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SOME STUDIES ON PRE-RICE MUNG CROP AND OBSERVATIONAL CROPPING PATTERNS IN FARMERS' FIELDS AT SOLANA, TUGUEGARAO, PHILIPPINES, 1981

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SOME STUDIES ON PRE-RICE MUNG CROP AND OBSERVATIONAL CROPPING PATTERNS IN FARMERS' FIELDS AT SOLANA, TUGUEGARAO, PHILIPPINES, 1981

INTRODUCTION

The Cropping Systems Program of the International Rice Research Institute (IRRI) established an on-farm cropping systems research site in 1980, in cooperation with the Cagayan Integrated Agricultural Development Project (CIADP) and the Philippine Council for Agricultural Resources Research (PCARR), at Solana, Tuguegarao, Cagayan Province of the Philippines. The general objective of the project is to increase food production on the small farms in the area through the development and adoption of more productive cropping patterns.

The Site is located in the Municipality of Solana, Cagayan, about 8 km northeast of Tuguegarao and about 500 km north of Manila. The site includes three contiguous barangays (villages) -- Bangag, Bauan, and Iraga. The site has 5 wet months (July to November) with more than 200 mm rainfall/month and 4 dry months (January-April) with less than 100 mm rainfall/month. Rain normally starts in late May and declines starting the first week of December. The total average annual rainfall is about 1755 mm.

The site is broadly classified into two landtypes -- 'bangkag' and 'talon'. The Bangkag area comprises the cultivable portions of the recent floodplains bordering the Cagayan river. The silty clay loam soil (31.6% clay, 67.8% silt, 0.6% sand) is lighter in texture and has a pH of about 6.6. The cation exchange capacity (CEC) of the 'bangkag' soil is 32.9 meq/100 g. The soil contains 1.23% organic carbon, 0.13% total N, 268 ppm K and 12 ppm P. During the non-flooded

period from December to July, farmers grow upland crops in the bangkag area, mainly corn and peanut. Some farmers also grow these two crops in an intercropping combination. Short duration upland rice + corn is a possible alternative landuse pattern for the sole corn fields in the bangkag area. However, major research emphasis should be given on the improvement of farmers upland crops through identification and adoption of better varieties and crop management practices.

The 'talon' area is at a higher elevation (about 2-3 m) above the bangkag area and about 1 km away from the Cagayan River. Based on relative elevation and field level water regime, the 'talon' area is divided into 3 strata which are briefly described here (Gines and Morris, 1981).

First stratum. This is the highest portion of the 'talon' area which extends about 1/2 km from the 'bangkag'. The soils are predominantly silty clay loam (37.7% clay, 55.7% silt, 6.6% sand) with a pH of 6.3. The CEC value is 34.6 meq/100 g. The soil contains 1.3% organic carbon, 0.11% total N, 260 ppm K and 29 ppm P. The internal and surface drainge in this stratum is poor. The farmers' traditional cropping pattern is local mung-transplanted rice. Generally, mung is sown in mid-April and rice is transplanted in July-September.

Second stratum. This stratum is the intermediate portion of the sloping land between the first and third strata. The soil has a silty clay texture (54.1% clay, 43.3% silt and 2.6% sand) which is heavier than the first stratum but lighter than the third stratum. The average pH value of the soil is 6.2 and the cation exchange capacity (CEC) is 41.8 meq/100 g. The soil contains 1.4% organic carbon, 0.12% total N, 24 ppm P

and 335 ppm of K. Internal drainage is very poor and water accumulation on the surface is faster than in the first stratum. The farmers' traditional cropping pattern is mung-transplanted rice, as in the first stratum.

Third stratum. This stratum occupies the lowest portion of the 'talon' area. The soil texture is silty clay (59.3% clay, 39.6% silt, 1% sand) but much heavier than in the first and second strata. The average soil pH value is 6.2. The soil contains 1.7% organic carbon, 0.14% total N and 261 ppm of K and 21 ppm of P. Soil in the third stratum has the highest CEC value (44.5 meq/100 g) among the three strata. Water accumulates much faster in the third stratum, as compared to the first and second strata, and the fields remain flooded for a longer time. Farmers' traditional cropping pattern is a single crop of rice. In some years, depending on hydrology, the fields are also kept fallow. Farmers usually plant longer duration rice varieties in the third stratum while they use relatively shorter duration varieties in the first and second strata.

A BRIEF REIVEW OF PREVIOUS RESEARCH RESULTS

Farm surveys at the Solana research site (Gonzaga and Price, 1980) indicate that the average farm size in the area is 3 ha (1.5 ha in 'talon' + 1.5 ha in 'bangkag'). The farmers are share tenants. On an average, every family has 6 members out of which 2.5 persons/family are engaged in farming on a full time basis. Carabao (buffalo) is used as the draft power source. A 1980-81 monitoring study on 48 Solana farmer cooperators' income and expenditure (Gonzaga, 1982)

revealed that the average annual income of a farm family is about ₱2511 (₱1308 from farm income + ₱1203 from household income) while the average annual expenditure per family is about ₱3098 (only ₱337 for farming expenses + ₱2761 for household expenses). Thus there is an outstanding amount (₱587/family) of loan on the farms.

The grain yields of the mung crop range from 100-200 kg/ha in both the 'talon' and 'bangkag' areas. Rice yield in the 'talon' area ranges from 400 to 700 kg/ha while peanut yields in the 'bangkak' area range between 300 to 500 kg/ha. Survey results on the crop yields clearly indicate that the farmers' yields are really very poor and there is a challenge for yield improvement at the site. First year's (Gines and Morris, 1980) research trials at the site indicated yield ranges of 206-1861 kg/ha in first stratum and 142-595 kg/ha in the second stratum for the pre-rice mung crop. The grain yield of the transplanted rice following mung ranged from 3030 to 3062 kg/ha in the first stratum and from 3200 to 3200 kg/ha in the second stratum, depending on rice varieties. The varieties IR52 and IR36, when grown as the first crop under transplanted conditions, produced maximum grain yields of 3870 kg/ha and 3430 kg/ha, respectively. The yields from the 1981 direct seeded rice crop in the DSR-TPR-mung pattern ranged from 1860 to 4860 kg/ha. From the 1981 pre-rice upland crop variety trials, Godilano and Marra (1982) reported yield ranges of 380-1050 kg/ha for mung, 240-1050 kg/ha for cowpea, and 249-1300 kg/ha for bush sitao.

REPORTS ON SOME 1981 RESEARCH TRIALS ON PRE-RICE MUNG CROP AND OBSERVATIONAL CROPPING PATTERNS

In 1981, a few simple on-farm trials were implemented at the Solana site. The objectives of these studies were to determine whether the yields of the farmers' pre-rice mung crop could be improved through the manipulation of seed rate, tillage practices, seeding method and fertilizer application as well as to determine the production potentials of DSR-TPR-mung and TPR-mung cropping patterns at the site. The trials are briefly presented and discussed below.

1. Title: Effect of seedrate and seeding method on the yield of farmers' pre-rice mung crop.

   Specific objective: To determine whether the yields of farmers' mung crop, grown before rainy season rice, could be improved through higher seeding rate (30 kg/ha against farmers' low seed rate of about 15 kg/ha) and continuous seeding in furrows 30 cm apart (against farmers' dibbling seeding method with a spacing of approximately 30 cm x 15 cm).

   Materials and methods: The four treatments included in the study were:

   1. Continuous seeding in furrow soles 30 cm apart with 15 kg seed/ha
   2. Continuous seeding in furrow soles 30 cm apart with 30 kg seed/ha

3. Spaced dibbling with 30 cm x 15 cm spacing with 15 kg seed/ha

4. Spaced dibbling with 30 cm x 15 cm spacing with 30 kg seed/ha

The trials were planted in three farmers' fields (1 in Stratum I and 2 in Stratum II). There were no replications within the single fields. The two trials in second stratum were planted on April 27, 1981 and harvested on July 4, 1981. The trial in the first stratum was planted on May 9, 1981 and harvested on July 21, 1981. No fertilizers were applied in the trials. Data were collected on dates of planting and harvesting, plant population 21 days after seeding and at maturity, and grain yields.

Results and Discussion: The results on grain yields and plant population as influenced by the treatments are presented in Tables 1 and 2, respectively. As it can be seen from Table 1, the grain yield of mung ranged from 232 kg/ha to 1147 kg/ha depending on the treatment and experimental field. Results indicate that the yield of farmers' pre-rice mung crop could be significantly increased by using a higher seedrate (30 kg/ha). However, there was no significant difference among the two seeding methods in terms of mungbean yield. On an average, 15 kg seedrate/ha produced a grain yield of 392 kg/ha against a grain yield of 722 kg/ha with 30 kg seed rate/ha. Thus the 30 kg seed rate produced an additional benefit-cost ratio of 22.

Further, on an average, the farmers' dibbling method of row seeding and the newly introduced continuous seeding in furrow sole produced grain yields of 550 kg and 564 kg/ha, respectively. The maximum mung yield (1147 kg/ha) obtained from the trials came from a 30 kg seedrate/ha with farmers' dibbling seeding method.

As it can be seen from Table 2, the 30 kg seedrate gave a significantly higher plant population per unit area (about 46% higher) at 21 days after seeding as compared to that with 15 kg seedrate/ha. However, at maturity, although the 30 kg seedrate gave much higher plant populations per unit area than that with 15 kg seedrate, the difference was not statistically significant (Table 2).

The results of the trials indicate that a higher seedrate considerably help in attaining a higher plant population of mungbean in the field which ultimately lead to a higher grain yield. The average grain yields in the three individual fields were about 417 kg, 892 kg and 362 kg per ha. The difference among the fields in terms of grain yield is, probably, attributable mainly to soil moisture variation. No general differentiation could be made, based on the limited number of trials, between the two land strata in terms of mungbean yield.

Conclusions: Use of a 30 kg seedrate of mungbean per ha against the farmers' 15 kg seedrate can significantly improve per ha yield and total production of farmers' pre-rice mung crop at Solana. No yield advantage was obtained by replacing the farmers' dibbling seeding method with continuous row seeding in furrow sole, although this needs to be confirmed by further trials at the site.

2. Title: Stand establishment and weed growth in mungbean as influenced by tillage level and seedrate.

Specific objective: To determine the effect of high and low level tillage and three seedrates on stand establishment, weed competition and grain yield of pre-rice mung crop.

Materials and methods: An experiment was set in a farmer's field in stratum II at Solana in a split-plot design with two tillage levels(high level: 3 plowing + 3 harrowing; low level: just furrowing and putting the seeds in furrow sole) in the main plots and three seeding rates (15, 25 and 40 kg seed per ha) in the sub-plots. The treatments were replicated thrice. Seeds were sown continuously in furrows 30 cm apart on May 10, 1981. No fertilizers were applied. Data on plant population and weed infestation (dry weed weight/sq m) were collected on June 4,

1981. No reliable yield samples could be obtained since the crop was damaged, at the late pod-forming stage, by waterlogging caused by a typhoon on June 25, 1981.

Results and Discussion: The results of the study are presented in Tables 3 and 4 and Figure 1. As it can be seen in Table 1 and Figure 1, both high level tillage and higher seedrate consistently increased plant population per unit area. High tillage increased plant population by 55, 42, and 14 percent at 15 kg, 25 kg and 40 kg seed rates per ha, respectively, as compared to the low tillage treatment. These observations clearly indicate that high tillage is of advantage in attaining better crop stand, particularly with lower seed rates. The average plant densities per square meter in high and low tillage levels were 47 and 36, respectively. The seed rate had a statistically significant effect on mungbean plant population per unit area (Table 3). The 40 kg seed rate gave significantly (5% level of confidence) higher plant population per square meter as compared to that of 15 kg and 25 kg seed rates, the latter two seed rates giving statistically similar plant populations. At low level tillage, 25 kg and 40 kg seedrates gave 84 and 269 percent higher plant populations, respectively, as

compared to the 15 kg seed rate. At high tillage level, the same comparisons gave 68 and 172 percent higher plant populations.

Table 4 and Figure 1 present the data on the effect of tillage level and seedrate on weed infestation in the experimental mungbean crop. As it can be seen in Table 4, the effect of seedrate on the dry weed weight per square meter was not statistically significant. However, tillage level had a significant (5% level of confidence) eff ct on dry weed weight. On an average, the dry weed weight in low tillage level was 110 g/sq m as compared to 59 g/sq m in the high tillage treatment. Thus high tillage reduced weed infestation in the mung crop by 46 percent. There was no significant interaction between tillage level and seed rate in terms of plant population and dry weed weight per unit area in the mungbean crop.

Since reliable yield samples could not be collected due to typhoon damage on the crop at late growth stage, the effect of tillage level and seedrate on the grain yield could not be determined in this trial.

Conclusions: High tillage is more advantageous over low tillage in attaining better crop stand (higher plant population/ha), particularly with lower seedrates. High tillage also significantly reduces weed competition in mungbean thereby favoring grain yields. Higher seed rates (40 kg or 25 kg/ha) are useful for attaining adequate plant population per ha,

particularly when low level tillage operation is used. The experiment need to be repeated in order to determine the main effect and interaction of tillage level and seed-rate on the yield of pre-rice mung crop.

3. Title: Effect of NPK fertilizers on nodulation and grain yield of mungbean.

Specific objective: To detemrine whether the farmers' pre-rice mung crop at Solana site response to NPK fertilizers in terms of increased nodulation and grain yields.

Materials and methods: A fertilizer trial was conducted at Solana during the 1981 pre-rice mung crop season with five treatments: (a) control, (b) 60 kg P_2O_5/ha, (c) 40 kg K_2O/ha, (d) 60 kg P_2O_5/ha + 40 kg K_2O/ha, and (3) 20 kg N/ha + 60 kg P_2O_5/ha + 40 K_2O/ha. Fertilizers were applied in the furrows at seeding time. Farmers' variety of mung was used. The experiment was planted in four farmers' fields -- one in Stratum I and 4 in Stratum II. The trials were set in the 4 fields on May, April 28, April 28, and May 14, 1981 and the corresponding harvesting dates were July 13, July 1, July 1 and July 6, 1981. Data were collected on number of nodules per plant at 21 days after seeding and at flowering and grain yields.

Results and discussion . The results of the trials are presented in Tables 5 and 6 and Figure 2. As it can be seen in Table 5, there was no significant difference among the fertilizer treatments in terms of mungbean yield. The grain yield ranged from 331 kg to 1499 kg depending on treatments and fields. On an overall average, a yield of 900 kg/ha was obtained.

The average yields in the 4 experimental fields ranged from 456 kg to 1349 kg per ha. Higher yields were obtained in Stratum II as compared to the single field in Stratum I. No definite trend was observed in grain yield due to fertilizer treatments. The absence of a response by farmers' mung crop to applied fertilizer, in terms of grain yield, is rather difficult to explain. The inherent soil fertility and available soil moisture might be two important factors determining the response of the mung crop to added fertilizer elements. Studies are needed to investigate into the possible effects of these two factors as well as other logical determinants such as date of seeding and fertilizer placement method to obtain a better insight on the subject.

There was also no significant effect of the fertilizer treatments on the nodule number per plant (Table 6). However, although erratic, there were quantitative differences among different treatments and fields in terms of nodulation. Therefore, regression analysis was done to determine the possible relationship between the grain yields and number of nodules per plant. It was found that (Figure 2) there exists a significant relationship between the number of nodules per plant at flowering and mungbean yields. The number of nodules per plant was quite satisfactory. This indicates that inoculum present in the Solana soil

might be already adequate for the mungbean crop and fertilizer application may not significantly influence nodulation.

Conclusions : Application of NPK fertilizer elements does not have significant influence on the yield of pre-rice mungbean crop grown under rainfed conditions at Solana. One more season's trials may be conducted to reconfirm this particular finding. Number of nodules per plant at flowering significantly influences the grain yields.

4. Title: Observational study on a transplanted rice (TPR)-mungbean pattern.

Specific objective: To determine the performance of rice variety Chandina from Bangladesh in a TPR-mung pattern at Solana site.

Materials and methods: An observational planting of a TPR-mung cropping pattern was done in two farmers' fields in Stratum II at Solana. Variety Chandina from Bangladesh was tried as the TPR crop. Chandina (BR1) is a selection from advanced generation materials of the cross IR532, it is a sister line of IR20 and was released in Bangladesh in 1970 for the Aus (March-April to June-July) and Boro (December-January to April-May) seasons. It was also found suitable as a late transplant aman crop (July-August

November-December) in Bangladesh. Its height is about 81 to 91 cm and matures in 115 to 120 days in the aus season and in 145 to 150 days in the winter (boro) season. Chandina is resistant to bacterial blight and tungro but susceptible to bacterial leaf streak, sheath rot and bakanae (BRRI, 1978). It does not grow well in light-textured soil as a broadcast rainfed crop. Chandina yields 4.6 to 5.5 t/ha under good management. The grain is medium fine and is slightly smaller than that of IR20. Mature grain is straw color. The rice has 68 percent milling out turn. The cooked rice has very good eating quality. The two fields at Solana were planted on July 16 and 17, 1981, and harvested on September 25 and 24, 1981. Only 30 kg N/ha was applied, top-dressing could not be done due to flooding at panicle initiation stage. Data on some other aspects of crop management are given in Table 7.

Results and Discussion: As it can be seen from Table 7, Chandina matured within 71 days after transplanting at Solana. The average grain yield obtained at Bauan field was 5,228 kg/ha while that at Iraga field was 3939 kg/ha. The Solana site staff reported that the farmer cooperators like the variety very much and are planning to use it next year in their fields. They won't even share the harvested grains with the site staff!

Actually, initial plans were made to try Chandina in a TPR-TPR-mung pattern. Preparations for the second rice crop seedbeds were also made. But, unfortunately, the seedlings

were damaged by flooding and, therefore, a second rice crop could not be grown after harvesting Chandina. In future, care must be taken in putting seedbeds in a place where seedlings are not damaged by floods. If necessary, seedbeds should be prepared in upper situations using partial irrigation. However, present trials indicate that Chandina can be used as a TPR crop at the site with a quite satisfactory yield. Even higher yields, as compared to that obtained in the present study, is expected with better fertilizer management.

Conclusions: Chandina from Bangladesh was found to be a suitable rice variety for the first TPR rice crop at Solana and it has received high initial farmer acceptance.

5. Title: Extrapolation of two rainfed cropping patterns from Bangladesh to Solana cropping systems research site, Tuguegarao, Philippines.

Specific objective: To determine if two DSR-TPR and DSR-TPR-legume cropping patterns grown in the rainfed areas of Bangladesh could be successfully grown at Solana.

Materials and methods: Two rainfed cropping patterns-DSR(Hashikalmi)-TPR(Pajam) and DSR(Hashikalmi)-TPR (Nizersail)-legume (chickpea/mung) which are commonly used by many farmers in the rainfed areas of Bangaldesh were tested in an observational trial in the lowest part of Stratum II at Solana. The planting for both the patterns started on May 27, 1981 with the on-set of rains. The planting and harvesting dates of the individual crops in the patterns along with the corresponding yields are presented in Table 8.

Results and Discussion: As it can be seen in Table 8, the direct seeded first rice crop of variety Hashikalmi matured within 107 days after seeding and produced a grain yield of 2.4 t/ha. The second rice crop, in the DSR-TPR pattern, of variety Pajam (known as Mashuri in some other countries) gave a grain yield of 2.4 t/ha. Thus the total production from this DSR-TPR pattern was 4.8 t/ha. In the DSR-TPR-Chickpea/mung pattern, variety Nizersail was used as the TPR crop. This variety is photosensitive, has taller plant type and can yield up to 4.5 t/ha under good management. However, at the Solana field the stand establishment was badly affected by flood and as a result a grain yield of only 1.3 t/ha was obtained. The chickpea crop that followed the TPR Nizersail crop also had poor stand establishment, although the individual plants look quite healthy. The mungbean crop gave a grain yield of 110 kg/ha only.

The DSR Hashikalmi-TPR Pajam combination appears to be promising for the lowest part of Stratum II and also probably for the higher portion of Stratum III at Solana. In these areas pre-rice mungbean cannot be grown successfully because of frequent flooding during the later part of growth stage of mung. Also, dwarf high yielding rice varieties do not fit the hydrology in this part of the land topography. Therefore, it seems that although the total rice production from the Hashikalmi-pajam combination was only about 4.8 t/ha, this combination may constitute a practical land use pattern for the low-lying areas at Solana. Yields of these varieties can also be

considerably improved through better cultural practices. Because of its earliness, the variety Hashikalmi suffered from bird damage. If many farmers grow this variety in blocks then the bird damage at the ripening stage will be minimized. Post rice mung crop needs more research attention in terms of seeding date, tillage practice, stand establishment and efficient utilization of residual soil moisture. Although chickpea appears to be a potential post-rice crop at Solana, more elaborate studies are needed to introduce and establish this new crop at the Solana site.

Conclusions: A DSR-TPR pattern of Hashikalmi and Pajam varieties with intermediate plant height appears to be promising for the lowest part of Stratum II and highest part of Stratum III at the Solana Site. Comprehensive studies are needed on the post-rice mung and chickpea crop at this site in order to develop appropriate production technologies for these legume crops at Solana.

SUMMARY

The IRRI cropping systems program started a new on-farm research site at Solana, Tuguegarao, Cagayan Province of the Philippines in 1980 in cooperation with CIADP and PCARR. The site has 5 wet and 4 dry months with a total annual rainfall of about 1755 mm. The site is broadly classified into two landtypes: 'bangkak' -- the cultivable portion of recent floodplains bordering the Cagayan river, and 'talon' -- the higher area above the 'bangkag'. The 'talon' area is further

divided into three land strata depending on relative elevation and hydrology. The soils in the 'bangkag' and first stratum are silty clay loam while those in Strata II and III have silty clay texture.

In the 'bangkag' area farmers grow upland crops, such as corn and peanut, during the non-flooded dry season (December-July). In strata I and II farmers mainly grow a mung-transplanted rice pattern while in Stratum III a single rice crop is grown or in some years, with unfavorable hydrology, is kept fallow. The average farm size at the site is 3 ha. Farmers' crop yields are very poor, 100-200 kg/ha for mung and 400-700 kg/ha for rice. The average annual income/farm family at Solana is only about ₱2511.

This report presents the results on 5 simple on-farm trials conducted on 11 fields at Solana in 1981.

In a trial on 3 farmers' fields, 15 kg and 30 kg mungbean seed rates/ha were compared in two seeding methods (continuous seeding in furrow soles 30 cm apart and dibbling seeds in rows with 30 cm x 15 cm spacing). The grain yield ranged from 232 kg/ha to 1147 kg/ha which came from the 30 kg seedrate/ha with dibbling seeding method. The 30 kg seedrate/ha gave significantly higher grain yields and higher plant population per unit area, counted at 21 days after seeding, as compared to the 15 kg seedrate/ha. There was no significant difference between the two seeding methods in terms of plant population and grain yields of mungbean. A 30 kg seedrate/ha can be recommended for the farmers' pre-rice mung crop at Solana in order to increase yields and total production of mungbean in the area.

Another experiment on mung crop in a split-plot design with two tillage level (high level: 3 plowing+ 3 harrowing; low level: just furrowing and putting the

seeds in furrow sole) and three seeding rates (15, 25 and 40 kg seeds/ha) indicated that high tillage considerably increased mungbean populations in the field particularly with lower seed rates and significantly reduced weed competition. Although the seedrates did not have a statistically significant effect on weed competition but brought about significant increases in plant populations per unit area.

In a fertilizer trial conducted in 4 farmers' fields with 5 treatments (control, 60 kg P_2O_5/ha, 40 kg K_2O/ha, 60 kg P_2O_5 + 40 kg K_2O per ha, and 20 kg N + 60 kg P_2O_5 + 40 kg K_2O per ha) it was found that the farmers' pre-rice mung crop, grown under rainfed conditions, do not significantly respond to applied fertilizers in terms of grain yields. However, a significant relationship was observed between mung yields and number of nodules per plant at flowering.

Chandina (BR1), a Bangladesh rice variety and a selection from advanced generation of IR532 and a sister line of IR20, produced grain yields of 5228 kg and 3939 kg per ha in two farmers' fields at Solana during 1981 first rice season and received a high initial farmer acceptance.

A Bangladesh rainfed double rice crop pattern of DSR (Hashikalmi)-TPR(Pajam) extrapolated at Solana in 1981 produced a total grain yield of 4.8 t/ha (2.4 t/ha from DSR + 2.4 t/ha from TPR) and looked promising for the lowest portion of stratum II at Solana site. First season's plant growth of introduced chickpea from Bangladesh at Solana indicates potential for this crop in the area.

REFERENCES

Bangladesh Rice Research Institute (BRRI). 1978. About BRRI. BRRI, Joydebpur, Dacca, Bangladesh, November 1978.

Gines, H.C. and R.A. Morris. 1981. The Solana Cropping Systems research program: Agronomic adaptation. A paper presented at the IRRI Saturday Seminar on February 7, 1981.

Godilano, E.C. and D. Marra. 1982. Performance of various upland crop cultivars evaluated before rainfed wetland rice system at Solana, Tuguegarao, Cagayan Outreach, 1981 wet season. Paper presented to 2nd Annual Review of the IRRI-CIADP-PCARR Cropping Systems Outreach Site at Solana, Tuguegarao, Cagayan, March 29 - April 2, 1982.

Gonzaga, R. and E.C. Price. 1980. Site descriptions for design of cropping patterns in Solana, Cagayan. Cropping Systems Seminar, IRRI, Los Baños, February 1980.

Gonzaga, R. 1982. Tuesday multiple cropping seminar on cropping systems economics research at Solana site, March 23, 1982. IRRI, Los Baños, Laguna.

Table 1. Effect of seed rate and seeding method on the yield of farmers' mungbean crop at Solana Cropping Systems research site of IRRI, 1981.

Seed rate (kg/ha)	Seeding method	Mungbean yield (kg/ha) Farmer 1 (Stratum I)	Farmer 2 (Stratum II)	Farmer 3 (Stratum II)	Average*
15	Dibbling in rows	324	642	254	406.67 b
15	Continuous seeding in furrow sole	232	641	256	376.33 b
30	Dibbling in rows	542	1147	389	692.67a
30	Continuous seeding in furrow sole	568	1137	550	751.67a
	Average	416.50	891.75	362.25	

*Numbers followed by a common letter do not differ significantly at 5% level of significance.

Table 2. Effect of seed rate and seeding method on mungbean stand in farmers' fields at Solana Cropping Systems research site of IRRI, 1981.

Seed rate (kg/ha)	Seeding method	No. of plants/linear meter of row Farmer 1 (Stratum I)	Farmer 2 (Stratum II)	Farmer 3 (Stratum II)	Average*
		At 21 DAE			
15	Dibbling in rows	14	8	13	11.67 b
15	Continuous seeding in furrow sole	13	8	15	12.00 b
30	Dibbling in rows	20	17	16	17.67a
30	Continuous seeding in furrow sole	21	15	15	17.00a
		At maturity			
15	Dibbling in rows	13	6	13	10.67
15	Continuous seeding in furrow sole	12	5	15	10.67
30	Dibbling in rows	19	12	16	15.67
30	Continuous seeding in furrow sole	21	10	13	14.67

* Numbers followed by a common letter do not differ significantly from one another at 5% level of significance.

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Table 3. Effect of tillage level and seed rate on stand establishment in mungbean, IRRI Cropping Systems Research site at Solana, 1981.

Tillage level	No. of plants/sq m			
	15 kg seed rate/ha	25 kg seed rate/ha	40 kg seed rate/ha	Average
Low tillage (just furrowing for seeding)	17	31	63	37
High tillage (3 plowings + 3 harrowings)	26	44	72	47
Average	22 b*	38 b	67a	

*Number having uncommon letters within the row differ significantly from one another at 5% level of significance.

Table 4. Effect of tillage level and seed rate on weed infestation in mungbean crop, IRRI Cropping Systems Research site at Solana, 1981.

Tillage level	Dry weed weight (g/sq m)			
	15 kg seed rate/ha	25 kg seed rate/ha	40 kg seed rate/ha	Average*
Low tillage (just furrowing for seeding)	104	129	97	110 a
High tillage (3 plowing + 3 harrowing)	75	55	46	59 b
Average	89	92	71	

*Numbers having different letters are significantly different at 5% level of significance.

Table 5. Effect of NPK fertilizer rate on the yield of farmers mung crop at Solana cropping systems research site of IRRI, 1981.

Rate (kg/ha) of N - P_2O_5 - K_2O			Seed yield of mungbean (kg/ha)				
			Farmer 1 (Stratum I)	Farmer 2 (Stratum II)	Farmer 3 (Stratum II)	Farmer 4 (Stratum II)	Average*
0	0	0	556	1158	1104	676	874
0	60	0	363	924	1272	711	818
0	0	40	544	1293	1490	653	995
0	60	40	331	1123	1499	813	942
20	60	40	488	811	1379	815	873
Average			456	1062	1349	734	900

*The treatment means were not significantly different from one another.

Table 6. Effect of NPK fertilizer rate on the nodulation in mungbean in farmers' fields at Solana cropping systems research site of IRRI, 1981.

Rate (kg/ha) of N - P_2O_5 - K_2O			No. of nodules/plant				
			Farmer 1	Farmer 2	Farmer 3	Farmer 4	Average*
				21 Days After Emergence			
0	0	0	8	15	12	38	18
0	60	0	12	15	10	14	13
0	0	40	5	22	20	19	17
0	60	40	6	19	11	18	14
20	60	40	11	15	13	34	18
				At Flowering			
0	0	0	33	81	144	51	77
0	60	0	54	48	165	24	73
0	0	40	59	94	142	68	91
0	60	40	82	68	121	54	81
20	60	40	32	43	142	45	66

* Treatment means were not significantly different from one another.

Table 7. Management and performance of transplanted rice (Variety: Chandina) in a TPR-mung* pattern at two locations, IRRI Cropping Systems Research Site at Solana, Tuguegarao, 1981.

Observation	Location	
	Bauan	Iraga
1. Date of transplanting	7-16-81	7-17-81
2. Seedling age (days)	27	28
3. Kg N/ha	30	30
4. No. of handweeding	1	None
5. Insecticide application		
a. Azodrin .25 kg ai/ha	2 WAT**	2 WAT
b. Folidol .75 kg ai/ha	Post flowering stage	Post flowering stage
6. Harvesting date	9-25-81	9-24-81
7. Grain yield (kg/ha)	5228	3939

* Data on mung crop not yet available.
** Weeks after transplanting.

Table 8. Results on two observational cropping patterns tested at the IRRI cropping systems research site at Solana ,Tuguegarao, 1981.

Cropping pattern	Observation		
	Date of seeding/ transplanting	Date of harvesting	Yield (kg/ha)
1. a) Direct seeded rice (Hashikalmi)	27 May 1981	10 Sept 1981	2444
b) Transplanted rice (Pajam)	26 Sept. 1981	11 Jan. 1982	2353
2. a. Direct seeded rice (Hashikalmi)	27 May 1981	10 Sept. 1981	2444
b. Transplanted rice (Nizersail)	26 Sept 1981	29 Dec 1981	1284
c. Mung	30 Dec. 1981	15 March 1982	110

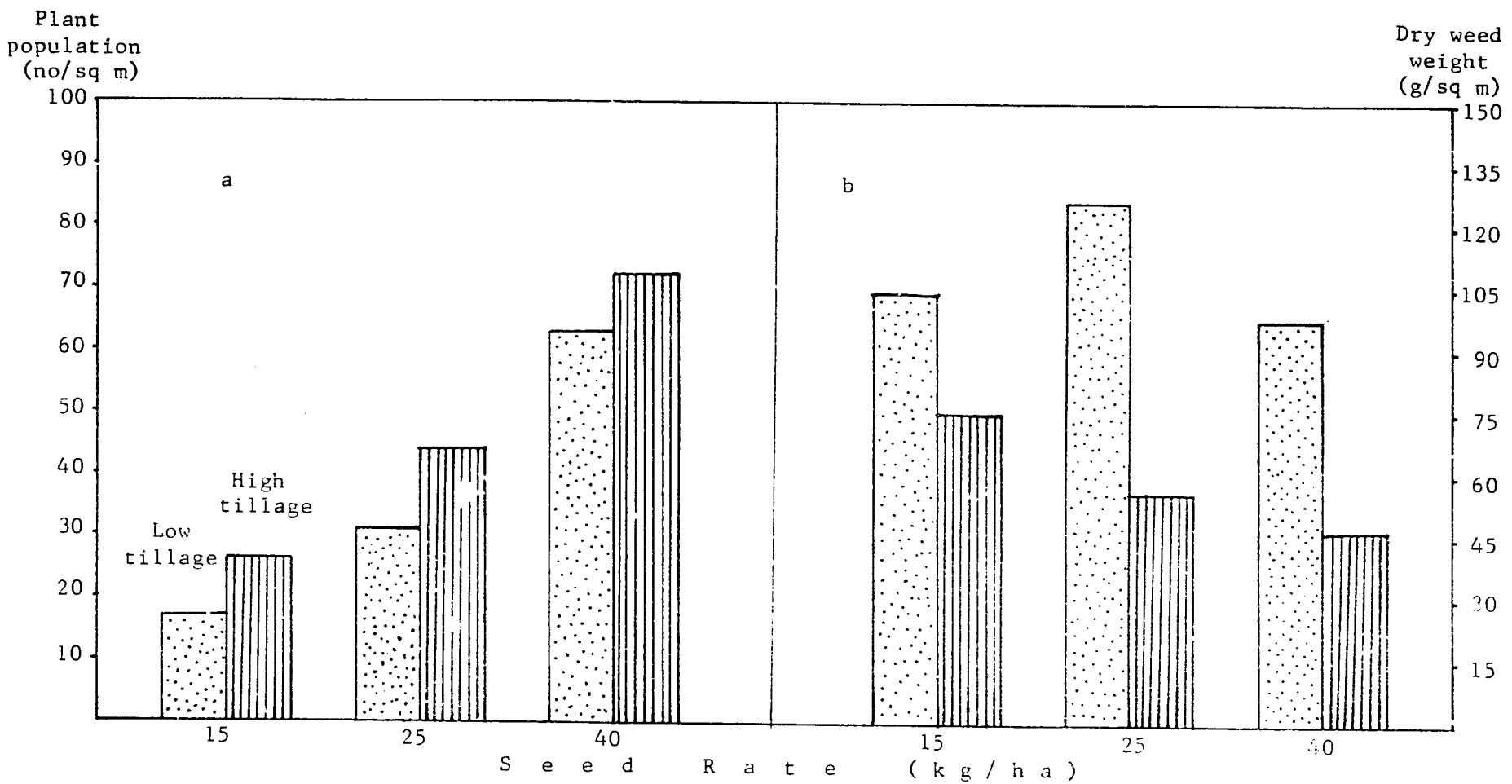

Fig. 1. Effect of tillage level and seed rate on (a) plant population and (b) weed growth in mungbean, Solana, Tuguegarao, 1981.

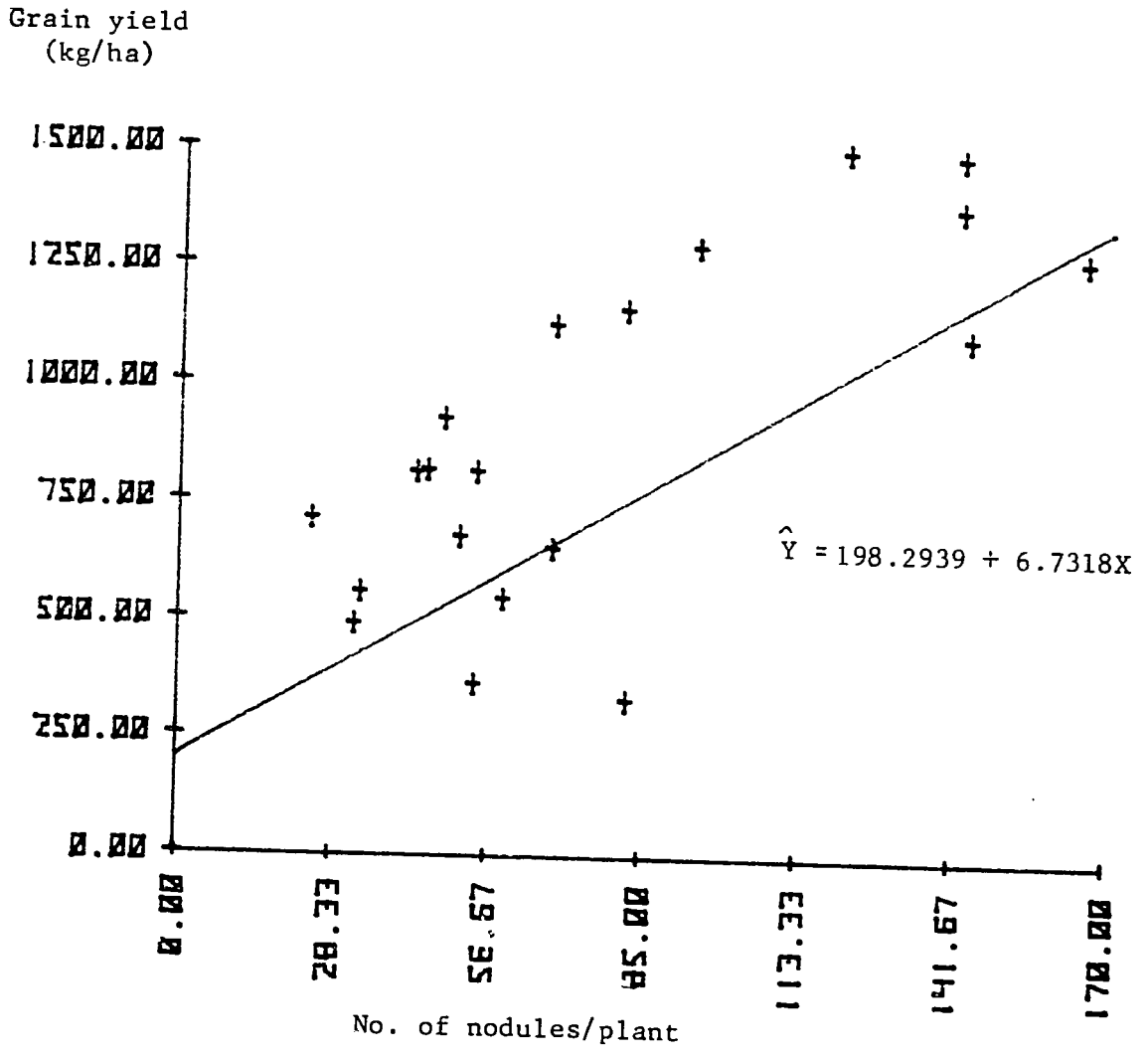

Fig. 2. Relationship between grain yield of mungbean and number of nodules/plant at flowering, Solana, Tuguegarao, 1981.