institute*)
J Res, Punjab Agr Univ (*Journal of Research, Punjab Agricultural University*)
J Sci Res Banaras Hindu Univ (*Journal of Scientific Research of the Banaras Hindu University*)
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Jap Agr Res Quart (*Japan Agricultural Research Quarterly*)
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Res Bull Taiwan Fert Co (*Research Bulletin of the Taiwan Fertilizer Company*)

Res Rpt Fukuoka Agr Exp Sta (*Research Report of the Fukuoka Agricultural Experiment Station*)

Rev Agr Sucr Ile Maurice (*Revue Agricole et Sucriere de l'île Maurice*)

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