AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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Batch 97

1. SUBJECT CLASSIFICATION

A. PRIMARY
Serials Y-AA50-0000-G148

B. SECONDARY
Food production and nuerition--Research--Tanzania

2. TITLE AND SUBTITLE

Agricultural research project:Tanzania: annual report,1977

3. AUTHOR(S)

(101) Int.Inst.of Tropical Agriculture,Ibadan

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1978	54p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

IITA

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

(Research summary)

9. ABSTRACT

10. CONTROL NUMBER

PN-AAG-288

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Tanzania

13. PROJECT NUMBER

621010700

14. CONTRACT NUMBER

AID-621-001-T

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

1977

ANNUAL PROGRESS REPORT

AGRICULTURAL RESEARCH PROJECT 107

IITA/USAID - TANZANIA CONTRACT

Contract No. AID-621-001-T

(CIMMYT and ICRISAT Participating)

IITA/USAID - TANZANIA

AGRICULTURAL RESEARCH PROJECT 107

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I. Introduction

The USAID Agricultural Research Project has as its objective to assist the Tanzanian Ministry of Agriculture in the development of a Food Crops Research Program which will effectively lead and stimulate the production sector of these crops in Tanzania. The United States Agency for International Development (USAID) provides funding for technical assistance, participant training and selected commodities which can only be purchased outside Tanzania. The provision of these inputs is made, for the most part, through a contract with the International Institute of Tropical Agriculture (IITA). A subcontract between IITA and the International Center for Improvement of Maize and Wheat (CIMMYT) was effected for the purpose of obtaining from CIMMYT staffing and technical backstopping for the Maize Section of the Project.

The original Contract between USAID and IITA (No.REDSO/WA-C-74-7) was in effect during the three-year period November 1, 1973 through October 31, 1976. A second Contract (No.621-001-T) covering the period November 1, 1976 through October 31, 1979 is now in effect. The areas of activity prescribed by the Contract include administrative organization of food crop research and research in maize and grain legumes. In December 1977 USAID Washington approved the Tanzanian Ministry request to include research with sorghum and millet crops. This approval presupposes a subcontractual arrangement between IITA and the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) for the staff and backstopping of Sorghum/Millet Research.

This Report covers the activities during the period January 1 through December 31, 1977.

II. Summary

The Agricultural Research Project began functioning in November, 1973 with the arrival of two expatriate scientists specialized in Maize Breeding and Agronomy. In 1974 a Legume Agronomist was added, and in 1975 a Legume Breeder-Pathologist and Project Coordinator (all expatriates) joined the Project. The Ministry meanwhile assigned a number of its promising young field officers to work with the expatriates, and adds annually new staff as they become available from the University and the Training Centers. (See appendix).

Maize was initiated as the number one priority, and research on this crop has been intense since 1974. One new variety (Tuxpeno) has been released for low-medium altitudes. A new high yielding hybrid for long season high altitudes was released this year, and other promising varieties are advancing through the testing system. Considerable data on agronomic inputs and improved management practices for many of the different ecological areas have been accumulated. A preliminary extension type hand-book on Maize Production has been published and this will be updated as more information is gathered. There still remain problems, however; one of the most serious is control of the destructive maize streak disease. Some progress is being made but no immediate relief is anticipated.

Legume research which started a year later is coming along well. This section works with a number of different species, and therefore, faces a variety of problems. An improved variety of cowpeas was nearly ready for release when it was suddenly struck by a serious new disease. The problem is rapidly being overcome.

A new high yielding variety of green gram was released this year, and the introduced variety of soybean (Bossier) has been found to be superior over a wide range of ecological conditions. Phaseolus (common beans) research is being intensified as this is probably the most favored grain legume in Tanzania. Germ plasm of beans, both from within and from abroad, is being rapidly accumulated. The International Center for Tropical Agriculture (CIAT) located in Colombia has been a major contributor of bean cultivars. As soon as Tanzanian Staff can be trained to man Stations where Phaseolus are better adapted than Ilonga this part of the effort will move ahead faster. In the area of legume crops agronomic research, enough data has now been gathered on management and inputs so that extension type bulletins can be produced. It is anticipated this will be done during the current year. There are however, innumerable problems of disease, insect and management for specific areas which must be attended in the future.

III. Project Coordination Activities

Project coordination activities involves backstopping research administration and planning at the Ministry level, backstopping and coordination of the contract field effort and liaison for the Contractor with the Ministry, USAID, Subcontractors and other interested parties.

A. Ministry Backstopping - A major effort in backstopping research administration during this period was a study made by a Senior Research Administration Consultant.

The Director of the Crops Development Division, having assessed the overall output of the Research Section as poor, sought recommendations as to how to get more from the limited Ministry resources. He requested IITA to provide an outside consultant to study the problem.

In response to the Ministry request, the services of Dr. H. Albrecht, a long time Research Administrator and former Director of IITA, were obtained. Dr. Albrecht spent five weeks reviewing the resources and activities of the Crops Research Section. Following are some of the points he emphasized in his report:

1. Research staff spread too thinly, directors and individual researchers together should eliminate the more pedestrian and inactive projects in favor of those of substance.

2. A need to relieve research staff of responsibilities for the production phase of institute or station programs.

3. The Ministry should stipulate more clearly its research policy tying it in with national policies, and make sure research workers are aware of the purposes and philosophies underpinning the Ministries mandates.

4. Budget disbursements must be made such that they provide full protection of the institutes research enterprise. Allocations should be line-itemed by project and/or function to insure that the research responsibilities are fully discharged within the limitation of funds.

Research should be freed from competition with production for funds, manpower, equipment and space resources presently imposed by the dual purpose assignment given to the institutes and stations.

5. Appropriately, emphasis has been made in plant breeding and agronomy, but soon adequate attention must be given to strengthening the areas of science needed to round out the crop research and crop production programs. Considered of special importance are expertise in plant pathology, entomology, plant physiology and soil fertility. Other areas which should be represented at each institute are weed control, production economics, agricultural engineering, farm management and land use.

6. Training of research officers at the graduate level should move ahead regardless of the fact it possibly will aggravate the manpower shortage in the short run. The Trauma will be over sooner if the effort is made in the next few years when expatriate participation in certain key crops projects is still in force.

7. Junior staff, especially mechanics, field laboratory and maintenance workers must be upgraded through training.

8. Every center in the research system has inoperative equipment due to lack of spare parts and service. Increasing inventories of spare parts and systematic reordering requires a larger initial outlay of funds, but increases the efficiency and yield of equipment and manpower several fold.

B. Field Program Backstopping - Monitoring field activities, the provision of funds and the acquisition of commodities (both local and from the [illegible] Section) in support of the field programs demands a major portion of time within the coordinating activity.

1. (Field Monitoring) For the purpose of keeping abreast of the field work, visits are routinely made by the Coordinator to the Ilonga ARI twice monthly. Visits to other Institutes and Experiment Stations which participate in the Food Crops Research are also made as time permits. Where possible these trips are made in company with the Chief Research Officer.

2. (Project Budgeting) Operational funds for the Project, apart from travel costs of Contract personnel, are provided through Ministry votes to the Ilonga Agricultural Research Institute. Budgeting is on a fiscal year basis (July through June). Using the experience of the previous years a detailed budget request for July 77 - June 78 was presented in the amount of T.Sh.730,000/-. This budget was to cover not only the Ilonga activity, but the Village Trial Activity on a national scale. The latter was programed for considerable expansion during the 77-78 season. Unfortunately, the Director of the Crops Division was on a mission outside Tanzania at the time the budget was considered at the national level. The result was an allocation less than one third the request. If this had stood, much of the programed activity would have had to be cancelled; realizing this the Director supplemented the budget from development funds intended for other project to bring the total to T.Sh.650,000/-. This amount, although short of actual needs, should prevent any significant cut in the program for the 77-78 crop season.

3. (Commodities) The bulk of the commodities purchased through the USAID loan to Tanzania (No 621-H-017-11) and ordered in 1975 and 1976 were received and put to their intended use in 1977 (listed in 1976 report). Only a few items, including one [illegible] tor, 2 disk plows and 2 disk harrows, had not yet been assembled and despatched to the field at this writing. Because of the substantial procurement of commodities during 1975 and 1976, only a very modest sum of $15,000 was available through the Contract for commodity purchases in 1977.

The Ford Foundation replenished its fund for local purchase of supplies and equipment with an addition of $30,000. The closing of the border between Kenya and Tanzania complicated utilization of these funds in that needed items which are more generally available in Kenya are now difficult to bring into Tanzania. However, through special permits, or use of airfreight, a number of acquisitions were made in Kenya. Others were purchased locally.

C. Participant Training - Training Tanzanians to a level at which they can successfully man an on-going program is the priority objective of the Agricultural Research Project. This is done on a day to day basis working with Contract Staff through in-servicing programs at the International Institutes, and through formal degree programs mainly at U.S. Universities.

During Calendar 1977 the following training programs were made available to Tanzanian Staff:

Continuing Degree Studies -	(5 U.S. Univ.	- USAID	sponsored
	(1 U.S. Univ.	- Ford F.	"
New Degree Programs -	(6 U.S. Univ.	- USAID	"
	(1 U.S. Univ.	- Ford F.	"
In-Service Training or Workshops -	(5 IITA	- USAID	"
	(4 CIMMYT	- "	"
	(3 ICRISAT	- "	"
	(6 IITA	- IITA	"
	(2 IITA	- Ford F.	"
	(1 CIMMYT	- CIMMYT	"

Although some degree training was done earlier by USAID outside the Contract, the real thrust began in FY 1976 when 5 B.Sc. and 1 M.Sc. programs were initiated (one Ph.D. program was already underway). In FY 1977 new degree program initiated were 2 B.Sc. and 5 M.Sc. The FY 1978 projection for new degree starts in 4 B.Sc., 5 M.Sc. and 1 Ph.D. An equivalent intensity of degree training is anticipated through 1982.

IV. Maize Research Activities

Maize research enjoyed an eventful and successful year during 1977. Dr. J A. Deutsch arrived in late February as maize agronomist. His arrival was invaluable as the project had been without an agronomist since November 1975. Other staff additions at Ilonga were Alfred Moshi and David Mwanjali, research officers, and William Mgeni, an assistant agricultural officer. All arrived about July 1

Peter Matowo, research officer, was assigned maize research responsibilities at Maruku The assignment of the two research officers at Ilonga considerably strengthen headquarters capabilities, while the new officer at Maruku enabled maize research trials to be effectively carried out in West Lake Region.

Field operation went smoothly as equipment was sufficient for the volume of work and no major repair problems were encountered. For the first time dry season nurseries were planted in a timely manner and were properly irrigated as a result of the installation of a new irrigation pump and the addition of sufficient irrigation pipe.

In February, a temperature and humidity controlled seed store became operational.

Unreliable air transport to areas such as Mwanza and Mtwara resulted in all travel being done by road. In certain cases this required considerably more time for supervision trials activities.

A. Preliminary Composite Development - A cooperative effort with the International Wheat and Maize Center (CIMMYT) is aimed at developing genetically broad based composites that are Streak tolerant. Approximately 15,000 progenies from three composites (late white dent, late white flint and intermediate flint-dent) were screened for streak disease tolerance. Selections were made and further screening will be carried out in 1978. One series of selections will be screened simultaneously in Tanzania, Zaire and Nigeria. The development of streak tolerant composites has just been started and preliminary observations suggest that

During the 1977 season, maize research initiated the development of a long season high altitude composite suitable for areas above 1500 m. with 5-6 months of reliable rainfall. Evaluation of materials for inclusion in the composite was carried out at Njombe where climatic and disease (H. Turcicum) conditions are ideal. Approximately 1,000 ear rows of material were evaluated for disease reaction. Only a quarter of the material was of interest and selections were made within that fraction. The material will be re-evaluated in 1978.

The 1977 dry season nursery was utilized to produce crosses between 22 high elevation hybrids, Tuxpeno (NJ), and IPTT 34, as well as to produce crosses among the hybrids. These crosses will be evaluated at Njombe along with the above mentioned material. An initial experimental variety should be produced by 1980 and be ready for extensive testing in 1981.

B. Progeny Trials -- Progeny Trials are conducted to evaluate single ear selections for inclusion in experimental varieties and/or improved composites. During 1977 progenies were produced at Ilonga and tested in selected environments for the following 8 varieties: Katumani, Katumbili, UCA Lote 23, Lote 24, Tuxpeno, Tuxpeno (NJ) and Quality Protein. Based on yield trial results, selected progenies were crossed to produce experimental varieties and new progenies for evaluation in 1978.

In addition to progenies developed at Ilonga, four progeny trials (IPTT) were received from CIMMYT and were grown in 1977. Of the four IPTTs two were of interest. IPTT 21 (a Tuxpeno) was grown at Ilonga and yields of over 8 tons/ha were recorded for the best entries.

Seed of the best 10 families was obtained from CIMMYT for production of an experimental variety that will be tested in 1978. IPTT 34, classified as an intermediate elevation white flint population, was grown at Njombe. The trial was a striking contrast to adjacent highland materials of 2.5 to 3 m since the average height was 1.75 m. Ten progenies were notable for their resistance to H. Turcicum. At harvest yields of 7 and 8 tons/ha were recorded for a number of the better entries. Based on yield and disease resistance, selected progenies were crossed to produce a new set of progenies and an experimental variety for testing in 1978.

C. Variety Trials - Three variety trials, the Tanzania Maize Variety Trial - high and low series (TMVT) and the Tanzania Quality Protein Maize Variety Trial (TQPMVT), were grown at a selected number of locations in 1977. The findings are summarized below:

TMVT - high series evaluated a group of varieties suited for production in areas above 1,500 meters with rainfall durations of from three to five months. Obviously, some varieties such as UCA, H632, H622 are better suited to shorter rainfall periods while varieties such as H613, H614, and H6303 are better suited to longer rainfall periods. Consequently, comparisons between varieties are most meaningful when made within these groupings. Within the UCA, H632, and H622 varieties no differences in yield were observed. Two varieties from the UCA composite were tested, UCA original and UCA select 74. The UCA select 74 was developed to improve resistance to stalk lodging. At those locations in which lodging was substantial UCA select 74 had significantly less stalk lodging than the parent composite.

Among the longer duration varieties, H613, H614 and H6302, yield differences were noted. H6302, a new hybrid released for production in 1978, outyielded the check variety H613 by 12 per cent over all locations. H6302 has demonstrated a 25 per cent yield advantage over H613 in particular areas such as Njombe district and parts of Mbeya region. A limited acreage was grown by the Wattle Company at Njombe this year with a yield of 8.75 tons/ha being realized from one 40 ha. field. H6302 has shown greater resistance to lodging than 613. As a result of performance to date, H6302 is expected to be an excellent replacement of H613.

Tuxpeno has shown reasonable performance as a short duration variety in the dryer high elevation areas such as Ismani and Ukiriguru. Tuxpeno yields are higher and stalk lodging is less than that of Katumani, the traditional short season variety.

TMVT - low series evaluated a group of varieties suitable for production below 1,500 meters. With the exception of Katumani, all varieties tested were full season varieties. No differences in yield were observed for data combined over 5 locations, except for Katumani and Experiment 7423 which were lower yielding. At locations where stalk lodging was marked Tuxpeno showed superiority in lodging resistance as compared to Ilonga Composite.

TQPMVT evaluated a series of quality protein maizes and normal maize checks for a second year. No differences in yield or other characters were observed for the varieties tested. A third year of testing will be conducted in 1978 after which the desirability of releasing a quality protein will be made.

In summary, Maize Breeding Research in 1977, enjoyed an improved staff position, initiated the development of a long, season high elevation composite, continued recurrent improvement of 8 composites, and release an improved high elevation long season variety.

D. Village Trials - Table I shows the distribution of the trials in the districts, - both number distributed and those which were successful. Weather (low rainfall) and inadequate transport (poor maintenance and/or shortage of spare parts) were the main causes of failure of trials.

1. (Variety Trials) In the highland areas, there were no significant differences between varieties. Table 2 shows the mean variety yields for Mbeya Region, a high, wet areas and for Moshi Region, a high, but dryer area.

In the lowland areas, no significant varietal difference were seen. Table 3 shows typical varietal yields for the lowland areas.

2. (Fertilizer Trials) In the wet, highland areas, a significantly higher yield from fertilizer was obtained (Table 4). At both the subsidized and unsubsidized fertilizer prices, application of 120 kg. of N appears to be economical.

In the dryer, higher areas no significant yield increase was obtained from fertilizer application.

In the lowland areas, results were mixed. In Kilosa district, fertilizer application increased yields (Table 5) and application of 40 kg. N per ha would be economical for the farmer. Other areas showed no significant yield increase to fertilizer.

The results from Kilosa district demonstrate the need for several years of testing before making recommendation to farmers. In the two previous seasons, fertilizer use was not economical. Based on the three-year average yield data, with the present maize price and subsidized fertilizer prices, the use of fertilizer is not economical for the farmers.

3. (Managements Trials) Three factors of the management trials are weeding (early and late, late only and herbicide); fertilizer (+ or -), and plant density (recommended 44,000 plants/ha and half stand). Partly due to transportation limitations, most weeding treatments were not timely, negating their use as a treatment. Fertilizer effects were the same as those shown in the fertilizer trial, i.e. only the high, wet area showed an economic yield increase. In most cases, the higher plant density gave a higher yield. In Kilosa district, the increase was 25%, from 18 q/ha to 25 q/ha, a 37 fold return on seed investment alone. However, the increase could actually be greater since very few trials actually achieved and maintained the recommended density to harvest time, even though there were sufficient plants at thinning time.

With more staff for 1978, adequate transportation at each station and a better understanding of the problems of the village trials, the number of trials distributed and the number of data sets returned should be greater.

4. (On-Station Trials) Three on-station agronomy trials were conducted by the IMRP. A plant distribution trial in the lowlands, and density and insecticide trials nationwide.

It has been shown in the wet highland areas, that with 44,000 plants any configuration of plant-stands of up to 4 plants/hill at 1.2 meter between hills will give the same yield. However, no data is available for the lowlands and presumably under the lower moisture regime, plant to plant competition could be important. Based on data from the first of 3 years, it appears that 2 plants/hill with 60 cm. spacing does not decrease yield significantly but higher plant stands/hill seem to cause a yield reduction.

Of the 9 insecticides tested, none appeared to be significantly different in control of corn stalk borer than DDT. However, it should be added that borer infestation in most test fields was very low even in the check plots (less than 0.5 borer/stalk). The trial will be repeated in 1978 and 1979 before recommendations are made.

Sometimes a farmer is forced to plant maize later than the ideal time. Katumani, a short season variety gives half the yield of varieties when planting at the recommended planting rate (44,000 plants/ha.). However, maturity is about 5 weeks earlier than the standard varieties. In highland areas, planting of Katumani (100,000 plants/ha) gave yields approaching the standard variety in the first planting and maintained those yields over a 6 week plant period while the yield of the standard dropped to less than half the Katumani yield at the last planting. In the lowlands, a similar trend occured but optimum density was about 75,000 plants/ha.

Table 1

Distribution of Village Trials in Tanzania

District	Number of Trials	
	Distributed	Data Received
Mbeya	6	4
Songea	4	2
Iringa	5	3*
Moshi	6	3
Tanga	4	0
Mtwara	3	1*
Ifakara	3	2
Kilosa	13	10
Mwanza	3	1
	47	26

* Average yield of all plots was less than 200 kg/ha from drought stress.

Table 2

Grain yield (q/ha) for village variety trials grown in 1977

	Variety Mean	
	Mbeya Region (5 location)	Moshi Region (2 location)
H 6302	51.7	36.0
H 613	50.8	32.1
UCA	48.1	25.9
UCA Select 74	44.1	26.5
Local	43.9	27.5
Tuxpeno	24.5	-
Mean	47.0	29.5

Table 3

Grain yield (q/ha) for the village variety trial grown at 8 locations in Kilosa district in 1977.

Variety	Variety Mean
Tuxpeno	30.2
Tuxpeno Select 74	32.1
Ilonga Composite	32.2
Katumani	21.9
Local	20.3
Mean	28.1

Table 4

Grain yield (q/ha) for the village fertilizer trial grown at 2 locations in Mbeya Region in 1977

	P_2O_5 (kg/ha)		
Nitrogen (kg/ha)	0	30	Nitrogen Mean
0	52.7	53.9	53.3
40	72.7	61.1	66.9
80	66.8	72.9	69.8
120	73.8	84.6	79.2
Mean P_2O_5	66.5	68.1	67.3
Nitrogen LSD (05)	12.4		

Table 5

Grain yield (q/ha) for the village fertilizer trial grown at 4 locations in Kilosa District in 1977

	P_2O_5 (kg/ha)		
Nitrogen (kg/ha)	0	30	Nitrogen Mean
0	28.3	28.0	28.1
20	32.1	35.1	33.6
40	33.3	37.9	35.6
60	40.3	33.7	37.0
Mean P_2O_5	33.5	33.7	33.6
Nitrogen LSD (05)	4.1		

V. Legume Research Activity

The Legume Research Activity must divide its efforts among a number of important grain legumes produced in Tanzania. These include cowpeas, phaseolus beans, soybeans, green grams, and to a lesser extent pigeon peas. The activity is broadly divided into a breeding-pathology section and an agronomic section.

Breeding and Pathology

Nineteen seventy-seven was the second full year of operation for the Legume Breeding and Plant Pathology Section of the National Grain Legume Research Project. During the year research was intensified towards the main objectives of:

(a) identifying high yielding and widely adapted genotypes of cowpea, phaseolus beans, soybeans and green grams using a series of multilocation testing sites; and

(b) stabilizing the yields through breeding against stress factors such as pests, diseases and others. In the pathology work the main emphasis continued to be assessing the prevalence and relative importance of various diseases in legume growing regions of Tanzania, identifying the sources of resistance and utilizing them in the breeding program.

A summary of the findings is presented below:

A. Cowpeas - The trials conducted were

1. Tanzania Cowpea Uniform Cultivar Trial
2. Evaluation of Short Duration Cowpea Cultivars
   (a) Tanzania Early Maturing and Determinate Cowpea Yield Trial
   (b) Comparative Yields of Early Maturing Cowpeas and Green Gram
   (c) IITA Cowpea, Uniform Cultivar Trial No.2.

3. Tanzania Cowpea Preliminary Yield Trial.

1. (Tanzania Cowpea Uniform Cultivar Trial) Twelve cultivars were tested at eight locations with three insecticide sprays applied at 20, 40 and 60 days after planting. At four locations an additional set was kept unsprayed for comparison. Results showed that Tvu 1977-OID, Tvx 418-IF, SVS_3, Tvx 966-OID, Tvx 33-B-6-2-B and Tvu 1502-IC were higher yielding with wider adaptability. Tvu 1502-IC, Tvx 33-B-6-2B and SVS-66 proved better than others under no insecticide sprays.

SVS_3 found best in last year's trials continued to perform well but suffered badly from a top necrosis virus disease at Ilonga.

2. (Evaluation of Short Duration Cowpea Cultivars) Early maturing and determinate short duration varieties of grain legumes are very useful as catch crop effectively utilizing short rains or gap in the cropping sequence, and as an intercrop with cereals, sisal and other crops.

In 1975/76 several cultivars from India and IITA were tested at Ilonga. During this year twelve selected lines were tested at six locations. More new introductions were evaluated at Ilonga. In two additional experiments yielding ability of these cultivars was compared with that of green gram cultivars which have similar growth habit and duration.

The trials conducted at Ilonga showed that the cultivars 750 x C20-11B, P-33-868-IC, 1/2/3, Tvx 12-01E and 5/8/2/2 are very suitable for plantings in the short rainy season as a catch crop since they mature in 65-70

SVS_3, found best in the long rains, was not suitable for planting in December - January, as it is photosensitive and yielded only half as much as the above listed cultivars. 5/8/2/2 yielded very well in both seasons.

Early maturing cultivars Tvx 309-IG, Tvx 7-5H, Tvx 289-P_2-2 and Tvx 1836-90E from IITA performed well at Ilonga during the long rains. Their suitability as a catch crop in the short rains needs further tests.

In trials to determine comparative performance of early maturing cowpeas and green gram, the green gram cultivars yielded as good as the best cowpea lines in the same duration of 65-70 days. Thus they are equally suitable as a catch crop.

When a catch crop (December-February) of early maturing cowpeas or green gram was followed by another crop in the long rains at Ilonga a total seed yield of 3,405 kg/ha was realized entirely under rainfed conditions.

3. (Tanzania Cowpea Preliminary Yield Trial) When forty-two new cowpea introductions were tested against four checks (SVS_3, Tvx 966-OID, Tvu 1977-OD and Tvx 33-B-6-2-B) at eight locations only Tvx 337-3F and Tvx-227 E showed wider adaptability and high yielding ability.

B. Green Gram - Twelve cultivars were tested at ten locations. Location mean yields for the experiment varied between 2,250 kg/ha at Ilonga and 134 kg/ha at Mtwara. Varietal means varied between 914 kg/ha (Tvau 87) and 463 kg/ha (IPA 5910). Among the cultivars none proved consistently better over others at all the locations. Highest yield obtained was 2,660 kg/ha with Tvau 90 at Ilonga

For the last two years Ilonga and Ismani seemed to have a more favorable environment for green gram production, giving as good or better yields than the cowpeas and with less disease and pest problems.

On the basis of the results from last three seasons, Tvau 81 was released as the first green gram variety in Tanzania. The breeders seed has been supplied to the National Seed Production Farm for further multiplication. A Swahili name "NURU" has been given to this variety.

C. Soybean - Three yield evaluation trials conducted were:

1. Tanzania Soybean Uniform Cultivar Trial
2. Tanzania Soybean Preliminary Yield Trial
3. Intsoy/IITA Soybean Uniform Cultivar Trial, 1977.

1. (Tanzania Soybean Uniform Cultivar Trial)

Different sets of cultivars were tested at low (upto 1,000 m) medium (1,000 - 1,500 m) and high (above 1,500 m) altitudes.

Among the three low altitude trials only the one at Ilonga produced significant results. L_4 gave the highest yield (1 762 kg/ha) followed by Blyvoor White, L_2, Bossier and others. A long duration cultivars 1H/192 and Jupiter gave low yields (1,015 and 782 kg/ha).

Among the locations in the medium altitude range very high yields (2 090 kg/ha location mean) were obtained at Sulusi; Williams and L_4 yielded over 3,000 kg/ha. The trials at Ukiriguru and Ismani suffered from drought. Average yields for the three locations were highest for L_4 (1,725 kg/ha) followed

For the high altitude (Njombe) L_4 gave significantly higher yields than the others.

This year's findings clearly indicated that L_4 and Bossier have high yield potential and wide adaptability, and are suitable for cultivation at all the altitudes.

2. (Tanzania Soybean Preliminary Yield Trial) Twenty breeding lines found promising during 1975/76 were tested at three locations in the low altitude range. None was found superior than the checks, L_4 and Bossier.

3. (INTSOY/IITA Soybean Uniform Trial, 1977) The trial with eighteen cultivars was conducted only at Ilonga. Although already tested and proved superior cultivars like Bossier, L_4 and Cobb gave significantly higher yields than the others some of the new genotypes like TGM 220-1-2205, TGM 210-1-2363 and TGM 249-4-b showed good yield potential. In spite of poor plant stand they yielded between 1,300-1,950 kg/ha.

D. Beans - Three multilocation trials were conducted.

1. (Tanzania Bean Variety Trial) Of the three locations where this experiment was conducted, reliable data could be obtained only from Ilonga. Of the nine cultivars previously found promising at Ilonga, Mbeya or Lyamungu tested in this trial, a mosaic resistant cultivar Monroe gave the highest yield (1,457 kg/ha) whereas T_3, a promising line for the Southern highlands, gave the lowest yields (703 kg/ha), probably due to its extreme susceptibility to mosaic virus.

2. (Tanzania Bean Preliminary Trial) Fifty-six cultivars were tested at Ilonga and Lyamungu. At Lyamungu the experiment was affected by moisture stress due to late planting. At Ilonga P-311-4-1, a line from CIAT gave the highest yields of 1,395 kg/ha compared to 1,069 kg/ha of the Canadian Wonder used as check. Although the yield differences were not significant at Lyamungu, a cultivar Algarobo, gave two times the yield of Canadian Wonder.

3. (CIAT International Yield and Adaptation Nursery for Dry Beans) Twenty cultivars from CIAT, Cali, Colombia, were evaluated at three locations. Results from only one are available. P-450, P-[illegible], P-392 and P-755 gave significantly better yields than the local check Canadian Wonder. They will be further tested in the Tanzania Bean Preliminary Yield Trial 1977/76.

E. Germplasm Collection and Evaluation - During the year the following introductions were received:

1. (Green gram) 255 germplasm lines received from AVRDC, Taiwan were evaluated during September-November, 1976. Observations on number of clusters/plant, number of pods/cluster, pod length, seeds/pod and 100 seed weight were recorded. Several of the promising lines from this collection will be further evaluated at Ilonga during March-June, 1978.

2. (Bean)

(a) 300 new germplasm lines received from EAAFRO during 1976 were evaluated for yields and disease reaction.

(b) 746 promising germplasm lines from CIAT were evaluated at Ilonga and Mbeya for yield and reaction to mosaic, rust, bacterial blight and other diseases. About 144 germplasm lines from the above 1,046 lines were selected to be evaluated in the Tanzania Bean Preliminary Yield Trial during 1977/78.

3. (Soybean) 280 soybean breeding lines from AVRDC were received and multiplied. 64 promising lines were selected for further evaluation under Tanzania Soybean Preliminary Yield Trial at several locations.

4. (Bambara nuts) 1,663 lines were received from Ukiriguru ARI for maintenance and multiplication. They were grown under irrigation. Many had lost viability.

5. (Cowpea) 285 lines of Tanzanian Cowpea collection formerly maintained at Ukiriguru ARI were grown during April-July. On the basis of visual observations several lines were selected for further testing in Tanzanian Cowpea Preliminary Yield Trial.

F. Crossing Program - During the year under report, work on crossing and selecting cowpeas for disease resistance was intensified. Several F_2 populations from IITA were grown and selections made. Several disease resistant selections from the SVS_1 backcross program were multiplied for further testing in 1978.

About 300 new crosses were made to combine resistance to three viruses (top necrosis (TN) cowpea aphid-borne mosaic (CAMV) cowpea yellow mosaic virus (CYMV), two bacterial diseases (bacterial pustule, bacterial blight) and several fungal diseases (rust, cercospora leaf spot and possible septoria leaf spot).

C. Plant Pathology Studies. Through a series of disease nurseries several cowpea and bean lines were identified which possess good field resistance to important disease. Several cowpea lines have already been crossed in the cowpea disease resistance breeding program.

During the year, a virus disease problem, probably already existing in the area, became very severe in cv. SVS_3. Infection at seedling stage resulted in death of the growing point and ultimately of the whole seedling. Isolation and inoculation studies indicated that a sap transmissible virus was involved. The disease was tentatively named as "Top Necrosis". Since it was much more destructive than other virus diseases prevalent here, immediate search for sources of resistance was initiated from among multiple disease resistant germplasm lines. Of more than 200 lines tested 18 were found to be completely resistant. They were immediately crossed with SVS_3 and other high yielding lines. Within the next 6 months we expect to have derivatives from these crosses with resistance to TN, CAMV, CYMV, BB, BP, and rust diseases.

In genetical studies on the mode of inheritance of top necrosis virus resistance, the results from inoculations of F_1, and F_2 and test crosses indicated that the resistance in all the eighteen germplasm lines was recessive and probably monogenic with some modifying genes, R x R crosses showed that the gene(s) for resistance in Tvua 1,190, 612 and 1,948 are at different loci.

In search for stable sources of resistance to bacterial pustule (BP) disease in cowpea, detailed studies on pathogenic variability in the pathogen (Xanthomonas sp.) were undertaken.

When 577 cowpea germplasm lines identified to be resistant to BP in Nigeria were inoculated by injection-infiltration with bacterial suspension with an isolate of the pathogen from Tanzania, only 18 lines proved resistant. Six gave hypersensitive brown reaction within 72 hours and in twelve lines the inoculated area slowly turned greenish yellow and developed minute raised spots but little or no secondary spread. The former type of reaction was controlled by a dominant gene and the latter by a recessive gene. The hypersensitive reaction was dominant over the recessive-gene-controlled reaction. A third race subsequently discovered was pathogenic to all the hypersensitively reacting resistant lines. Recessive-gene-controlled resistance seems to be more stable.

Agronomy Section

The Agronomy Subprogram of the National Grain Legume Research Program is responsible for identifying critical management factors and for developing practical and economic practices for growing grain legumes. The ultimate objective of the agronomy research program is to develop and continuously refine a "production package" for the grain legume crops. The 1976/77 season was the second in which a full-scale agronomic research program has been carried out. It is expected that after one more season's data, the National Grain Legume Research Program will have refined these "production packages" to the point that a production handbook can be prepared to transfer this information to extension personnel and grain legume producers.

During the 1976/77 season, experiments were carried out at Ilonga ARI and at eleven other research stations and at 30 on-farm test sites (Village Trials). All data has not yet been completely analyzed so the following is a preliminary summary of the results of these trials.

A. Beans - Phaseolus beans are a very important crop in Tanzania, but agronomic studies were only this year initiated. These included fertilization, insect control, and intercropping studies.

1. (Fertilization) Significant yield responses to fertilization were obtained at the four locations for which data is available. At two locations (Lambo and Ilonga), there was a significant response to nitrogen, at one location (Maruku) to phosphorus, and one location (Njombe) to both nitrogen and phosphorus. At the latter location, the N x P interaction was also significant. These are to be considered preliminary trials but indicate the need for more extensive testing under actual farm conditions in order to develop regional fertilizer recommendations for maximum economic yield.

2. (Insect Control) The effect of insect control at various growth stages (aldrin seed dressing and/or endosulfan spray at preflowering, flowering and/or podding) on yield and insect damage was assessed at six locations (Uyole, Njombe, Ismani, Ilonga, Lambo, Maruku). At only two locations (Ismani and Lambo) did any insect control treatments result in a marked yield increase over the control. At Lambo, protection during the preflowering stage appeared to be most important. At Ismani, the preflowering and podding stages seemed most susceptible to insect damage. Full interpretation of this data must await detailed statistical analysis but the results indicate that, in general, insect control in beans is a considerably less important management factor than for many of the other grain legumes.

3. (Bean/Maize Intercropping) A trial was conducted at Uyole and Lambo to determine appropriate planting densities for beans and maize when intercropped. Only data from Lambo have thus far been received. These results indicate that it is possible to get over 1,000 kg/ha. of beans under a full stand of maize. Yields of intercropped beans were higher with a population of 111,111/ha. than with 222,222/ha. Maize yields were not reduced by intercropping. These results suggest that bean/maize systems can be highly productive and deserve further study.

B. Cowpeas - A very intensive effort was made during the past season to identify the major management factors important to cowpea production. These were related to insect control, weed control, time of planting and multiple cropping.

1. (Insect Control) Insect damage probably represents the greatest constraints to increased cowpea production and thus major effort has been put into research on insect control.

a) Ultra-low-volume (ULV) Insecticide Application. ULV application of thiodan (0.6 kg. a.i./ha at 30, 45 and 60 DAP) was as effective as conventional high volume (HV) application on both cv. SVS-3 (pods borne within leaf canopy) and cv. Ife Brown (pods borne above canopy). ULV application has the advantages that no water need be carried (HV required 250-500 l/ha.) and less time is required (one man can spray 5 ha/day compared to 1 ha/day by HV)

b) Insecticide Spray Schedule.

At seven village trial sites in Kilosa district, endosulfan (0.5 kg/ha.) was applied at 0, 2 (40 and 60 DAP), 3 (30, 40 and 60 DAP) or 6 (every ten days from 10 to 60 DAP) times. Economic analysis showed that insecticide application was highly profitable and that it would be in the farmers interest to use the most intensive spray schedule (6 applications).

c) Weeding and Insect Control.

Cowpeas (cv. SVS-3) were grown with and without insect control (6 applications of endosulfan at 0.5 kg a.i./ha) under three weeding practices: none, one or two hand-weedings. Grain yield losses due to insect damage were greatest under weedy conditions. Economic analysis shows that, in order of increasing level of inputs, the farmer would be best advised to employ the following practices: (1st) one handweeding - no insect control, (2nd) one handweeding + insect control, (3rd) two hand-weedings + insect control. Insect control without handweeding or two handweedings without insect control are practices which are economically poor choices because they have lower net benefits and higher costs than alternative practices.

d) Comparison of Fenitrothion and Endosulfan.

In an insecticide screening trial conducted in 1976, fenitrothion provided as good insect control as endosulfan which is the standard recommendation for cowpeas in Tanzania.

These two compounds are comparable in price and fenitrothion would have an advantage in that it has a considerably lower mammalian toxicity than endosulfan. Thus, the two insecticides were compared more intensively in 1977. They were applied at 0.5 and 1.0 kg a.i./ha to cv. Ife Brown at 15, 30, 45 and 60 DAP at several locations. The results from four locations indicate that fenitrothion is not, in fact, as effective as endosulfan and that 0.5 kg a.i. endosulfan is an adequate dosage.

e) Effect of Insect Control at Various Growth Stages.

The effect of insect control (endosulfan at 1 kg a.i./ha) at various growth stages (preflowering, flowering and/or podding) on insect damage and yield of cv. Ife Brown was assessed. Control during the podding stage (from 47 to 69 DAP) was most important. Insecticide application during the flowering stage (34 to 41 DAP) resulted in yield increases which were significant but lesser in magnitude. This type of information, if gathered over a number of locations and years, should aid in developing an optimum schedule for insecticide application.

f) Insect Resistance Screening.

Thirty-three lines from the grain legume entomology program at IITA were grown with and without insect control (endosulfan, 1 kg a.i./ha at weekly intervals). All were erect, determinate types and three varieties of similar plant type which had performed well in Tanzania in previous testing with insect control were included for comparison.

Yield without insect control (range = 113 to 982 kg/ha.) and relative yield when untreated with insecticide as compared to when treated (range = 17 to 48%) were used as criteria for selection for further testing. Lines ranking high in both parameters were 3/8/2/2 (from Tanzania program) and E-3, E-8 and ER-1 (from IITA).

A more thorough evaluation for insect resistance was made on seven lines which have been identified as having resistance to one or more insect pests in Tanzania or elsewhere. The yield of TVu 7274 was least reduced by insect damage and insect damage assessment indicated a resistance to Taeniothrips sjostedti and pod sucking bugs.

2. (Weed Control) The weed problem can vary with spacing, plant type or the cropping system. Possibilities for herbicide use are not yet fully explored.

a) Weeding : Row Spacing x Plant Type Interaction. Two plant types (semi-erect compact, cv Ife Brown and indeterminate, leafy, cv. SVS-3) were planted at three row spacings (40, 60 and 80 cm) and grown under two weeding regimes (one handweeding or two handweedings). SVS 3 was more competitive against weeds than Ife Brown. Under the low level of weed control, highest yields of both varieties were obtained at the narrowest row spacing. Under the high level of weed control, highest yields of SVS-3 were obtained at the widest row spacing while the highest yields of Ife Brown were obtained at the intermediate row spacing.

These results demonstrate that spacing recommendations derived from tests under weed free conditions may not be optimal for the farmer who is often using a lower level of management in weed control.

b) Weeding x Cropping System Interaction.

In order to determine if intercropping maize with cowpeas provides any advantage over monocropping in terms of reduced weeding requirements, cowpeas and maize were grown as monocrops and in association as intercrops under three levels of weeding (none, one handweeding and clean weeded). With no weeding, intercropping gave double the maize yields obtained under monocropping (1043 vs. 570 kg/ha) and an increase in productivity of 83%. However, with only one handweeding Intercropping provided no advantage over monocropping in terms of weed control. Increase in productivity due to intercropping was only 15%, the same as under clean weeded conditions.

c) Herbicide Screening

Six herbicides were applied at two rates to cv. SVS-3 at Msimba Seed Farm. The entire trial was inadvertently handweeded before any data was taken but early inspection of the trial had indicated that the crop tolerated metribuzin at 0.75 kg a.i./ha. This would appear to be a promising treatment as metribuzin at this rate has given effective control of weeds in soybeans.

3. (Time of Planting) Two cowpea cultivars (SVS-3 and VITA-3) were planted at nine locations at four times from the beginning of the rains until 1½ months before the average date on which the rains cease and were grown with and without insect control.

At Ilonga, with insect control, early plantings of both SVS-3 at VITA-3 (mid January and early February) produced yields 40% higher than those from the planting made in early March, which has been considered the optimum planting time. Yields from the early plantings, with insect control, were approximately 2,000 kg/ha for both varieties. With insect control, the late planting (late March) gave yields which are markedly lower than those from the planting made in early March (37% and 22% lower yields for VITA-3 and SVS-3, respectively). Without insect control VITA-3 gave yields of less than 120 kg/ha regardless of planting time. SVS-3, without insect control, also gave very low yields from the first two planting but planting made in early and late March gave yields of close to 1,000 kg/ha.

Results from other locations have yet to be analyzed but observations during the growing season indicated that time of planting may be a critical management factor in cowpea production. The need seems obvious for conducting trials such as this for a number of years in the important cowpea growing areas in order to develop recommendations for optimum time of planting.

4. (Effect of Leaf Plucking on Grain Yield) As cowpea leaves are commonly picked for use as a vegetable, the effect of leaf plucking on grain yield of two cultivators (SVS-3 - leafy, semi-prostrate and Ife Brown - compact, semi-erect) was investigated. Two methods of picking were utilized: picking the 3rd and 4th leaves from apical end of stems or picking the stem tips.

Picking commenced at 21 or 35 DAP and continued until 42 or 56 DAP. None of the picking treatments had a significant effect on grain yield of either variety. The most intensive picking regime resulted in 350 and 450 kg/ha of leaves (dry weight) for Ife Brown and SVS-3, respectively). This represents a significant addition to the total food production per hectare of cowpeas.

5. (Variety x Cropping System x Insect Control Interaction) Three cultivators (SVS-3, Ife Brown and VITA-5) were grown in three cropping systems (monocrop, intercropped with maize at recommended maize density of 44,444/ha. or intercropped with maize at farmers' density of 22,222/ha with or without insect control. The trial was conducted at six locations but only the data for Ilonga have been processed. Intercropping cowpea and maize resulted in an average increase in total productivity of 22% over monocropping. Maize density had no significant effect on total productivity as the yield responses of maize and cowpeas to differences in maize density were compensatory. Without insect control, cowpea yields were half of those obtained with insect control under monocropping as well as under both intercropping systems indicating that intercropping offered no advantage over monocropping in terms of reduced insect damage. Without cowpea insect control, intercropping resulted in an average increase in total productivity over monocropping of 17% while with insect control the increase in productivity was 27%. SVS-3 appeared to be poorly adapted for intercropping as it climbed the maize stalks and caused a reduction in maize yield.

Partial budget analysis shows that, if the farmer desires to grow cowpeas, of the various alternatives represented, he would be best advised to grow cv. SVS-3 as a monocrop with insect control. Intercropping cowpeas with maize may, however, offer a real advantage over monocropping in terms of risk aversion.

6. (Multiple Cropping Systems) Previous work has indicated that cowpeas can fit well into cropping systems with other crops thus increasing overall crop productivity. Work was carried out this season on intercropping and relay cropping.

a) Cowpea Varietal Evaluation for Intercropping and Relay Cropping.

Six cultivars (SVS-3, SVS-6, VITA-5, VITA-4, TVx -33, and Ife Brown were grown as a monocrop, as an intercrop planted at the same time as maize and as a relay crop planted after maize. All varieties except VITA 5 and Ife Brown climbed the maize stalks when grown as an intercrop planted as at the same time as maize and thus appear to be poorly adapted to this type of cropping system. Yields of all cowpea varieties when relay planted were very low and this system may not be as productive as 1976 results indicated. Further interpretation of the trial results must await full statistical analysis.

b) Relay Cropping Cowpeas after Maize - Effects of Density and Maize Row Spacing.

Relay planting cowpeas after maize at such a time that the maize is harvested before the cowpeas flower appeared in a previous trial to be a cropping system offering the possibility of intensifying crop production.

A trial was conducted this year to determine the appropriate densities of the two crops in this system and the optimum spacing between maize rows. Maize (cv. Katumani) was grown in rows 1 or 2 m. apart and at densities of 25,000, 37,500, or 50,000/ha. The relay cropped cowpeas (cv. VITA 5) were grown at densities of 50,000, 75,000 and 100,000/ha.

There was little difference in total productivity (LER) among any of the various treatments except that those treatments in which both crops were grown at the lowest densities had a markedly lower productivity. It would appear that at all higher densities of either or both crops a productivity plateau is reached and that only the proportion of the two crops in the total yield varies with the different treatments. In contrast to results obtained last year, the results of this trial showed this plateau to be a level no higher than productivity under monocropping.

C. Soybeans - In an effort to determine the potential for soybeans as a small farmer cash crop, village trials were a major effort this season. Village trial work involved varietal testing and investigation of the effects of inoculation and fertilization. On station trials included work on inoculation, seed viability and weed control.

1. (Varietal Testing) Four varieties were tested at 25 village trial sites. Bossier, L4, Hardee and 3H/1 were tested at the 14 low elevation (1000 m.) sites. Bossier and L4 gave the highest and 3H/1 the lowest yields in all areas.

The average yield for Bossier across all low elevation locations was 1100 kg/ha. The varieties tested at the 11 high elevation sites were Bossier, Blackhawk, Hardee and 188-2. Bossier and 188-2 gave the highest yield and Blackhawk at lowest. The average yield for Bossier across all high elevation locations was 1600 kg/ha.

2. (Crop Nutrition)

a) Response to Fertilization and Inoculation.

A trial was conducted at 23 village trial sites to determine the response of soybeans (cv. Bossier) to fertilizer elements and inoculation. Inoculation, in general, resulted in marked yield increases. Overall results show a 35% increase with inoculation alone. In none of the areas was there a significant response to P or K or to a "starter" application of N.

b) Varietal Differences in Response to Inoculation.

Results of trials conducted in 1976 suggested that cv. 3H/1 nodulated well without application of inoculant. To ascertain whether this observation was correct, 3H/1 and Bossier were planted with and without application of inoculant. Bossier, without inoculation did not nodulate but, with inoculation, was well nodulated. For 3H/1, although the number and weight of nodules per plant doubled with inoculation, plants were still well nodulated without inoculation. It was not possible to determine the effectiveness of nodulation of 3H/1 by the indigenous Rhizobium strains as even Bossier showed no yield response to inoculation; soil N masked any differences in yield due to nodulation.

Further work in this area should be carried out because if there are soybean genotypes which can be nodulated effectively by indigenous strains of Rhizobium this could be an important factor to be incorporated into a breeding program.

3. (Seed Quality and Viability) The production of good quality seed with high viability is a problem in many tropical areas and represents a major obstacle to soybean production. Some of the varieties (e.g. Bossier) which have shown promise in recent testing are known to be very susceptible to seed quality problems in other areas. Recent work with soybeans in this program has in general been conducted using seed produced under irrigation in the dry season. In this situation conditions are optimal for high quality seed production and the storage period is relatively short. Thus it seemed well to determine to what extent the seed quality problem exists under Tanzanian conditions. Four cultivars (Bossier, L4, 188-2 and Jupiter) were planted from seed produced in the previous rainy season and stored under ambient conditions for eight months or produced in the dry season under irrigation and stored for only two months. The results indicate that production of high quality seed under Ilonga conditions is not a major problem. The emergence of 188-2 from seed produced in the rainy season was as high as that produced under irrigation and the seed of Bossier, L4 and Jupiter produced in the rainy season was only slightly less viable than the seed produced under irrigation. The lowest emergence percentage was only 71% (Jupiter).

4. (Weed Control)

a) Margin of Selectivity of Metribuzin.

Herbicide screening trials conducted in 1976 showed metribuzin to be a promising treatment. These trials indicated, however, that the margin of selectivity (rate at which crop injury occurs relative to rate required for effective weed control) is also narrow. Thus a trial was conducted to determine the optimum rate on a clay loam soil (typical of soils of Ilonga A.R.I. and Msimba Seed Farm) and the extent to which that rate could be exceeded before crop injury reached an unacceptable level. An additional objective was to determine if the rate of metribuzin required for adequate weed control could be reduced by applying it in combination with alachlor.

Under the conditions prevailing in this trial, the optimal rate of metribuzin was determined to be 1.4 kg a.i./ha and the rate could be doubled before crop injury became pronounced. By applying metribuzin in combination with alachlor (2.25 kg a.i./ha) the rate of metribuzin required for adequate weed control could be reduced to 0,87 kg a.i./ha. These rates, however, should be verified by further testing as the amount of rainfall received during the two week period after planting and herbicide application was very slight.

b) Varietal Differences in Tolerance to Metribuzin.

Work done elsewhere has shown that there are differences between soybean varieties in their tolerance to metribuzin. As all testing conducted here has utilized cv. Bossier a trial was conducted to determine if any of the varieties currently used or any of the ones showing promise in recent testing might have a low tolerance for this compound. Metribuzin was applied at 0, 1 and 2 kg a.i./ha to 9 cultivars and all plots were kept weed-free by handweeding so that any differences in yield between herbicide treatments would be due to the direct effect of the chemical on the soybean plant.

No significant differences were found between cultivars in their reaction to metribuzin. At rates of 1 and 2 kg a.i./ha grain yields were 96% and 94% of the untreated control, respectively. Thus it would appear that metribuzin is suitable for use on all varieties tested.

c) Herbicide Evaluation.

Nine herbicide treatments were compared in a trial on Msimba Seed Farm as part of an effort to develop on improved herbicide recommendation for the farm as the presently used treatment is inadequate. The best treatment was metribuzin (0.75 kg a.i./ha) plus alachlor (2 kg a.i./ha).

D. Pigeon Peas - Pigeon peas are commonly grown as an intercrop and among the grain legumes would appear to be a crop especially well adapted to intercropping with cereals. Work has begun to attempt to determine [illegible] parameters for maximum productivity in such systems. Also [illegible] work continued with early maturing, semi-dwarf pigeon pea varieties which appear to offer certain desirable characteristics not found in the commonly grown late maturing, spreading types.

1. (Pigeon Pea/Maize Intercropping) Two pigeon pea varieties, SD-8125 (early, semi-dwarf) and I-7065 (late, spreading) were intercropped with two maize varieties, Katumani (early) and Tuxpeno (full season). The intercropped pigeon pea [illegible] 50%, 75% and 100% of the recommended density for monoculture (83,888 and 55,555/ha. for SD-8125 and I-7065 respectively). Intercropped maize was grown at populations considered optimal for monoculture (55,555 and 44,444 for Katumani and Tuxpeno, respectively). Neither pigeon pea variety, at even the highest population, reduced maize yields below monocrop levels. However the yield of intercropped pigeon peas were much lower than monocrop yields. Tuxpeno depressed pigeon peas yields to a greater extent than Katumani although there was no difference in maize yield between the two varieties. I-6025 gave very low yields, both as an intercrop and as a monocrop. This may have been due to a severe infestation of pollen beetles (Mylabris sp.) during flowering of this variety. These results suggest that the effects of varying maize population on the productivity of the intercrop system should be investigated.

2. (Spacing Requirements)

A trial was conducted to determine optimum row spacing for two semi-dwarf varieties differing in plant type, 3D-8125 (spreading) and 4T-1103 (soytype). Results have not yet been analysed.

E. Green Grams

(Weed Control) - Six herbicides, available in East Africa were applied at several rates to cv. IPA 5915. Metribuzin, which has shown promise for soybeans and cowpeas, was extremely injurious to the crop. Fluorodifen also caused unacceptable crop injury. Metalchlor, butachlor, and alachlor gave good grass control but were ineffective against broadleaves. Chloramben at the rate of 3 kg a.i./ha gave adequate broadleaf and grass control and caused little crop injury.

F. Trials involving more than one Legume -

1. (Relay Cropping of Legumes before Cereals) Erect, determinate cowpeas (cv. 1247) and green grams (cv. TVau 81) were used in a relay cropping system with maize (cv. Tuxpeno), sorghum (cv. Serena) and bulrush millet (cv. Serere Composite). The legume was planted with the first rain and the cereal was relay planted 3 weeks later. This system was compared with an intercropping system in which the legume and cereal are planted at the same time and with monoculture.

In the relay cropping system, with all cereals, both legumes gave yields which were approximately 75% of monocrop yields.

In contrast, when intercropped, the legumes gave yields which were only 16% of monocrop yields. Under relay cropping, cereal yields were reduced to a varying extend depending upon the cereal and on the legume in which it was relay planted. On the average, yield reduction from relay cropping (as compared to monocropping) in the two legumes was 2%, 23% and 16% for sorghum, maize, and bulrush millet respectively. Green grams appeared to cause slighely greater cereal yield reductions than cowpeas. When the legume and cereal were planted at the same time, there was no reduction in cereal yield (as compared to monoculture) except for bulrush millet, the yield of which was reduced 30%. Total productivity of the relay cropping system involving either cowpea or green grams and sorghum or maize was very high being as much as 94% greater than under monocropping. In economic terms, the crop value per hectare was approximately doubled by planting cowpeas or green grams before sorghum or maize. In areas, such as Morogoro region, where the cereal crop need not be planted with the first rains, this relay cropping system may hold promise as a means of intensifying crop production.

2. (Effect of Atrazine Residues on Grain Legumes)

Information on the effects of atrazine residues on grain legumes should be useful in view of the increasing use of atrazine for weed control in maize and sorghum. Thus, in the last growing season, atrazine was applied to maize at rates of 0,1 2,3,4 5, and 6 kg a.i./ha.

Next season, four legume species (Cowpeas, green grams, pigeon peas and soybeans) will be planted and the residual effects on growth and yield observed.

3. (Comparison of Determinate-type Cowpeas and Green Grams in Intercropping with Maize) Most intercropping work with cowpeas has focused on the use of indeterminate plant types. This trial was conducted to evaluate the performance of determinate-type cowpeas under intercropping and to compare it with that of green-grams, another legume with similar growth habit. Two erect, determinate-type cowpeas (1247 and TVx 12) and two greengram varieties (IPA 5915 and TVau 92) were grown as monocrops and as intercrops with maize (cv. Katumani). An indeterminate, semi-prostrate cowpea variety (VITA-5) was included for comparison under intercropping. The determinate type cowpeas and greengrams performed similarly to the semi-prostrate cowpea variety in that their yields were depressed about 75% as compared to monocropping. They had no effect on maize yield and the intercropping system resulted in about a 20% increase in total productivity (LER).

VI. Program Expansion

Sorghum and Millet have been officially added to the Food Crops Research Project receiving support from the USAID with the signing of a new Project Agreement on December 29, 1977. This provides for the addition of two expatriate scientists to do research on these crops, and training of appropriate Tanzanian Staff to eventually take over the work.

In anticipation of this agreement the Ministry has worked out a project scheme outlining the objectives, training and time table for achieving a sustained Tanzanian program in sorghum/millet research. This was done in collaboration with ICRISAT, the International Center specializing in sorghum research. Also three Tanzanians have gone to ICRISAT for in-servicing training during the past year, and the first expatriate coming for this section has been nominated and is expected in January 1978. It is anticipated that research with these crops will move forward very rapidly.

Plans are being developed to add two other crops, or crop groups, to the Food Crops Research Project in the near future. These are Rice and Root Crops (the latter being cassava and sweet potato). A project proposal has been developed and presented to USAID on Root Crops, and it is anticipated a project proposal for Rice will be presented the end of March 1978. Considerable work is already being done on cassava in cooperation with IITA and four Tanzanians have done in-service training at that Institute. One of the four is presently doing a Master's Degree at the University of Ibadan, also sponsored by IITA.

VII. Development of Research Facilities

Another important aspect of the Food Crops Research Project is the development of the research facilities where the work is to be done. The Ilonga ARI has been selected as the major center or Headquarters for this Project.

In order that it may properly serve this function a development plan for the Station was drawn up by a team of experts from IITA and CIMMYT. The plan in itself is useless unless it is realized. Toward this end the Ministry has requested approximately five and a half million shillings from the sale of U.S. Food Grains in Tanzania to initiate the work in 1978. USAID has committed $300,000 in the recently signed Project Agreement toward the purchase of commodities (those which must be imported) for this purpose. It is extremely important that the shilling input be realized so that the physical development of Project facilities can match the progress of the other phases. The major portion of research for three of the five sections in the Food Crops Research Project will be centered at the Ilonga ARI (Maize, Grain Legume and Sorghum/Millet). Root Crops will be centered at the Mtwara ARI, and Rice most likely at Katrin. Many of the other ARIs and sub-stations will have important roles in the nationally coordinated effort. It is important, therefore, that attention be paid to appropriate development of other stations as well

Appendix A

Project Staff List (Includes Contract Staff as well as all Ministry Research and Field Officers)

Administration

David D. Masanja	Director, Crop Development Div.	Pamba House
John M. Liwenga	Chief Research Officer	" "
Paul C. Duffield	General Coordinator	" "
Paul K. Haule	Director, ARI, Ilonga	Ilonga
Delphine Gracias	Secretary	Pamba House

Maize Research

David W. Sperling	Maize Breeder	Ilonga
James A. Deutsch	" Agronomist	"
Alfred J. Moshi	" Agronomy	"
Zubeda O. Mduruma	" Breeding	"
Mfaume D. Mwanjali	" Plant Protection	"
Nick G. Lyimo	" Breeding	Degree Training
Tobias A. Mtui	" Agronomy	" "
Ester E. Lyimo	" Breeding	Uyole
Hatibu E. Zuberi	" Agronomy	"
Canisius J. Ndunguru	" "	Degree Training
Robert B. Tuni	" "	" "
Mackenzie J. Kapalasula	" "	Naliendele
Stephen J. Haule	" "	Degree Training
Herman B. Akonaay	" "	Ukiriguru
T. B. Rai	" "	Mlingano
S. Nahamu	" "	"
Daniel L. Kessy	" "	Tumbi
Peter R. Matowo	" "	Maruku
Gallus J. Mwageni	" "	Degree Training

Legume Research

Frank E. Brockman	Legume	Agronomist	Ilonga
Prabodh N. Patel	"	Breeder	"
Mgheni E.T. Mmbaga		Agronomy	"
Henry K. Leyna		Breeding	"
Fred Z. Muchange		Agronomy	Degree Training
Furah F.A. Mbowe			Ilonga
Joseph K. Mligo	Legume		Ilonga
Catherine A. Kuwite	"	Pathology	Ilonga
E. Marenge	"	"	Dip. Tr.
Tuaeli A. Masha	"	Agronomy	Ilonga
P. M. Mapema	"	"	"
N. S. Mwangosi	"	"	"
Joseph A. Asenga	"	"	Degree Training
Anderson E.M. Temu	"	"	" "
C. M. Mayona	"	"	Uyole
Margaret M. Mkuchu	Legume	Breeding	"
Epimaki M.K. Koinange	"	"	Lyamungu
Ramadhani I. Chambuya	"	Agronomy	"
Juhudi Y. Chambi	"	"	Naliendele
Catherine S. Muhalet	"	Breeding	Degree Training
Alphonce M.K. Mhoja	"	Agronomy	Ukiriguru
Mary Mgonja	"	"	Katrin
Imelda J. Ndamugoha	"	"	Maruku

Appendix B

Funding - Expenditures Since Initiation of Project
(U.S. dollar or dollar equivalent)

	1972-76	1977	1978 est.
I. USAID			
A. IITA Contract			
1. Technical Assistance	406,339	314,456	600,000
2. Training	79,132	152,198	236,000
3. Commodities	130,139	21,124	30,000
	615,610	487,778	866,000
B. Direct USAID			
1. Technical Assistance	126,000	5,800	218,000
2. Participants	75,000	7,200	10,000
3. Commodities	92,000	11,000	250,000
	193,000	24,000	478,000
II. Ford Foundation			
1. Technical Assistance	96,889	-	-
2. Participants	39,932	20,000	26,000
3. Commodities	20,783	12,000	18,000
	157,604	32,000	44,000
III. Tanzanian Government			
1. Recurrent vote	75,000	22,000	60,000
2. Development vote	173,000	32,000	641,000
3. Trust Fund	30,000	14,000	17,000
	278,000	68,000	718,000
Grand Totals	1,244,214	611,778	2,106,000