Report of
The Upland Crops Varietal Improvement Monitoring Tour

MAY 26 – JUNE 4, 1986

ASIAN RICE FARMING SYSTEMS NETWORK
THE INTERNATIONAL RICE RESEARCH INSTITUTE
LOS BAÑOS, LAGUNA, PHILIPPINES

TABLE OF CONTENTS

PARTICIPANTS

Akhter Hossain Khan	-	*Bangladesh Rice Research Institute Joydebpur, Dhaka Bangladesh*
Rasidin Azwar	-	*Sukarami Research Institute for Food Crops Bandar Buat Padang P.O. Box 34 Padang, West Sumatra Indonesia*
Jai Raj Joshi	-	*Department of Agriculture Khumaltar Nepal*
Bhartendu Mishra	-	*National Oil Seed Development Program Nawal Pur (Sarlahi) Nepal*
Bashir Ahmed Malik	-	*National Agriculture Research Centre P.O. National Institute of Health National Park Road Islamabad Pakistan*
Candida Adalla	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*
Daprosa del Rosario	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*
Ruben Villareal	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*
Arceli Pua	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*

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Ruben Villareal	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*
Arceli Pua	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*

Rudy Navarro	-	*Institute of Plant Breeding* *U.P. at Los Banos* *College, Laguna* *Philippines*
Miguel Deniega	-	*Ministry of Agriculture and Food* *Pili, Camarines Sur* *Philippines*
Ricardo Lantican	-	*Institute of Plant Breeding* *U.P. at Los Banos* *College, Laguna* *Philippines*
Anek Chotiyarnwong	-	*Chiang Mai Field Crops Research Center Department of Agriculture* *Bangkok* *Thailand*
Somyot Pichitporn	-	*Chainat Field Crops Research Center* *Department of Agriculture* *Bangkok* *Thailand*
Anon Watayanon	-	*Khon Kaen Field Crops Research Center* *Khon Kaen* *Thailand*
K. Hetiarachchi	-	*Maha Illuppallama Research Station* *Maha Illuppallama* *Sri Lanka*
K.H. Sarananda	-	*Vanathavilla Research Station* *Vanathavilla* *Sri Lanka*
Kenneth MacKay	-	*Agriculture, Food and Nutrition Sciences Division* *International Development Research Centre* *Tanglin P.O. Box 101* *Singapore 9124*
Virgilio Carangal	-	*Rice Farming Systems Program* *International Rice Research Institute* *P.O. Box 933* *Manila* *Philippines*

R.K. Pandey	-	*Rice Farming Systems Program* *International Rice Research Institute* *P.O. Box 933* *Manila* *Philippines*
Esteban Godilano	-	*Rice Farming Systems Program* *International Rice Research Institute* *P.O. Box 933* *Manila* *Philippines*
Rolando Labios	-	*Rice Farming Systems Program* *International Rice Research Institute* *P.O. Box 933* *Manila* *Philippines*
Antonio Morales	-	*Rice Farming Systems Program* *International Rice Research Institute* *P.O. Box 933* *Manila* *Philippines*

INVITED SPEAKERS

Salud Barroga	-	*Ministry of Agriculture and Food* *San Fernando, La Union* *Philippines*
Jindra Demeterio	-	*Ministry of Agriculture and Food* *Diliman, Quezon City* *Metro Manila* *Philippines*
Isagani Herrera	-	*Ministry of Agriculture and Food* *San Fernando, Pampanga* *Philippines*
Hermenegildo Gines	-	*Multiple Cropping Department* *(Guimba Outreach Project)* *International Rice Research Institute* *P.O. Box 933, Manila* *Philippines*
Mauro Guico	-	*Ministry of Agriculture and Food* *Santa Barbara, Pangasinan* *Philippines*

Raul Sanchez	-	*Institute of Animal Science (Crop-Livestock Project) Santa Barbara, Pangasinan Philippines*
A.M. Salazar	-	*Institute of Plant Breeding U.P. at Los Banos College, Laguna Philippines*

P R O G R A M

May 25, Sunday

	Arrival	

May 26, Monday

0800	IRRI Slide Show	
0845	Briefing Varietal Improvement for Rice-Based Farming Systems	R.A. Villareal
0945	Picture Taking	
1000	Coffee Break	
1015	Asian Farming Systems Network	V.R. Carangal
1100	IRRI-IITA Grain Legume Project	R.K. Pandey
1200	Lunch	
1330	Screening of other upland crops	A.C. Morales
1415	Field visit and discussions: - IRRI Farm	A.C. Morales

May 27, Tuesday

0800	IPB varietal improvement activities	E.T. Rasco
0845	Breeding techniques for rice-based cropping systems	R.S. Navarro
0945	Coffee Break	
1000	Breeding for waterlogging and drought tolerance	D.A. del Rosario
1100	Breeding for disease resistance	A.R. Pua
1200	Lunch	
1330	Breeding insect tolerance	C.B. Adalla

1415	Sorghum and corn varietal improvement	A.M. Salazar
1530	Coffee Break	
1545	Field visits	R.S. Navarro

May 28, Wednesday

0700	Leave for Guimba, Nueva Ecija	
1000	Briefing RIARS activities in Region III	I. Herrera
1200	Lunch	
1330	Visit Guimba cropping systems site	G. Gines
1600	Leave for Pangasinan Stay (PVI Hotel)	

May 29, Thursday

0800	Briefing: Crop-Livestock Research	M. Guico/ R. Sanchez
1000	Field visit IPB varietal evaluation in Pangasinan State University	R.S. Navarro
1200	Lunch: Urdaneta	
1330	Visit Santa Barbara Crop-Livestock Site - Carusocan and Malanay	
1600	Proceed to Baguio Hyatt	

May 30, Friday

0830	Varietal testing of upland crops before and after rice	A.H. Khan
1015	Coffee Break	
1030	Varietal improvement of soybean for rice farming systems and soybean varietal testing after rice in Thailand	Anek Chotiyarnwong
1130	Regional Integrated Agricultural Research Systems Activities in Region I	Salud Barroga

1245	Lunch	
1400	Progress of the peanut varietal improvement for rice farming systems in Thailand	Anon Watayanon
1500	Progress on varietal development and evaluation of pulses in rice-based cropping systems	Bashir Ahmed Malik
1600	Coffee Break	
1615	Varietal testing of upland crops in Thailand	Somyot Pichitporn

<u>May 31, Saturday</u>

0830	Progress of varietal screening of upland crops for tolerance to acid soils in Indonesia	Rasidin Azwar
0930	Peanut improvement in Nepal	
1015	Coffee Break	
1030	Varietal testing of upland crops in rice-based cropping systems	Jai Raj Joshi
1100	Cropping systems research in Sorsogon, Philippines	Miguel Deniega
1200	Lunch	
1330	Varietal improvement and testing Sri Lanka	K. Hetiarachchi
1415	Varietal testing of upland crops in Vanalhavilla	K.H. Sarananda
1445	Working Group Discussion: Varietal Testing	Rasidin Azwar
1530	Coffee Break	
1545	Continue: Discussion	

<u>June 1, Sunday</u>

Free Time

June 2, Monday

0800	Leave Baguio	
1100	Visit Central Luzon State University	
1200	Lunch	
1300	Visit farming systems farm	
1400	Leave for Manila	

June 3, Tuesday

0830	Farming systems research and development in the Philippines	Jindra Demeterio
0930	Varietal screening and testing in Claveria	R.K. Pandey
1030	Working Group Discussion: Varietal Release	Ruben Villareal
1230	Lunch	
1400	Working Group Discussion: Breeding of upland crops for rice farming systems	Rudy Navarro

June 4, Wednesday

0830	Working Group Report 1: Observations and Recommendation	Anek Chotiyarnwong
0900	Working Group Report 1: Observations and Recommendation	Bashir Ahmed Malik
0930	Working Group Report 2: Varietal Improvement	Rudy Navarro
1015	Coffee Break	
1030	Working Group Report 3: Varietal Testing	Rasidin Azwar
1145	Working Group Report 4: Varietal Release	Ruben Villareal
1200	Planning Meeting	V. R. Carangal
1330	Lunch	

WORKING GROUP REPORT I - OBSERVATIONS AND RECOMMENDATIONS

GROUP 1

Ø Pre-rice legumes:

Upland crops planted before rice often times are compounded by problems such as poor seed emergence, diseases and water logging during the late vegetative stage.

It is therefore imperative that upland crops planted in this condition should possess the following:

1. High seed viability if planted under dry condition (condition such as dry seeded establishment to rice)
2. Disease resistance which could be equated to a higher quality fodder crops at harvest
3. Early crop establishment and good stand could be attained thru the following technique.
   - Land preparation right after the first rain and immediate seeding. (these could be attained by using special farm implement)
   - Land preparation after the harvest of the last crop in the pattern (e.g. Iloilo farmers who practice DSR establishment), thus seed survival at dry planting is a must.
   - Provision of drainage canal to immediately removed excess water in the field. Experience shows that there are crop cultivars that can survived two to three days of flooding.

Although matured technology before rice planting exist yet this is only under research managed trials on experiment station and or farmers fields, a mechanism on how this can be effectively transferred into farmers utilization should be developed and implemented, the participation of the extensionist is needed.

ø Crop-Livestock

Establishment of legumes in between the two rice crops should be further studied instead of growing grasses which will be very hard to sell to small farmers. Other legumes both forage or grains should be tested. In Pakistan, rice bean showed good response to longer submergence provided the crop ae well established. Product utilization of both fodder and grains should be further exploited and probably chicken which is commonly raised and an immediate source of cash should also be included.

Draft and power requirements to established upland corps in a rice system should be evaluated. The aim is to be able to plant immediately thus avoiding consequence of moisture stress at the later crop growth stage.

ø Recommendation

Upland crops use in a rice system is the key to increasing productivity. However management to further increase yield with minimum input should be studied to further increase income.

OBSERVATION AND RECOMMENDATION

GROUP I (Members)

1.	A.H. Khan	-	Bangladesh
2.	J.R. Joshi	-	Nepal
3.	M. Deniega	-	Philippines
4.	R.K. Pandey	-	IRRI
5.	E.C. Godilano	-	IRRI
6.	K.H. Sarananda	-	Sri Lanka
7.	A. Chotiyarnwong	-	Thailand

WORKING GROUP REPORT I - OBSERVATIONS AND RECOMMENDATIONS

GROUP 2

1. The group concluded that monitoring is a very useful activity of Asian Farming Systems Network. It has provided an opportunity and the participants to get together for exchange of their experiences and personal acquaintance. Knowing each other personally would prove a vital tool for further strengthening of the program in the region. The group further suggests that monitoring tour should continue as regular activity. We appreciate the superb arrangements made by the organizers, under the dynamic leadership of Dr. V.R. Carañgal.

2. It has been observed that the Network is doing a quite satisfactory varietal testing activity. The group suggests that the Network may undertake crop testing/screening simultaneously. This may provide more forage legume crops and other minor legumes, some which have not been properly explored by national and international programs. It was also suggested that data on preference or palatability or acceptability of these new crops residues by animals be recorded to prioritize the improvement efforts after initial screening of new crops.

3. There was a feeling that with the increasing cropping intensity on the farms as promoted by the Asian Farming Systems Netowrk, lot of biomass and production is going to be obtained per unit area, which may influence or effect the soil fertility status of the soil. It has been suggested by the group that some arrangements be worked under the Network to follow-up the soil fertility status on medium to long term basis.

4. The cooperators approach observed in the Carusocan and Malanay crop-livestock sites is an excellent activity, worth testing by other national programs of the Network. To achieve further efficiency in the utilization of the rice straw and green matter, a provision of manually operated chaff cutters to the cooperators is suggested. It is a very simple equipment, greatly used in Pakistan by crop-livestock farmers. It is quite cheap and its use will not only increase the fodder and rice straw utilization efficiency, but will also reduce the wastage of straw and fodder which is being presently fed to animals as unchaffed.

5. The varietal testing base of some legumes needs diversification. There is a need to get varieties from other breeding program. The diversification suggested would result into better utilization of the resources used for conducting varietal testing trials by the national program in the Network. The suggestion is based mainly on the observations made by some of the national programs during their presentations about the susceptibility of many mungbean entries in the trials to mung yellow mosaic virus. Pakistan has identified several tolerant varieties and it can be made available to national programs.

6. It has been observed that yellow mosaic virus of mungbean does not exist in Southeast Asia, hence the mungbean materials emerging from the breeding programs of these countries do not possess resistance. As a result, materials in the varietal testing trials are conducted in the countries having MYMV as a major disease. Therefore, these countries do not get the benefit often excellent efforts and hard

work of the breeders, who bred these varieties. The group appreciates the offer of Pakistan representative for screening of advance liens/segregating materials of mungbean of those countries against MYMV, if such nurseries are sent by the regional coordinator to Pakistan.

7. Nepal and Sri Lanka emphasized inclusion of short duration varieties of peanut into the varietal testing trials going to them. It was observed that some national programs like Thailand materials with 80-90 days maturity range. This material maybe useful for Nepal, Sri Lanka and Pakistan. Even if the maturity of this material gets prolonged to 120 days, it is considered early by about 20 days than the local peanut material.

8. During presentation of progress reports peanut digging has been expressed by some national programs as a major constraints. Some countires in the region like Pakistan have developed very simple peanut diggers, both animal and tractor drive. it is suggested that the Network coordinator may obtain a few units and give to the national programs for testing in their environment.

9. The group suggests that the invitation to the participants through their organizations be sent well in advance to provide them sufficient time to seek the clearance of their Government which is a pre-requisite for participation.

Members

1.	Bashir Ahmed Malik	-	Pakistan	(Chairman)
2.	Rudy Navarro	-	Philippines	(Member)
3.	Arceli Pua	-	"	"
4.	Miguel Deniega	-	"	"
5.	Rasidin Azwar	-	Indonesia	"
6.	Anon Watayanon	-	Thailand	"
7.	Somyot Pichitporn	-	"	"
8.	Bharantendu Mishra	-	Nepal	"
9.	K. Hitiarachchi	-	Sri Lanka	"

WORKING GROUP REPORT II - VARIETAL IMPROVEMENT

Chairman - Rudy Navarro

The initial discussions made on the varietal improvement was based on the items discussed in the varietal evaluation session.

The group decided that varietal improvement works should be focussed on the rice-based systems such as rainfed lowland and partially irrigated lowland. It was also recognized that breeding efforts should also include the upland condition. For the lowland rice-based sites, 2 growing conditions were also recognized; the pre-rice and post-rice. Under the different sites and growing conditions, the crops that fit in each condition as well as the constraints were identified. It was also stressed that attempts should be done by the Network to identify, collect and screen other minor legume species that could be used in the Network for purposes of crop diversification.

The salient points discussed during the session were the identification of specific areas of collaboration and the manner by which this collaboration will be implemented in the Network. During the discussions, the following areas of collaboration were identified:

1. Diseases
   a. Mungbean yellow mosaic
   b. Soybean rust
2. Drought tolerance
3. Waterlogging tolerance
4. Acid tolerance
5. Insect pest

Regarding the manner of collaboration, it was suggested that national breeding programs as well as international institutes/ centers working on specific area of collaboration will generate and provide promising materials to the lead institution which will collect and distribute these materials to interested national programs. The national programs and international institutes and centers that were identified to generate materials as well as the lead institution responsible for the collection and distribution of the materials for each specific problem area in the Network are presented below:

Area of collaboration	National/International Program	Lead Institute
1. Disease		
a. Yellow mosaic (mungbean and blackgram)	Pakistan, Sri Lanka and Bangladesh	Pakistan
b. Soybean rust	Philippines, Thailand, Indonesia and AVRDC	AVRDC
2. Drought	Philippines, Thailand, Indonesia, ICRISAT, IITA	IPB/IRRI
3. Waterlogging	Philippines, Indonesia, and AVRDC	IPB/IRRI
4. Acid	Philippines, Indonesia, Thailand and IITA	IPB/IRRI
5. Insect pest		
a. Beanfly (Mungbean)	Philippines and AVRDC	AVRDC
b. Podborer and bruchid	Philippines and IITA	IPB/IITA

It was also stressed that in addition to the responsibility of the lead institution to collect and disbribute the generated promising materials for each specific problem area, the lead institute will also prepare the methodology to be used in the screening of the materials.

For drought, waterlogging and acid tolerance variety trials, the collaborators will provide the Network coordinator promising materials for multiplication and distribution as an observation trial in the Network.

Finally, the group agreed that the Network Coordinator will initiate the necessary steps/arrangements for the successful implementation of these collaborative undertakings.

WORKING GROUP REPORT III - VARIETAL TESTING

Chairman - Rasidin Azwar

1. All participants of the monitoring tour stressed in the discussion about the importance of varietal testing for rice-based farming systems. Progress of the on-going program was pointed out in several crops.

2. Potential of various crops and varietal sources that can be fitted into the system in view of their grain yields, fodder yields, growing period and soil conservation (Table 1) were discussed and considered in the testing program.

3. In relation to rice crop, the possible cropping pattern of upland crops and their possible production constraints were defined in formulating varietal trials. Successful varieties for a given cropping pattern were expected to be tolerant to the prevailing environmental stresses that can be summarized as follows:

Production Constraint	Upland Crops in Rice-Based Pattern			
	Rainfed lowland		Irrigated lowland	Upland
	Pre	Post		
Drought		x		x
Water logging	x	x	x	x
Adverse soil (low pH)				x
Pest and disease	x	x	x	x
Appropriate maturity	x	x	x	
Shade				x
Cold temperature		x		

4. Testing materials from different sources will be pooled in the Network and distributed to national coordinator(s). Promising varieties from national program must be sent to the Network Coordinator for seed increase and inclusion in the trial. The Network will send promising varieties (8-12 entries). National programs will include their promising materials from their preliminary yield trial or breeding program to have a maximum of 15-20 entries (depending on available local entries) in the trial.

5. The varietal testing will be considered as preliminary yield trial in the target environment. Promising entries from this trial will be included in the advanced or regional trials.

6. Cultural management measures for each trial will be location specific and the input used should be minimum, preferably inputs used in cropping pattern testing.

7. General guidlines for cultural practices and data management will be provided in the field book by the Network. Fodder yield should be added to the present data sheet. National programs are encourage to analyze chemical composition of the plant biomass (protein and fiber content) in at least one location.

8. An uniform rating scales for pest and disease damages will be restudied and changes will be distributed to the cooperators.

9. There are good materials of mungbean resistant to yellow mosaic virus and blackgram varieties. Mr. Malik, the Coordinator of Grain Legume Program is willing to provide one set of their advanced trials to Bangladesh, IRRI, Sri Lanka and Thailand for testing.

Table 1. Selected upland crops from different sources that can be used in various cropping patterns for intensive rice-based farming systems.

Crops	Sources of Tested Materials: National	Sources of Tested Materials: International	Environments 1/ 1	2	3	4
∅ Food Legumes						
1. Soybean (SB)	China, Philippines, Indonesia, Thailand	AVRDC, IITA		x	x	x
2. Peanut (PN)	China, Philippines, Thailand	ICRISAT		x		x
3. Mungbean (MG)	Philippines, Thailand, Indonesia, Pakistan	AVRDC	x	x	x	x
4. Cowpea (CP)	Philippines, Thailand, Others	IITA	x		x	x
5. Chickpea (ChP)	Pakistan	ICRISAT	x	x		x
6. Blackgram (BG)	Pakistan, Thailand, Sri Lanka		x	x		x
7. Lentil (LT)		ICARDA	x	x		x
8. Minor legumes for cover crops and forage (Atsuki, Siratro, etc.)			x	x		x
∅ Cereal Grain Crops						
9. Corn (GC, FC)	Nepal, Philippines, Thailand Indonesia	CIMMYT	x	x		x
10. Sorghum (SG)	Philippines, Thailand, Indonesia	ICRISAT	x	x		x
11. Wheat (WT)	Pakistan, Philippines Bangladesh, Indonesia	CIMMYT		x		x

NOTE: Exchange of materials to crops that is of out most importance to individual countries will be facilitated by the Network Coordinator of the ARFSN.

1/ 1 = PRE-RICE, 2 = POST RICE, 3 = IRRIGATED, 4 = UPLAND

WORKING GROUP REPORT IV - VARIETAL RELEASE DISCUSSION

Chairman - Dean Ruben L. Villareal

Dean Villareal presented the varietal release scheme in the Philippines citing the grain legume as specific case or example. The discussion was followed by a lively and critical analysis of the problems and constraints of the Philippine scheme as perceived by the local participants. The brainstorming of the Philippine varietal release procedure was made in an effort to give the participants a good perspective of the scheme so that future problems arising from similar experience maybe avoided.

The procedure of varietal releases in other countries was elucidated by the following participants:

a. Dr. Bashir Ahmed Malik (Pakistan)

b. Mr. Anek Chotiyarnwong (Thailand)

c. Dr. Rasidin Azwar (Indonesia)

d. Mr. Akhter Hossain Khan (Bangladesh)

e. Mr. K. Hetiararchchi (Sri Lanka)

f. Mr. Jai Raj Joshi (Nepal)

Based on the presentations of the aforementioned participants, there appears to have varying lengths and complexity of tests from country to country. In all cases however, varietal release is done by a technical committee or groups representing the various discipline of varietal improvement (breeding, entomologists, pathologists, plant pathologists, etc.). This committee identifies appropriate cultivar from a coordinated federal/or provincial trials usually coordinated by specific crop breeders.

The testing scheme is generally common to all countries. It starts from a preliminary or standard yield trial. Promising materials from the test are put into the advance trial for 2-4 seasons and selected materials are evaluated into a multilocational or regional trials usually made in 2-4 seasons. On this basis, selected materials go to on-farm trials for wider adaptability tests and initial farmers acceptability of the promising cultivar. It is proposed by the network coordinator that in sites or areas where there is a farming system sites, varietal testing of promising entries should be tested in an appropriate or most suitable cropping system. Final recommendation or variety naming is made by a board or council composed of various government and private agencies or institutions involved in agricultural research and development and headed by the minister or head of the Department of Agriculture.

Commercial seed production also varied from country to country ranging from full government venture to predominantly private sector. The production of breeder and foundation seeds still rest on the technical committee supervising the coordinated trial.

Finally, the network coordinator, Dr. Carañgal, emphasized that the ultimate objective of this project is to provide national programs promising materials adapted for planting before and after rice. The promising materials from the Network trials should be included in the advanced yield trials. In addition, resource scarce nation may set their own prioritization on which crop/cropping system to intensify. Based on this priorities varietal testing and recommendations should be more specific for the different environments where the crops are grown such as for before rice and after rice in lowland and upland conditions.

VARIETAL TESTING OF UPLAND CROPS BEFORE AND AFTER RICE

A.H. Khan, N.E. Elahi, A. Quddus
S.M.R. Karim and A.K.M. Faruque[1]

INTRODUCTION

Bangladesh Agriculture is dominated by rice cultivation which covers 74 percent of the total cultivated area and is practiced by ninety two percent of the farmers. The cropping patterns of Bangladesh are essentially rice-based. Various upland crops like wheat, corn, barley, pulses, oil seeds, potato, sweet potato and vegetables etc. are grown either under rainfed or irrigated conditions before and after rice. The Rice Farming Systems Division (RFSD) of BRRI has been conducting rice-based cropping systems research for the last 11 years. The Bangladesh Agricultural Research Institute (BARI) is the authorized institution of developing varieties of upland crops except sugarcane and jute. The RFSD of BRRI has been conducting research on screening/ identificaiton of suitable cultivars/lines by receiving advanced breeding lines/varieties from BARI as well as from international sources for fitting in existing rice-based cropping systems since 1976. This paper briefly presents results of upland crop tested by RFSD of BRRI during 1985-86.

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[1]Senior Scientific Officers, and Scientific Officer, respectively, Rice Farming Systems Division, Bangladesh Rice Research Institute, Joydebpur, Gazipur, Bangladesh.

RESULTS OF UPLAND CROP VARIETY TESTING

Cowpea

Without the addition of organic matter into the soil and the continuous removal of nutrients by intensive crop cultivation, micro-nutrient deficiency has been induced in the irrigated and rainfed situations. The importance of legume crops in the cropping systems has been recognized as an important source of nutrients for the soil, livestock and humans.

Replicated trials with 31 advanced lines of cowpea received from IRRI were conducted in RCB in the premonsoon season at BRRI farm, Joydebpur to identify short duration (preferably 60 days) suitable lines for dual purpose use of green biomass for manuring/fodder and green pod consumption. A fertilizer rate of 30-60-40 kg/ha of N, P_2O_5 and K_2O respectively, was applied as basal. Seeds were drilled in furrows made 50 cm apart maintaining plant spacing 10 cm. Heavy rains resulted in several days of saturated to water logged conditions in the early vegetative stage. Of the 31 lines tested, 13 were severely damaged by fusarium wilt.

Agronomic informations on 18 lines are presented in table 1. Lines 1-8 and 9-18 were seeded on April 30 and May 9, 1985, respectively. Table shows that maturity days after emergence to first priming of dry pods was found to vary from 54 to 93 days and plant height from 32 to 70 cms. Results indicated that the lines TVx 3238-01G and BS(6-14R x AS) were found promising with dry grain yields of 2009 and 1835 kg/ha, green bio-mass of 10.3 and 12.1 t/ha, and maturity of 56 and 59 days, respectively. IT82D-889 with 54 days maturity produced 1538 kg/ha of grain but plant dried along with pod maturity. The green pod of this line is long (20.0 cm), soft and favoured as a vegetable cowpea but if it is harvested green, biomass produciton would definitely be higher. The higher grain yield is attributed to the long pod and number of pods/ plant.

Pigeonpea

One variety (C11) of pigeonpea received from IRRI was grown at BRRI farm, Joydebpur to assess its performance including ratooning ability. This was sown on May 5, 1985. October 20, 1985 was observed as 50 percent flowering date. The variety produced 2000 kg of grain per hectare in five primings started from December 21, 1985 to March 15, 1986 at an interval of 15 to 20 days. At fifth priming all plants were pruned at 30 cm height from the ground and allowed to emerge new shoots. Few days later unfortuantely while new shoots emerging, most plants were damaged and ratooning was not possible to continue.

Vegetables and Pulses

Bangladeshi farmers grow several non-rice crops in their rice-based cropping patterns. In the last few years lot of informations have been generated on various crops to be grown in combinations with rice. But very little attention has been given on rice-based cropping systems of marginal areas where soil conditions along with moisture supply considered as limiting factors to crop growth.

Sreepur, a farming systems research site of RFSD, is a representative of marginal areas. The soil is characterized by "Chala" and "Byde". The byde is depressed valleys in forest areas and the existing major cropping pattern is double rice crops of local Aus-local T. Aman. The chala type of land is little bit higher than byde land, well drained, very low in nitrogen and organic matter content having pH value of 4.5. Farmers' predominant cropping patterns are single local Aus (DSR) and sugarcane. After local Aus, the land remains fallow for the remaining months. Rice Farming Systems Division has been doing research at the site since 1983 to diversify cropping, identify problems of crop production and explore possibilities of growing new crops in the area. Several non-rice crops were screened during last three years.

In upland crop screening, potato showed potential in the Sreepur area. Three potato cultivars, Diamont, Cardinal and Multa were evaluated in 1984 rabi season after rice. Diamont and Multa were found suitable for the area with yield of 10.8 and 11.9 t/ha, respectively. But farmers did not show their interest to include potato in their cropping systems because of high initial cash involvement for seed tuber. An attempt was, therefore, undertaken to increase potato acrage by minimizing seed cost. Cultivar Diamont with three tuber cuts were included in the study and planted after rice on December 1, 1985. Results from two farmers' field indicated that though tuber with one cut and tuber cut with as many eyes as present produced less yield in both types of land after two and one rice than yield obtained from whole tuber but 34 to 56 percent tuber seed cost could be saved compared to whole tuber (Table 2). Whole tuber produced 13.1 and 10.9 t/ha of tuber in Byde and Chala land, respectively. Both tuber cuts gave similar yield (11.4 t/ha) after two rice in Byde. In chala land, tuber with one cut and tuber with many cuts produced 10.0 and 8.0 t/ha of potato, respectively. Further studies on economics are needed to popularize the practice.

Single corp of DSR is the major practice of Sreepur farmers in acidic chala land. To diversify cropping, varieties of several non-rice crops were evaluated at the site during last two years. Variety 2410 of blackgram, CES-2F-1 of mungbean and Miyashige of radish were grown well and selected as potential cultivar for the area. To find out the optimum time of planting, cropping pattern trials involving BR20 (Direct seeded upland rice) followed by blackgram (2410), mungbean (CES-2F-1) and radish (Miyashige) were conducted in 1985. Planting, harvesting time and agronomic productivity of the patterns are presented in Table 3. Results indicated that first crop (BR20) gave more than 2.3 t/ha grain at first planting but delay in seeding consistently decreased grain yield. The low yield of rice was attributed to limited soil moisture available during reproductive to ripening stage. On the other hand radish delayed planting showed increasing tend in yield with highest (5.2 t/ha) obtained at third planting after rice but blackgram and mungbean produced 1500 and 420 kg/ha of grain at second planting. Considering the market price and deficit of rice in the area farmers may be advised to grow BR20 followed by blackgram and or radish.

Upland crop trial in saline area

The area is located in Sonagazi Upa-zila in the southern part of the country. The soil is characterized as calcareous alluvium and is sandy loam having pH 7.9. The salinity level in the area is less than 4 m mhos/cm from June to October and greater than 5 m mhos/cm from late October to mid June.

Several upland crops were tested in order to find out well adopted salt tolerant crops during rabi season 1985. All crops were grown under rainfed conditions except four vegetable crops (cabbage, cauliflower, tomato and radish) which received one to two bucket irrigations. From data it was observed that though yield was low but all crops showed prospect to adopt under that situation (Table 4). The varietal reaction of a given crop to soil stress condition may be different. So, the identification and develcpment of varieties of various crops are needed for the area.

Wheat trial at Thakurgaon

Dramatic change in Bangladesh Agriculture has been brought with expansion of irrigation facilities and the availability of modern wheat varieties. Considering the country's food demand, cost of production and suitability, rice-based cropping patterns are being intensified with the inclusion of wheat. The soil of North Bangladesh Tubewell project area is light textured and farmers adopted wheat after T.Aman in their rice-based cropping systems. Planting time, which greatly affected grain yield is the important factor of wheat cultivation. In general, the late harvesting of T.Aman causes delayed seeding of wheat results in low yield due to rice in temperature along with dry weather starting from reproductive through ripening phase. Therefore, wheat varieties with yield potential for late seeding are needed.

A replicated trial was conducted to evaluate the performance of six wheat varieties at the project area of North Bangladesh Tubewell Project, Thakurgaon, in 1985-86 rabi season. After harvesting T.Aman seeds were sown on December 12, 1985 and harvested on April 2, 1986.

Only one irrigations was provided at 22 days after seeding. Table 5 shows that the highest grain yield (3.5 t/ha) was obtained from variety Kanchan followed by the grain yield (3.0 t/ha) of Akbar. Balaka and Barkat produced 2.8 and 2.0 t/ha, respectively. The grain yields of Sonalika and Ananda were less than 2.0 t/ha. Differences in grain yield may be attributed to varietal characteristics. Varietal performances indicated that Kanchan and Akbar can be grown under late seeding condition after T.Aman in that area.

Non-rice crop in Barind Tract

The Barind Tract covers 0.7 million hectares in the North West part of the country having more than 200 mm of rainfall per month from June to August. The Tract is classified as dry zone of the country. Farmers generally grow non-rice crops after rice under rainfed condition. Of the non-rice crops gram, barley, linseed and wheat are popularly grown either single or mixed cropping with low productivity (Table 6). Productivity of the non-rice crops could be increased with availability of modern varieties together with associate production practices.

Non-rice crops included in the pattern tested at different multi-location test sites in 1985 showed that the yield of rice over the local increased by 136 percent while the non-rice crops like gram, barley and linseed did not show increasing trend in yield (Table 7). The low yield of the non-rice crops is attributed to the drought effect on the crop. Varieties having tolerance to drought along with improved management may improve the yield and income.

CONCLUSIONS

Cropping patterns of Bangladesh are rice-based. Various non-rice crops are grown before and after rice. Non-rice crops cultivation are not always possible due to drought after rice and if grown before rice suffered from water logging. Suitable cultivars are needed for intensifying cropping systems in low rainfall Barind Tract, acid upland soil, saline belt and flood free area both under irrigated and rainfed situations. Attention has to be given on varietal tolerance to drought, water logging, extreme temperature, salinity and competitive ability of cultivars in inter- or mixed cropping while developing varieties of non-rice crops. Presently, RFSD of BRRI is actively participating with BARI regarding the varietal testing program. Asian Rice Farming Systems Network varietal testing program supplied seeds of non-rice crops and those are being evaluated by RFS Division of BRRI. Present collaborative approach should be continued for identifying/developing varieties of upland crops for different agro-ecological zones mentioned above.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to the scientists working in RFS Division and Sonagazi Regional station of BRRI and also to the scientists working at Thakurgaon Tubewell Project area.

Table 1. Agronomic performance of dual purpose cowpea lines grown in Kharif season for rice-based cropping systems at BRRI Farm, Joydebpur, 1985. Average of 3 trials with 3 replications.

	Lines	Plant type[1]	Date of 50% flowering at DAE (days)	Plant height (cm)	Pods/ plant	Pod length (cm)	Seeds/ pod	Grain yield (kg/ ha)	Green biomass harvest (t/ha)	Maturity after emergence (days)
1)	TVx 3238-01G	D	40	50	10	13.3	13	2009	10.3	56
2)	IT81D-1205-174	ID	48	54	7	16.5	15	1168	25.6	77
3)	TVx 3627-012F	D	48	60	5	15.0	14	709	5.7	71
4)	TVx 1948-012F	ID	49	70	5	17.0	16	683	9.7	88
5)	TVx 3871-02F	ID	50	50	6	14.0	12	486	9.2	89
6)	IT82E-27	ID	54	63	5	16.0	13	411	14.0	93
7)	TVx 4654-44E	D	52	32	4	13.0	10	184	6.1	90
8)	TVx 1836-013J	ID	49	51	4	15.0	11	119	8.3	67
9)	IT 81D-1228-10	ID	48	56	5	14.0	14	440	16.5	79
10)	IT 81D-1228-12	ID	46	51	4	15.0	12	362	14.0	82
11)	BS_3 (6-14R x AS)	ID	46	50	7	19.0	18	1835	12.1	59
12)	IT 82D-889	D	40	57	8	20.0	18	1538	5.6	54
13)	IT82E-56	ID	45	64	5	13.5	11	477	8.1	63
14)	IT62F-18	ID	46	61	5	13.0	13	453	15.0	60
15)	IT82F-60	ID	48	55	5	14.0	14	310	11.2	64
16)	TVx 2939-09D	ID	46	45	7	13.0	13	1035	10.1	76
17)	TVx 3381-02F	ID	48	49	5	14.0	13	556	14.6	82
18)	TVx 3910-02J	D	48	43	7	12.6	12	1037	11.0	70

[1] D = Determinate; ID = Indeterminate; DAE = Days after emergence

Table 2. Effect of potato seed size on the yield of potato under supplemental irrigations in two land types, during rabi season, Sreepur, 1985. Average of 12 replications.

Potato tuber size	Yield (t/ha) After two rice (Byde land non-acidic soil)	Yield (t/ha) After one rice (Chala land, acidic soil)	% less seed needed over whole tuber
Whole tuber	13.1	10.9	-
Tuber with one cut	11.4	10.0	34
Tuber cut with as many eyes as present	11.4	8.0	56

Acidic soil: pH 4.5

Table 3. Date of seeding and harvesting and yield (kg/ha) of three rainfed cropping patterns under acid upland (Chala land) soil at Sreepur, 1985.

Aus	Rabi	First Seeding				Second Seeding				Third Seeding			
		1st Crop		2nd Crop		1st Crop		2nd Crop		1st Crop		2nd Crop	
		D/S	D/H	D/S	D/H	D/S	D/H	D/S	D/H	D/S	D/H	D/S	D/H
BR20	Blackgram	May 1	Aug 17	Sept 12	Nov 24	May 15	Aug 28	Sept 18	Nov 28	May 30	Sept 9	Sept 21	Dec 3
	(2410)		(2560)		(1110)		(1287)		(1500)		(991)		(510)
BR20	Mungbean	May 1	Aug 17	Sept 12	Nov 15	May 15	Aug 28	Sept 18	Nov 26	May 30	Sept 9	Sept 21	Dec 4
	(CES-2F-1)		(2302)		(285)		(1413)		(420)		(901)		(300)
BR20	Radish	May 1	Aug 17	Sept 12	Nov 2	May 15	Aug 28	Sept 18	Nov 12	May 30	Sept 9	Sept 21	Nov 20
	(Miyashige)		(2384)		(2834)		(1418)		(4349)		(1051)		(5249)

D/S = Date of Seeding, D/H = Date of Harvesting; Figures in parentheses indicate yield.

Table 4. Yield and growth duration of different rabi crops grown in saline soil at BRRI Regional Station, Sonagazi, 1985.

Variety	Duration (days)	Yield (t/ha)
Potato	110	9.75
Onion	110	4.32
Garlic	115	1.45
Radish	95	18.25
Mustard	110	0.54
Rye 5	110	0.32
Mung	113	0.49
Chilli	135	2.75*
Cauliflower	111	9.85
Tomato (Ruma)	135	15.07
Tomato (Tedy)	134	17.50
Brinjal	130	12.80
Cabbage	129	11.67
Turnip	117	9.03
Knokhol	113	11.63
Carrot	111	1.97
Sweet potato	159	12.75
Bittergourd	149	0.97

*Green weight.

Table 5. Grain yield of six wheat varieties grown after T.Aman in North Bangladesh Tubewell Project area, Thakurgaon, Rabi, 1985.

Variety	Yield (t/ha)	Grain size* and colour*	
Kanchan	3.50	Bold	white
Akbar	3.00	Medium	white
Balaka	2.80	Medium	white
Barkat	2.00	Medium	white
Sonalika	1.85	Bold	white
Ananda	1.33	Medium	white

*Source: Wheat Research Project, BARI.

Table 6. Management practices and inputs used by the farmers in low rainfall Barind areas during rabi season, 1981.

Observations	Wheat	Grain	Barley+ Gram	Linseed+ Gram	Gram+ Barley	Gram+Barley+ Linseed
Samples (no.)	3	2	15	5	15	25
Average no. ploughing	3	2	3	2	3	4
Average no. laddering	2	2	3	2	3	3
Rate of $N-P_2O_5-K_2O$ (kg/ha)	0-0-0	0-0-0	0-0-0	0-0-0	0-0-0	0-0-0
Yield (kg/ha)	2200	350	190+980	310+415	180+1100	90+600+160
Cost (Tk/ha)	879	757	785	793	852	726
Net return (Tk/ha)	4621	1643	5693	2807	6108	5734

Table 7. Yield of participating and non-participating farmers' patterns at four multi-location test sites in the Barind Tract, 1984-85.

Sites	Participating Farmers				Non-Participating Farmers			
	Cropping Pattern		Yield (t/ha)[1/]		Cropping Pattern		Yield (t/ha)[1/]	
	Rabi	T.Aman	Rabi	T.Aman	Rabi	T.Aman	Rabi	T.Aman
Godagari	Wheat	BR11	1.8	6.3	Linseed	Local	0.3	2.4
	Gram+Barley	BR10	0.5+1.5	5.5	Wheat	Local	1.2	2.3
Paba	Wheat	BR11	1.9	5.8	Gram+Barley	Local	0.7+0.8	2.3
	Gram+Barley	BR10	0.9+1.3	6.0	Gram+Linseed	Local	1.6+0.2	2.4
Nachole	Wheat	BR11	1.6	6.0	Wheat	BR11	2.2	4.5
	Gram+Barley	BR10	0.6+0.7	6.5	Gram+Barley	BR10	0.5+0.5	4.3
Khaloo	Wheat	BR11	2.8	6.2	Wheat	Local	2.9	2.9
	Gram+Barley	BR10	0.3+0.8	4.9	Wheat	BR11	2.9	4.5

[1/] Average of two farmers' plot.

VARIETAL IMPROVEMENT OF SOYBEAN FOR RICE FARMING SYSTEM AND SOYBEAN VARIETAL TESTING AFTER RICE IN THAILAND

Anek Chotiyarnwong [1]

Most of the Asian countries where rice is the main food crop, rice areas remain fallow for a period of 3 to 6 months during the dry season. Limited water availability has been the primary cause for this area to be left uncultivated. However in areas where cropping system have been intensified, such as northern Thailand, rotations of rice-soybean-corn or rice-rice-soybean are quite common.

Soybean is planted after rice in rice-soybean double cropping pattern in northern Thailand. It is grown in the paddy field after rice crop between December to April. Results of the experiments in cropping system conducted in the farmer fields indicated that no-tillage planting was suitable for soybean establishment. Burning rice stubble resulted in better control of weeds and enhanced between crop stand. Flooding the field prior to planting resulted in poor and ununiform soybean stand. The most suitable planting technique was to allow soybean seed to germinate in moist soil until reaching unifoliate leaf stage before first irrigation would be given. Broad-casting soybean seed was not suitable for practices.

The production of soybean in Thailand is approximately one-half of the requirement of the country. From the amount of soybean

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[1] Soybean Breeder, Chiang Mai Field Crop Research Center, Chiang Mai, 50290, Field Crop Institute, Department of Agriculture, Thailand.

utilized in 1984/85 of 400,000 tons, 246,448 tons had been grown in Thailand and the rest of 253,552 tons had been imported into the country (Table 1). About 30% is consumed direct as various kinds of food, 12% is used as seeds and 58% by crushing mills.

Approximately 200,400 hectares of land were grown to soybean in Thailand in 1984/85 (Table 1).

Breeding Objective

1. Early maturity: It is important in increasing cropping intensity. This is needed especially for upland crops grown under pre-rice environment because of the short growing period available, and for post-rice environment to minimize exposure of crops to moisture stress in the later part of the growing season. However, for lowland crop under post-rice environment some areas are limited by the irrigated water. Early maturing is important for rice-based farming system.
2. Drought tolerance: Upland crops or some lowland crops are grown on residual moisture or limited moisture this trait is the most important character. It is needed at seedling stage or pod seeting stage for pre-rice and at later stage for post-rice.
3. Photoperiod insensitive: Growing at post-rice soybean is generally towards shorter day length and therefore this trait is especially important to soybean.
4. Minimum input type: The material should be able to yield with little fertilizer use and no pesticides since majority of farmers have problems obtaining them and would not take too much risk when planting a crop under stress conditions.

5. Resistance to disease: Soybean rust is the most important for pre-rice soybean and downy mildew for post-rice.
6. Crop residues for animal feeds: It is also significant to identify dual-purpose crops for grain and backyard livestock feeds.

There are many other traits that breeders normally select such as resistance to pests and diseases; non shattering ability; seed dormancy; non lodging; seed longevity; etc. Examples of desirable legumes varietal characteristics needed by Thailand national programs for soybean, mung-bean and peanut are shown in Table 2.

Varietal Testing of Soybean

The province of Chiang Mai is considered one of the leading areas in soybean production (Agricultural Statistics Center, 1985). The province planted only 38,166 hectares. About 80% was grown in dry season or after rice. In the rainy season, transplanted rice and wet bed rice are planted in July, while broadcast rice is planted in June. The rice crop matures and ready for harvesting between the last week of November to the first week of december. Soybean is planted during the last week of December up to the 10^{th} of January (Pookapakdi, 1982). If soybean is planted later, the risk of being destroy by rainfall in May will be great.

Varietal testing of soybean in farmer field and Chiang Mai Field Crop Research Center had been grown in dry season or after rice. Soybean cultivars from AVRDC, IRRI, IITA and some promising in Thailand should be evaluated in dry season, 1985 (Tables 3-9).

We can be concluded, AGS 183 from AVRDC (Table 3), TGX 252-71C, TGX 536-02D, TGX 573-6C and TGX 711-01D from IITA (Table 6) gave the average yield higher than local cultivar.

Summary

Four main conditions that are common in the rice producing areas of Thailand should be considered in legumes breeding programs:

1. Before lowland rice at the beginning of the rainy season.
2. After lowland rice of the dry season.
3. Upland areas at the beginning of the rainy season.
4. Upland areas at the late rainy season.

Specific breeding objectives depending on the environmental conditions in the field must be developed and relevant research issues addressed.

Breeding programs have only recently focused on the specific environmental conditions under which legumes are grown in cropping systems in farmers fields.

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Table 1. Area, production and yield of soybean in Thailand.

Region	Planted Area (ha)		Production (tons)		Yield (t/ha)	
	1983/84	1984/85	1983/84	1984/85	1983/84	1984/85
North Eastern	12,775	20,019	13,310	23,214	1.07	1.22
Northern	137,183	165,730	154,101	206,678	1.16	1.29
Central Plain	11,396	14,659	11,712	16,547	1.08	1.17
Southern	4	-	3	-	1.34	-
Total	161,358	200,408	179,126	246,448	1.13	1.23

Source: Agricultural Statistics Center, 1985.

Table 2. Desirable legumes varietal characteristics for rice-based cropping system in Thailand.

Characters	Soybean	Mungbean	Peanut
High stable yield	x	x	x
Big seed		x	
Photoperiod insensitive	x		
Green seed		x	
Early maturity	x	x	x
Mid maturity	x		
Resistance to rust	x		x
Resistance to downy mildew	x		
Uniform maturity	x	x	x
Good seedling vigor	x		x
Non shattering	x	x	
Drought tolerance	x	x	x
Shade tolerance	x		
Low pH tolerance	x	x	
Resistance to moisture logging		x	
Seed dormancy			x
Cold tolerance		x	x
Resistance to Cercospora leaf spot		x	
Resistance to Powdery mildew		x	
Tolerance to Bacterial wilt			x
High shelling percentage			x
Light colored seed coat (pink)			x

Table 3. Grain yield, 100 seed weight and maturity of soybean cultivars from AVRDC evaluated at Chiang Main, Thailand after rice 1985.

Entry No	Cultivar	Yield (t/ha)	100 Seed wt. (gm.)	Maturity
1.	AGS 183	1.46 a	11.2 f	87
2.	SJ.5	1.02 b	14.6 bc	93
3.	AGS 129	1.01 b	13.2 c-e	83
4.	AGS 172	0.81 bc	14.3 de	90
5.	AGS 146	0.79 bc	13.0 c-e	87
6.	AGS 228	0.69 cd	14.1 b-d	90
7.	AGS 208	0.69 cd	16.6 a	86
8.	AGS 217	0.66 cd	14.1 b-d	90
9.	AGS 58	0.63 c-e	15.3 ab	87
10.	AGS 29	0.62 c-e	11.9 ef	93
11.	AGS 133	0.47 de	14.4 b-d	87
12.	AGS 204	0.38 e	13.6 b-d	86
Average		0.77	13.8	
C.V.(%)		20.9	7.6	

Table 4. Grain yield, 100 seed weight and maturity of some promising soybean cultivars evaluated at Chiang Mai, Thailand after rice, 1985.

Entry No	Cultivars	Yield (t/ha)	100 Seed wt. (gm.)	Maturity
1.	60014 - 7 - 40 - 3	1.44 ab	11.6 d-g	98
2.	60014 - 7 - 61 - 1	1.28 b-d	11.3 e-g	97
3.	60014 - 7 - 61 - 3	1.27 e-g	11.1 e-g	95
4.	60014 - 7 - 61 - 5	1.38 b-c	10.8 fg	98
5.	60011 - 5 - 2 - 49 - 3	1.28 b-d	12.4 b-f	96
6.	SJ.4	1.76 a	14.2 a	102
Average		1.03	12.3	
C.V. (%)		20.1	6.9	

30 promising soybean cultivars ;

60014 = TN # 4 x Clark 63

60011 = Clark 63 x TN # 4

Table 5. Grain yield, plant height, pods per plant and 100-seed weight of soybean cultivars from IRRI evaluated at Chiang Mai after rice 1985.

	Cultivars	yield (t/ha)	Plant height	Pods plant	100 Seed wt. (g)
1.	UPL SY. 2	0.71	68	38	13.1
2.	Clark 63	0.60	61	46	12.7
3.	7207-1	0.90	57	48	13.0
4.	30290-11	0.89	47	67	14.8
5.	Guntur	0.69	88	59	8.3
6.	7521-26-2	1.06	51	49	13.2
7.	AGS 144	0.76	43	43	13.1
8.	G 2261	0.41	42	34	12.1
9.	SJ.4	1.11	63	67	10.7
10.	SJ.5	0.91	56	66	11.8
Average		0.81	58	52	12.3

Table 6. IITA International Soybean Varietal Trial, Medium Maturity set after rice 1985.

Cultivars	Yield (t/ha)	Plant height	Pods per plant	100 Seed wt.	Maturity
1. TGX 252-71 C	1.64	70	89	13.2	112
2. TGX 536-02 D	1.17	63	78	9.8	104
3. TGX 573-6 C	1.57	67	74	9.3	112
4. TGX 711-01 D	1.69	71	58	14.1	109
5. TGX 442-02 D	0.57	88	60	7.6	117
6. SJ.1	0.91	72	57	10.8	100
7. SJ.2	0.87	60	68	12.0	102
Average	1.06	71	65	9.7	
C.V. (%)	22.0				

Table 7. IITA International Soybean Varietional Trial, Late Maturity set after rice 1985.

Cultivars	Yield (t/ha)	Plant height	Pods per plant	100 Seed wt.	Maturity
1. TGX 304-059 D	0.81	87	60	9.3	111
2. TGX 306-36 C	0.59	78	63	6.7	104
3. TGX 713-011 D	0.69	70	37	8.6	118
4. TGX 742-05 D	0.84	81	51	6.5	127
5. TGX 742-012 D	0.69	70	70	7.3	120
6. SJ.1	1.06	81	41	10.5	113
7. SJ.5	0.79	70	40	10.6	110
Average	0.78	76	51	8.5	
C.V. (%)	32.3				

Table 8 Soybean Farm Trial at Chiang Mai after rice, dry season 1985.

Cultivars	Grain Yield (t/ha)		Average
	Location 1	Location 2	
1. SJ.1	1.70	1.53	1.61
2. SJ.2	1.97	1.50	1.73
3. SJ.4	1.70	1.37	1.53
4. SJ.5	1.96	1.67	1.81
5. 7508-50-10	2.00	1.97	1.98
6. 7608-25-4	1.17	1.06	1.11
Average	1.75	1.52	
C.V.(%)	15.1	17.1	
L.S.D. (5 %)	0.48	0.47	

Table 9. Comparison of grain yield between the experimental plot and farmer plot in the farmer field after rice 1985.

Farmer	Grain yield (t/ha)			Inereasing
	Experimental plot		Farmer plot	
	SJ.4	SJ.5	SJ.4	yield (%)
1.	2.51	2.59	1.32	90
2.	2.57	2.70	1.31	100
3.	2.41	2.34	1.87	27
Avweage	2.50	2.54	1.51	72

PROGRESS OF THE PEANUT VARIETAL IMPROVEMENT FOR RICE FARMING IN THAILAND

Anon Vatayanonta[1], Aran Patanothai[2] and Montien Somabhi[3]

INTRODUCTION

Although most of the rice lands in Thailand are cropped with monoculture. Here are still several multiple cropping patterns adopted for a long time by certain farmers. Growing peanut or native cowpea after rice without irrigation is the traditional double-cropping pattern practiced for over 20 years by the farmer of certain areas of the Northeast. Peanut grown after rice with irrigation in the Northern and Northeastern parts of Thailand is also as well established cropping system. One of the limiting factors, however, is the lack of peanut varieties suitable for these rice-based farming systems.

RICE-BASED PEANUT IMPROVEMENT PROGRAMS

Peanut varietal improvement for rice farming is one of many objectives of Thailand Coordinated Groundnut Improvement Program part of which financial supports are received from the International

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[1]Research Agronomist, Khon Kaen Field Crops Research Center, Field Crops Research Institute, Department of Agriculture, Thailand.

[2]Breeder and Leader, Groundut Improvement Project, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand.

[3]Director, Khon Kaen Field Crops Research Centre Field Crops Research Institute, Department of Agriculture, Thailand.

Development Research Centre (IDRC) and the Peanut Collaborative Research Support Program (Peanut CRSP). Peanut improvement for use as a dry season crop after rice in irrigated areas has been taken care of by the breeding program of the Department of Agriculture; and improvement for use before-rice and after-rice crop without irrigation have been emphasized by Khon Kaen University.

PROGRESS OF RESEARCH WORK

At Khon Kaen University work was done with two objectives. Screening of groundnut lines for the before-rice growing conditions was continued from the previous year. In the 1985 before-rice (early rainy) season, a substantial number of groundnut lines were yield tested in such a condition. These lines were groups according to how they were derived and tested in 12 yield trials, most of which were tested at two locations, e.g. Ban Muong, Khon Kaen, and KKU. The trials at KKU were originally intended to test those lines for tolerance to water logging conditions at late growth stage, the varietal characteristic required for the before-rice cropping system. However, creation of water logging condition at KKU was unsuccessful due to too good drainage capability of the soils. Therefore, they were considered as the normal yield trials as in another location.

Most of the lines tested in these trials were entries which have shown good performances in the yield trial sin the 1984 before-rice season. There were only four trials in which the entries were new lines entering yield testing in the before-rice growing conditions for the first time this year.

Yields obtained from these trials were quite high. Several entries gave yields of over 4 tons/ha, and in one trial the top yielding entry gave yield of over 5 tons/ha. In most of the trials, there were several lines showing superior performances to the check entry Tainan 9. It was noted that another released variety, Lampang, which was also included as a check showed good performance and was among the top yielding entries in several trials. This variety was also the top yeilding entry in several trials in the 1984 before-rice season. It was suggested, for now, this variety should be recommended for the before-rice cropping system.

A substantial number of groundnut lines were tested under the after-rice unirrigated growing condition at Khon Kaen University in the dry season of 1984/85. Ten yield trials with number of entries ranging from 16-30 were conducted. Materials tested in these yield trials included lines selected from the 1983/84 after-rice yield trials, observation nursery, and breeding nursery, and two set of the 1984 Coordinated Groundnut Preliminary Yeild Trials. Two hundred and forty eight lines selected from the materials received form NCSU in 1983 were grown in two replicates in the observation nursery. Additional 221 lines, mostly ICRISAT materials, were grown in the breeding nursery.

Despite som eproblems of the soil heterogeneity, particularly potassium deficiency in certain spots, Yield levels of the groundnut lines tested in the yield trials were quite high. Yields of the check entry Tainan 9 in these trials ranged from 801-1961 kg/ha. Quite a number of lines gave yields significantly higher than Tainan 9, some of which gave yields of more than 70% higher than Tainan 9. Many of these lines yielded more than 2 tons/ha, and the maximum yield of 3440 kg/ha was obtained from the cultivar CES 2-5 in the trial GB84-302.

Yield of the lines grown in the observation nursery were rather low, as were those of the check entry Tainan 9, presumably due to too late planting and severe potassium deficiency. Nevertheless, several lines showed yield superiority than the check entry Tainan 9 and were selected for subsequent testing. Similarly, promising lines in the breeding nursery were also selected for further testing.

The peanut improvement program of the Department of Agriculture for use in the rice-based cropping systems takes a different lines of approach quite different from that of Khon Kaen University. Emphases have been made on screening and testing early lines with maturity range between 80-85 days and screening and testing of normal maturity gropw with high yields for use in irrigated paddy fields during the dry season. Improvement for earliness, however, has a dual objective for inclusion in upland and rice cropping systems.

During early years, screenings of early materials were done in the main rainy season. However in recent years screenings and testings were done in early part of the rainy season to develop varieties suitable as the first crop before another crop of either rice or upland crops.

In 1985 there were 5 trials with lines or varieties from IRRI cropping system program, ICRISAT and other sources. From these trials, many lines and varieties gave yields as high as Tainan #9 and Lampang, check varieties, when harvested within 85 days. In some trials many lines performed better than the checks, e.g. (Table 9), and (Dh-3-20 x Chico)-F2-B1-B1-B1-EB1 (Table 11). These lines will be further tested under farmers' conditions.

The normal maturity liens were also tested separately during the dry season in the irrigated paddy field in 1985. Materials tested were from different sources. Some lines were from the breeding programs of the Departent of Agriculture, Khon Kaen University, and Kasetsart University. However, the majority of lines tested this year were introduced from ICRISAT and NCSU under the peanut collaborative research program. The tests under irrigated paddy field conditions were part of the peanut improvement program of the Department of Agriculture with aims to evolve varieties that could be recommended for use during the dry season. The test followed the four-step procedure, i.e. priliminary, standard, regional and farm trials.

Several sets of lines were included in the preliminary yield trials at Kalasin Field Crops Experiment Station. Table 12 shows some of the lines that performed well in these trials. They will be selected and included in the standard yield trials next year. These lines gave dry pod yield above 3 tons/ha.

More advanced materials were included in the standard yield trials. A number of lines like (MGS-1 x SM-5)-1, ICG 4645B NCAcc 17093, (Taiwan-2 x PI 33739F)-7, (Tainan 9 x PI 314817)-17-3-34, (Panjab x PI 314817)-15-2-34, (Taiwan 2 x PI 314817)-16-2-39, (Gadjah x PI 314817)-18-1-30, (Taiwan 2 x J11)-7-1-6, (Moket x J11)-12-3-26 and (Tainan 9 x J11)-11-1-17 gave dry pod yields 10% or more above the standard check, Tainan 9 (Table 13). Some of these lines also performed satisfactorily under the upland rainfed conditions. They will move to the more advanced trials.

Earlier received materials were tested at the regional yield trial stage. Table 14 shows the results of the trial conducted at Kalasin.

Lines that outyielded the check, Tainan 9, were TMV-3, Asiatica, ICG 460, and ICG 5084. After checking their performances in previous trials, some of these lines will be tested under farmer's conditions before releases.

PROBLEMS OF IMPROVEMENT

Major problems in screening lines were soil heterogeneity of farmers' fields and differences in elevations among the bundes fields with consequent differences in moisture conditions. Variation in rainfall from year to year was more of a problem for the before-rice testings. Variation in crop establishment was encountered in both before-rice and after-rice testings.

The most important aspect of breeding peanut, as well as other upalnd crops, for rice-based cropping systems has been material evaluations. Two general approaches can be taken in varietal screening. The first approach is to screen for the individual characteristics required, e.g. drough tolerance during early growth stage and flooding tolerance during late growing stage for the before-rice system, drought tolerance during late growth stage for the after-rice system, and earliness for both. The second approach is to screen for general performance under the conditions in which they will be grown. It is sometime difficult for the research workers to take appropriate steps in screening their materials.

Table 1. List of groundnut breeding trials conducted in the 1985 before-rice growing season at Ban Muong, Khon Kaen and at Khon Kaen University.

Trial no.	Group of lines	Location	No.of entries	Rows/ plot	No.of rep.
GB 85-101	Best entries trial	B.Muong KKU	24 24	4 4	4 4
GB 85-102	Lines from Coordinated Regional Y.T. and IRRI Trial	B.Muong KKU	20 20	4 2	4 2
GB 85-103	Lines from Coordinated Standard Yield Trial	B.Muong KKU	20 20	4 4	4 4
GB 85-104	Early-drought tolerant and rust res. lines from Kalasin	B.Muong KKU	12 12	4 2	4 2
GB 85-105	Lines selected from BN-1981 R, BN-1982 R, and ICGS NOS.	B.Muong KKU	18 18	4 2	4 2
GB 85-106	Lines from KKU collection	B.Muong KKU	16 16	4 2	4 2
GB 85-107	Lines selected from BN 1983 R	B.Muong KKU	20 20	4 2	4 2
GB 85-108	Local varieties	B.Muong	18	4	4
	Lines selected from BN 1984 BR :				
GB 85-109	Set I	B.Muong	24	2	2
GB 85-110	Set II	B.Muong	16	2	2
GB 85-111	Early lines from NCSU materials	B.Muong	24	2	2
GB 85-112	Early lines selected from BN 1984 R	KKU	24	2	2

Ban Muong - Date planted : 10 Jnue for GB 85-111, 29-30 April for other
Date harvested : 5-6 August 1985.

KKU - Date planted : 14-15 June ; Date harvested : 19-21 August 1985.

Table 2. Pod yields and weight of immature seeds per plot of the five top yielding entries at each location in the different yield trials of groundnut grown at Ban Muong, Khon Kaen, and at KKU in the 1985 before-rice season.

Entry no.	Identification	Pod yield				Immature seed (g/plot)	
		Ban Muong		KKU		Ban Muong	KKU
		kg/ha	%check	kg/ha	%check		
GB 85-101 : Best entries trial							
8	Virginia bunch 112-4	3294	178	4787	227	41	99
12	(MGS - 9 x chico)-16-1			3824	181		49
9	ICG 302 NCAC 586			3776	179		63
11	(MGS - 7 x SM - S)-1-5			3745	177		92
16	(MGS - 9 x Robut 33-1)5-2-2-3			3564	169		156
19	(Ah 65 x chico)2-6-6	3052	165			46	
2	KAC 249 (ICG 402)	2985	161			51	
13	69-PYS 10 > (C-124)	2803	151			28	
14	TSD 959	2762	149			57	
23	Tainan 9 (Check)	1854	100	2113	100	24	101
	LSD.05	900		579			
	C.V.(%)	43.8		20.6			
GB 85-102 : Lines selected from Coordinated Yield Trial and IRRI Trial							
16	ACC 12	4866	215			73	
14	CES 2-5	2861	126	3222	162	60	23
13	UPL-PN-2			2951	148		30
11	F 334-33	2791	123			82	
20	Lampang	2676	118			55	
4	KAC 304 (ICG 5020)	2665	118	2668	134	63	144
2	KAC 245 (ICG 1664)			2573	129		68
5	KAC 320 (ICG 464)			2398	121		92
19	Tainan 9 (check)	2265	100	1988	100	41	132
LSD.05		625		153			
C.V. (%)		33.3		17.6			

Table 2. (Continued).

Entry no.	Identification	Pod yield: Ban Muong kg/ha	Ban Muong %check	KKU kg/ha	KKU %check	Immature seed (g/plot): Ban Muong	KKU
GB 85-103 : Lines from Coordinated Standard Yield Trial							
20	Lonyun 6101	3598	169			55	
19	Lampang	3143	147	2823	130	44	180
3	(MGS 1 x SM 5)-1	2941	138	2473	114	54	98
1	No. 32			2787	128		116
12	J 11 x JG - 3	2691	126			68	
4	(MGS 1 x SM 5)-2	2678	126	2327	107	86	118
9	(Gadjah x PI 314817)-2			2229	103		134
18	Tainan 9 (check)	2131	100	2171	100	56	137
LSD .05		430		201			
C.V. (%)		22.1		24.2			
GB 85-104 : Early-Drought Tolerant and Rust Resistant Lines from Kalasin							
8	ICG 2324 SB NCACC 2470	4107	224			54	
9	ICG 1693 NCACC 2932	4045	221	2405	223	27	8
7	ICG 5034 SB NCACC 2045	3789	207	1787	166	43	35
5	TMV Long pod	3230	176			34	
2	Spanish peanut	3211	175			48	
6	TMV$_1$ R$_1$			1913	177		33
10	ICG 1682 SB NCACC 2485			1849	172		18
3	starr			1699	155		45
11	Tainan 9 (check)	1833	100	1078	100	34	78
LSD .05		435		125			
C.V. (%)		30.6		31.7			

Table 2. (Continued).

Entry no.	Identification	Pod yield Ban Muong kg/ha	Pod yield Ban Muong %check	Pod yield KKU kg/ha	Pod yield KKU %check	Immature seed (g/plot) Ban Muong	Immature seed (g/plot) KKU
GB 85-111 : Early Lines from NCSU Materials							
21	Lampang	4504	186			63	
24	Tainan 9 (check)	2428	100			117	
4	NCSU No. 313	2352	97			93	
22	NCSU No. 1234	2343	96			32	
15	NCSU No. 783	2190	90			36	
24	Tainan 9 (check)	2428	100			117	
LSD .05		149					
C.V. (%)		15.2					
GB 85-112 : Early Lines Selected from BN-1984 R							
34	Tainan 9 (check)			1755	100		80
3	(MGS-9 x Robut 33-1)-18-1-1-2			1558	89		59
4	(MGS-9 x Robut 33-1)-6-3-1-1-F7			1502	86		101
1	(MK 374 x Robut 33-1)-7-3-2-3			1385	79		141
32	(TMV-7 x Chico)-1-7-1-3			1381	79		97
34	Tainan 9 (check)			1755	100		80
LSD .05				135			
C.V. (%)				17.0			
GB 85-109 : Lines Selected from BN 1984 BR - Set I							
3	(Ah 65 x chico)-2-5-3	3120	131			29	
1	(Ah 65 x chico)-2-3-3	3070	129			83	
20	(MGS-9 x chico)-16-7-3-1	3005	127			35	
24	Lampang	2919	123			62	
12	(MGS-9 x chico)-3-8-2	2884	122			38	
23	Tainan 9 (check)	2373	100			44	
LSD .05		243					
C.V. (%)		20.0					

Table 2. (Continued).

Entry no.	Identification	Pod yield Ban Muong kg/ha	Pod yield Ban Muong %check	Pod yield KKU kg/ha	Pod yield KKU %check	Immature seed (g/plot) Ban Muong	Immature seed (g/plot) KKU
GB 85-110 : Lines Selected from BN 1984 BR - Set II							
5	(MGS xRobut 33-1)-5-3-1	5128	195			39	
16	Lampang	4701	179			41	
9	(TMV > x chico)-1-3-1	4621	176			81	
2	(NC 6 x Dht 200)F2-B1-B1-B2	4085	155			39	
3	(M 13 x Dht 200)F2-B1-B1-B2	3609	137			48	
15	Tainan 9 (check)	2631	100			46	
	LSD.05	297					
	C.V.(%)	31.6					
GB 85-107 : Lines Selected from BN-1983 R							
5	(MGS-9 x Robut 33-1) -5-2-2-1	4253	219			187	
7	(MGS-9 x Robut 33-1) -5-2-2-4	4149	213	2231	164	65	135
9	(GA 20>-3 x Robut 33-1) 12-2-3-2	3870	199	1824	134	114	111
8	(GA 207-3 x Robut 33-1) -11-2-3-1	3472	179			124	
1	(MGS x Robut 33-1)-5-3-2	3463	178	2250	165	113	124
3	(MGS-9 x Robut 33-1) -18-3-1-2			1847	136		75
17	(Ah 65 x chico)-15-5-2			1805	132		87
18	Tainan 9 (Check)	1945	100	1363	100	38	72
	LSD.05	247		141			
	C.V.(%)	20.9		23.6			

Table 2. (Continued).

Entry no.	Identification	Pod yield: Ban Muong kg/ha	Pod yield: Ban Muong %check	Pod yield: KKU kg/ha	Pod yield: KKU %check	Immature seed (g/plot): Ban Muong	Immature seed (g/plot): KKU
GB 85-108 : Local Varieties							
13	No.26 T.Niyomsongkrao, Udon	4154	148			75	
5	No.15 T.Nongbuakog, Chaiyaphum	4067	145			71	
11	No.24 T.Laem-ngob, Bangpid	3816	136	1761	110	73	73
3	No.4 T.Pansuek, Prajeenburi	3756	134			52	
9	No.22 T.Nongbuadaeng, Chaiyaphum	3712	132			49	
14	No.27 T.Niyomsongkrao, Udorn			2126	133		59
7	No.17 T.Nongbuayai, Chaiyaphum			1855	116		80
18	Lampang			1802	113		29
15	No.28 T.Pado,Udorn			1713	107		53
17	Tainan 9 (cheek)	2804	100	1595	100	61	88
LSD. 05		518		136			
C.V.(%)		21.?		23.8			
GB 85-105 : Lines Selected from BN-1981R, BN-1982 R, and ICGX NOS.							
2	(MGX x Robut 33-1)-5-3	4061	185			73	
10	(MGS-7 x SM -S)-1-4-3	3710	169	1868	128	63	
12	(M 13 x TMV 10) B2-16-3	3282	149			149	
6	(MGS -9 x chico)-14-4	3279	149			78	
4	(Ah 68 x chico)-3-5	3244	148			67	
11	(MGS -7 x SM -5)-3-2-1			1779	122		62
18	Lonyun 6101			1758	120		100
1	(MGS x Robut 33-1)-5-2			1725	118		101
7	(MGS-7 x SM-S)-1-6			1724	118		96
16	Tainan 9 (check)	2199	100	1463	100	46	112
	LSD.05	527	83				
	C.V.(%)	26.0	18.4				

Table 2. (Continued)

Entry no.	Identification	Pod yield Ban Muong kg/ha	Pod yield Ban Muong %check	Pod yield KKU kg/ha	Pod yield KKU %check	Immature seed (g/plot) Ban Muong	Immature seed (g/plot) KKU
GB 85-106 : Lines from KKU Collection							
3	JBM 19/3	3564	117	1993	104	74	136
11	Roi-et	3280	108			68	
16	Lampang	3140	103	1849	96	61	142
4	SD 50806	3068	101			39	
15	Tainan 9 (Check)	3047	100	1925	100	37	162
8	Improved spanish			2030	105		137
6	Roxo			1945	101		69
15	Tainan 9 (Check)	3047	100	1925	100	37	162
LSD.05		356		81			
C.v.(%)		19.1		15.0			

Table 3 List of groundnut breeding trials at Khon Kaen University in the 1984/85 after-rice season.

Type of trial, material, and trial no.	No.of entries	No.of rep.	Plot size (no.of 5m row)
I. <u>BREEDING NURSERY</u> (GB 84-311)	221	1	2
Materials :			
(1) KKU collection	(38)		
(2) ICGS Nos. from ICRISAT	(13)		
(3) Rust and LS low susceptible lines from Kalasin-Set 2	(8)		
(4) ICRISAT82-Set 1:Germplasm	(27)		
(5) ICRISAT82-Set 2:Rust res.	(9)		
(6) ICRISAT83-Set 1:Earliness	(7)		
(7) ICRISAT83-Set 1:Rust and LS res.	(11)		
(8) Local varieties from extension	(8)		
(9) ICRISAT82-Set 1:High yield and quality	(1)		
(10) ICRISAT82-Set 1:Rust and LS res.	(21)		
(11) ICRISAT79 :Earliness	(78)		
II. <u>OBSERVATION NURSERY</u>			
Material received from NCSU			
GB 84-312/1 - GB 84-312/8	30 each	2	2
GB 84-312/9	20	2	2
III. <u>YIELD TRIAL</u>			
1. Lines selected from 1983AR yield trials			
GB 84-301	24	4	4
GB 84-302	24	4	4
2. Lines selected from 1983 AR Observation Nursery			
GB 84-303	22	2	4
GB 84-304	22	2	4
GB 84-305	22	2	4
3. Lines selected from 1983 AR Breeding Nursery			
GB 84-306	30	2	2
GB 84-307	20	2	4
GB 84-308	16	2	4
4. 1984 Coordinated Preliminary Yield Trial			
GB 84-309 (medium seed)	30	2	4
GB 84-310 (large seed)	16	2	4

Date planted : GB 301-311 : 6-11 Dec., GB 312 : 27 Dec. 84.
Date harvested : GB 301-311 : 8-18 Mar., GB 312 : 17-18 Mar. 85.

Table 4 Performances of selected entries in the yield trials of groundnut lines grown at Khon kaen University in the 1984/85 after-rice season: Lines selected from the 1983/84 after-rice yield trials.

Entry no.	Pedigree	Pod yield kg/ha	Pod yield %check	Days to mat.	Shelling (%)	100 seed wt.(g)	Ag rating (1-9)
Set I : GB 84-301							
16	J 11 x JG 3	2419	146	117	70	37	4
15	Tifspan x NCAc 2944	2332	141	111	72	36	5
5	KAC 304 (ICG 5020 NCAc 1044)	2330	141	108	71	42	5
11	Robut 33-1-1B-17	2264	137	119	72	45	5
20	(MGS-1 x SM 5)-5	2224	134	109	71	35	6
19	(MGS-1 x SM 5)-2	2182	132	111	74	32	6
21	(MGS-1 x SM 5)-6	2036	123	108	75	32	5
3	KAC 249 (ICG 402 NCAc 2651)	2025	122	111	69	50	6
22	Argentine 8-3	2019	122	111	71	38	6
9	No 8	1941	117	126	58	63	5
8	Tainung 2	1861	113	110	69	35	5
17	Moket	1827	110	115	70	55	4
23	Lampang	1810	109	113	63	39	5
24	Tainan 9	1654	100	110	69	47	6
LSD.05		793					
C.V. (%)		29.5					
Set II : GB 84-302							
4	CES 2-25	3440	175	107	73	39	3
7	Virginia Improved R 5	3383	172	118	71	48	5
3	F 334-33	2637	134	111	73	49	5
10	Spanish XIV	2381	121	110	67	28	8
13	(MGS-7 x SM 5)-2-1	2155	110	114	72	32	5
15	(MGS-7 x SM 5)-4-5	2145	109	110	72	30	6
20	ICG 2339 SB NCAc 2690	2075	106	110	76	30	5
8	H 6	2051	105	107	72	55	5
1	Tipo 4	2041	104	107	70	37	7
17	(Spancross x NCAc 400)-F2 -P2-B1-B2-B1-B1-B1-B1	2015	103	107	72	32	5
24	Tainan 9	1961	100	103	67	39	5
LSD.05		942					
C.V. (%)		22.7					

Table 5 Performances of selected entries in the yield trials* of groundnut lines grown at Khon Kaen University in the 1984 /1985 after-rice season : Lines selected from the 1983 AR Observation Nursery.

Entry no.	Pedigree	Pod yield kg/ha	Pod yield %check	Days to mat.	Shelling (%)	100 seed wt.(g)	Ag rating (1-9)
Set I : GB 84-303							
3	SD 50948	1941	109	110	70	33	4
22	Tainan 9	1778	100	107	71	48	5
18	Local-Kok TaoTon, Cahiyaphum	1665	94	111	71	39	5
8	Spantex cusdo	1615	91	107	71	46	5
4	Kwanda	1598	90	114	70	37	6
11	Spanish IV	1598	90	111	75	39	5
	LSD.05	739					
	C.V. (%)	27.1					
Set II : GB 84-304							
15	ICG 2325 SB NCAc 2471	2671	172	118	57	49	3
11	ICGS 44	2498	161	118	58	40	4
16	ICG 2003 AN 55	2291	147	126	56	52	6
10	ICGS 19	2131	137	114	53	39	7
19	ICG 2309 SB NCAc 2155	2111	136	126	53	62	6
5	ICGS 11	2068	133	121	57	44	5
21	ICG 2304 NCAc 1826	1991	128	136	68	51	5
6	ICGS 16	1855	119	114	49	45	4
20	ICG 5002 SB NCAc 7	1841	118	122	52	47	7
18	ICG 2956 SM-5	1798	116	130	47	47	6
2	ICGS 8	1735	112	107	55	32	7
13	ICG 1671 NCAc 2750	1735	112	131	66	67	6
22	Tainan 9	1555	100	111	44	41	4
	LSD.05	708					
	C.V.(%)	18.7					
Set III : GB 84-305							
14	Panjab 1	1469	155	124	73	44	7
9	SB IX	1285	136	106	70	38	5
20	NCAc 10223	1076	114	135	63	53	5
18	M-13	1006	106	106	73	37	5
11	EH 3-30	966	102	106	71	37	7
22	Tainan 9	946	100	113	74	41	4
	LSD.05	635					
	C.V.(%)	26.3					

Table 6 Performances of selected entries in the yield trials of groundnut at Khon Kaen University in the 1984/85 after-rice season : Lines selected from the 1983 AR Breeding Nursery.

Entry no.	Pedigree	Pod yield kg/ha	Pod yield %check	Days to mat.	Shelling (%)	100 seed wt.(g)	Ag rating (1-9)
Set I : GB 84-306							
12	(MGS-9 x Robut 33-1)-6-6-3	1150	144	106	77	29	5
11	(MGS-9 x Robut 33-1)-6-6-2	881	110	106	73	26	6
9	(Dh 3-20 x Ec 76446 (292) F_2-B_1-B_1-B_1-B_2	850	106	114	66	37	6
13	(MGS-9 x Robut 33-1)-11-1-2	813	101	109	76	30	6
30	Tainan 9	801	100	110	71	44	5
	LSD.05	322					
	C.V.(%)	23.4					
Set II : GB 84-307							
1	(MGS x Robut 33-1)-5-3-1	2178	206	112	63	44	5
13	(MGS-9 x Chico)-12-3-1	1722	163	100	78	29	7
19	Lampang	1555	147	107	65	44	4
17	(MGS-9 x Chico)-15-2-5	1472	139	100	75	26	7
11	(MGS-9 x Chico)-1-1-3	1399	132	119	75	27	8
15	(MGS-9 x Chico)-14-14-2	1399	132	104	78	29	7
2	(MGS x Robut 33-1)-5-3-2	1322	125	116	69	37	5
3	(GA 207-3 x Robut 33-1) -11-4-2	1106	104	112	75	33	7
16	(MGS-9 x Chico)-14-4-3	1079	102	108	79	29	5
14	(MGS-9 x Chico)-14-4-1	1072	101	115	73	25	7
20	Tainan 9	1059	100	112	68	42	5
	LSD.05	599					
	C.V. (%)	24.7					
13	(X52-X-X-3XB x Chico)-8-1-1	2118	119	108	67	31	4
14	(X52-X-X-3XB x Chico)	1858	104	115	69	31	5
3	(MGS-9 x Chico)-16-1-1	1805	101	104	73	34	5
1	(MGS-9 x Chico)-15-3-2	1788	100	112	72	26	5
16	Tainan 9	1785	100	112	65	43	3
	LSD.05	812					
	C.V.(%)	26.2					

Table 7 Performance of selected entries inthe 1984 Coordinated Preliminary Yield Trials grown at KKU in the 1984/85 after-rice season.

Entry no.	Pedigree	Pod yield kg/ha	Pod yield %check	Days to mat.	Shelling (%)	100 seed wt.(g)	Ag rating (1-9)
Set I (medium seed) : GB 84-309							
6	ICG 1659 NCAc 2661	2234	164	123	63	51	5
25	ICGS 39	2141	158	120	71	40	5
23	ICGS 27	1881	138	123	73	34	5
22	DHT 200	1755	129	120	65	26	4
8	ICG 2375 NCAc 2939	1572	116	128	62	57	5
2	ICGS 6	1548	114	120	73	39	7
3	ICGS 19	1535	113	123	73	41	6
7	ICG 2950 SM-5	1525	112	128	69	49	7
29	Lampang	1495	110	116	68	41	5
27	(Taiwan 2 x PI 337394 F) -14	1449	107	123	73	37	6
1	ICG 402 NCAc 2651	1399	103	120	74	41	6
24	ICGS 31	1395	103	120	71	41	6
30	Tainan 9	1359	100	100	69	42	5
	LSD.05	726					
	C.V.(%)	30.8					
Set II (Large seed) : GB 84-310							
4	Kanto No.21	2105	165	123	67	53	5
14	RCM 387	1975	155	123	72	44	4
5	NC 4x	1702	133	133	60	55	5
12	KUP 24 D-248 W	1642	129	116	60	31	4
3	No.421	1568	123	128	60	52	6
16	Tainan 9	1275	100	107	69	43	6
2	No.36	1222	96	123	58	55	5
15	Moket	1182	93	120	55	53	5
	LSD.05	684					
	C.V.(%)	27.7					

Table 8 Average 100-seeds weight, shelling percentage, and adjusted pod yield.
Peanut Regional Yield Trial for Early Maturing and Drought Tolerant Varieties (80-85 days) in Roi-et (Lines from ICRISAT 1).

Identification	100 seed weight (gm.)	Shelling percentage	Adjusted pod yield (Kg/ha)
(MGS 9 x Chico)-12-16-3	28.9 c-e[1]	69.30	1456.3 ab
(MGS 9 x Chico)-12-16-5	31.3 ad	70.76	1531.3 ab
(MGS 9 x Chico)-12-16-1	31.0 b-d	71.21	1637.5 a
(Var 2-5 x Chico)-18-13-2	27.7 de	71.10	1318.8 ac
(MGS 9 x Chico)-12-13-2	33.4 ab	67.49	1500.0 ab
AK 12-24-5	26.1 ef	66.91	925.0 c
Spanish XIV	22.6 f	69.33	1037.5 bc
TMV 3	33.6 ab	67.08	1393.8 a-c
M 10	26.2 ef	71.47	1375.0 a-c
Tainan 9	34.9 a	73.44	1731.3 a
SK 38	32.1 a-c	64.52	1612.5 a
Lampang	35.2 a	67.74	1693.8 a
Grand mean	30.2	69.20	1437.5
F-test	**	NS	**
C.V. (%)	8.06	9.44	22.17
Sd	1.724	4.620	36.107

[1] Figures in the same column followed by the same letter are not significantly different by Duncan's new multiple range test at 5%.

Table 9 Average 100 seeds weight, shelling percentage and pod yield.
Peanut Standard Yield Trial for Early Maturing and Drought Tolerant Varieties (80-85 days) in Kalasin (Lines From ICRISAT 2)

Identification	100 seed weight (gm.)	Shelling percentage	pod yield (Kg/ha)
(Argentine x Chico)F2B-B2-B1-B1-EB1	25.6 c[1]	61.18 a-c	1293.8 c
(MGS 7 x G 201)F2-B1-B1	26.1 c	65.20 ab	1368.8 bc
(NCACC 2748 x Chico)F2-P1-B1-B1	37.3 a	52.59 c	1356.3 bc
(75-R x Chico)F2-P1-B1	23.8 c	69.22 ab	1350.0 bc
(75-24 x Chico)F2-E-B2-B1-B1-B4-B1	29.5 bc	65.68 ab	1450.0 a-c
(NCACC 2748 x Chico)-13-1-2	26.6 c	63.85 ab	1143.8 c
(TMV 7 x Chico)-13-4-5	25.9 c	70.70 a	1625.0 ab
(GA 207 x Robut 33-1)-5-11-1	29.4 bc	71.46 a	1656.3 a
(MGS 9 x Chico)-12-3-3	29.8 bc	64.86 ab	1387.5 bc
(TMV 7 x Chico)-13-12-1	26.0 c	62.33 a-c	1343.8 bc
(Var 2-5 x Chico)-18-11-2	29.4 bc	65.14 ab	1712.5 a
Tainan 9	27.5 c	64.86 ab	1156.3 c
SK 38	27.6 c	59.09 bc	1143.8 c
Lampang	34.5 ab	62.66 ab	1212.5 c
Grand mean	28.5	64.20	1212.5
F-test	**	*	**
C.V. (%)	13.44	9.84	14.08
Sd	2.707	4.467	21.853

[1] Figures in the same column followed by the same letter are not significantly different by Duncan's new multiple range test at 5%.

Table 10 Average 100 seeds weight, shelling percentage, and adjusted pod yield.
Peanut Standard Yield Trial for Early Maturing (80-85 days) in Roi-et (Lines from Collection 2).

Identifications	100 seeds weight (gm.)	Shelling percentage	Adjusted pod yield (Kg/ha)
(TMV7 x Chico)-13-22-7	33.3 b-f[1]	55.74 fg	1768.8 a-c
(Var 2-5 x Chico)-18-13-2	27.5 i	62.08 c-f	1981.3 a
(MGS9 x Chico)-12-13-2	32.5 c-g	61.38 d-f	1656.3 a-d
(MGS9 x Chico)-12-16-3	29.7 g-i	69.91 a-c	1875.0 ab
(MGS9 x Chico)-12-13-3	30.3 f-i	64.24 b-e	1987.5 a
NCACC 1336	31.7 d-g	63.53 b-f	1856.3 ab
NCACC 2861	34.9 b-d	56.24 e-g	1468.8 b-d
AH 24439	38.2 a	61.73 c-f	1937.5 ab
NCACC 16035	31.3 e-h	68.66 a-d	1800.0 ab
Tainung 2	34.8 b-d	64.46 b-d	2018.75 a
NCACC 1044	36.4 ab	68.56 a-d	1937.5 ab
Natal Common	30.1 f-i	73.05 a	1856.25 ab
NCACC 2651	34.4 b-e	63.69 b-f	1968.8 a
NCACC 17090	28.4 hi	53.90 g	1343.8 cd
Tainan 9	35.7 a-c	70.56 ab	1668.8 a-d
SK 38	33.3 b-f	63.01 b-f	1281.3 d
Lampang	34.9 b-d	66.11 a-d	1875.0 ab
Chico	22.8 j	65.46 a-d	1550.0 a-d
Grand mean	32.2	64.02	1768.8
F-Test	**	**	**
C.V. (%)	6.25	7.77	15.87
Sd	1.425	3.515	31.764

[1] Figures in the same column followed by the same letter are not significantly different by Duncan's new multiple range test at 5%.

Table 11 Average 100 seeds weight, shelling percentage and adjusted pod yield.
Peanut Preliminary Yield Trial for Early Maturing and Drought Tolorant Varieties (80-85 days) : Planting in Early Rainy Season.

Identification	100 seeds weight (gm.)	Shelling percentage	pod yield (Kg/ha)
(Ah 330 x 91176)EF2-B1-B1-B1-B1	27.2 d-f[1]	68.70 c-f	1537.5 a-d
(Dh 3-20 x Chico)F2-B1-B1-B1-EB1	31.8 a-c	69.77 b-f	1812.5 a
(Manfred x Chico)F2-IE-B1-B1	34.2 ab	67.42 ef	1250.0 c-g
(75-24 x Chico)F2-B1-B2E-B1-B1	26.3 fg	69.95 b-f	1618.8 a-c
(NCACC 2748 x Chico)F2-P8-B1-B1	30.7 b-d	66.63 f	1506.3 a-d
(NCACC 2748 x Chico)F2-B4-B1-B1	32.5 ab	67.30 ef	1562.5 a-d
(75-24 x Chico)F2-B1-EB2-B2-B1	25.0 fg	72.55 a-c	1262.5 c-g
(TMV 7 x Chico)F2-P5-B1-B1-B2-B1	27.5 d-f	69.68 b-f	1593.8 a-d
(75-24 x Chico)F2-EB2-B2-B1-B2-B1	27.0 d-f	74.43 a	1500.0 a-d
(NCACC 2748 x Chico)-3-1-2	25.8 fg	68.50 df	1043.8 fg
(Argentine x Robut 33-1)-3-1-1	30.4 b-e	69.98 b-f	1368.8 b-f
(MGS-9 x Chico)-12-13-3	26.8 ef	73.14 ab	1062.5 e-g
(TMV-7 x Chico)-13-1-1	23.1 g	68.56 d-f	1000.0 fg
(TMV-7 x Chico)-12-22-7	27.1 d-f	68.90 c-f	1275.0 c-g
(TMV-7 x Chico)-13-4-5	26.7 ef	68.55 d-f	1193.8 d-g
T9	34.7 a	68.14 d-f	1550.0 a-d
(Var 2-5 x Chico)-18-11-2	27.3 d-f	71.72 a-d	1456.3 a-e
RCM 387	32.9 ab	53.46 h	1075.0 e-g
NCACC 17093	33.9 ab	60.76 g	1737.5 ab
NCACC 2679	32.7 ab	70.92 a-e	1587.5 a-d
Argentine	28.3 c-f	58.06 h	1281.3 c-g
Tainan 9	32.8 ab	69.05 c-f	1062.5 e-g
SK 38	33.3 ab	63.07 g	881.4 g
Lampang	35.0 a	67.91 d-f	1500.0 a-d
Grand mean	29.7	67.80	1362.5
F-test	**	**	**
C.V. (%)	7.70	3.43	18.03
Sd	1.616	1.642	27.785

[1] Figures in the same column followed by the same letter are not significantly different by Duncan's new multiple range test at 5%.

Table 12 Performances of selected entries in the Preliminary Yield Trials of peanut lines, Kalasin Field Crops Experiment Station, dry season, 1985 (With irrigation).

Identification	Pod yield Kg/ha	Pod yield % check
Set I Lines from NCSU		
Tatui-Sanbra	3763	135
PI 268708	3250	116
Paraguay FFA	3163	113
PI 268968	2994	107
PI 268643	2931	105
Tainan 9	2794	100
Set II Lines selected from Coordinated Yield Trial		
ICGS 31	3719	113
(Taiwan 2 x PI 337394 F)-1	3494	106
DHT 200	3381	103
Tainan 9	3294	100
Set III Lines From ICRISAT		
(Spancross x EC76446 (292))	3288	120
NCAC 17090	3213	117
(NCAC 2768 x NCAC 17090)	2950	107
(Faizpur 1-5 x PI 259747)	2919	106
Tainan 9	2750	100

Table 13 Performances of selected entries in the Standard Yield Trial of peanut lines, Kalasin Field Crops Experiment Station, dry season, 1985.

Identification	Pod yield	
	Kg/ha	% check
Set I Lines selected from Coordinated Yield Trial		
(MGS-1 x SM-5)-1	3744	122
ICG 464 SB NCACC 17093	3575	117
(Taiwan 2 x PI 337394 F)-7	3344	109
(Gadjah x PI 314817)-4	3200	104
(Tifspan x NCACC 2944)	3194	104
Tainan 9	3068	100
Set II Lines from Kalasin and ICRISAT		
(Tainan 9 x PI 3148179)-17-3-34	2281	132
(Panjab x PI 314817)-15-2-34	2281	132
(Taiwan 2 x PI 314817)-16-2-39	2244	130
(Gadjah x PI 314817)-18-1-30	2156	125
Tainan 9	1725	100
Set III Lines from Kalasin		
(Taiwan 2 x J11)-7-1-6	2661	123
(Moket x J11)-12-3-26	2650	123
(Tainan 9 x J11)-11-1-17	2556	119
(Moket x J11)-13-6-36	2406	112
Tainan 9	2156	100

Table 14 Performances of selected entries in the Regional Yield Trials of peanut lines, Kalasin Field Crops Experiment Station, dry season, 1985.

Identification	Pod yield	
	Kg/ha	% check
TMV_3	2419	111
Asiatica	2413	110
ICG 460	2306	106
ICG 5084	2250	103
Tainan 9	2188	100

VARIETAL TESTING OF UPLAND CROPS IN THAILAND

Somyot Pichitporn[1] and Mark Potan[2]

Rice plantation occupies 12 million hectare which is about 61% of agricultural area in Thailand. After rice harvest some areas are available to grow upland crops such as mungbean, soybean, peanut, cowpea and corn etc. Recently, the national policy is emphasized to replace dry season rice with other field crops, this is due to many constrained situation amount of water for irrigation and low price of rice for examples. To assist the farmer, the suitable variety of various field crops and profitable method of planting have been accelerated taking into account by the government.

Upland crops, besides in the upland conditions, can be also planted either before or after rice. Planting after rice, irrigation water is needed while planting before rice is relied on rain condition. The suitable planting times are from December to February for after rice and from April to May for before rice (Appendix 1).

Varietal testing of upland crops in rice-based cropping system project was carried out during 1984-1985 by the Field Crop Research Institute in the cooperation with International Rice Research Institute (IRRI). The 21 trials regarding mungbean, soybean, peanut,

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[1] Mungbean Breeder, Chai Nat Field Crop Research Center, Chai Nat 17000, Thailand.

[2] Oil Crops Specialist, Field Crop Research Institute, Department of Agriculture, Bangkhen, Bangkok 10900, Thailand.

cowpea and corn were carried out at many locations both in government station/center and in farmer's field which were scattered around the Center, North, and Northeast regions of Thailand (Fig. 1 and Appendix 2).

The results of this testing in 1984-1985 are summarized as follows:

Mungbean

The results of testing after rice at Chai Nat Pitsanulok and Si-Samrong revealed that the yield obtained from Chai-Nat, Pitsanulok and Si-samrong were 1.9, 0.42 and 0.65 tons/ha respectively. According to the average yield 3 tested places, U-thong 1 gave the highest yield of all varieties tested (Table 1). The seed sizes of all varieties were relatively large but U-thong 1 was the largest of about 70 g/1000 seeds (Table 2).

Peanut

Peanut varietal trials were tested after rice at 4 locations. The successful trials were obtained from Chiengmani, Chai-Nat and Khon-Kaen. The results showed that Tainan 1, the recommended variety yielded the highest dry seed weight of about 1.96 tons/ha, followed by ACC 12 and M10 of about 1.90 and 1.84 tons/ha respectively (Table 3). One hundred seed weight of M10 was about 46.7 g which was higher than other varieties (Table 4).

The results of Trial at Khon-Kaen Maha-Sarakam and Roiet were shown in Table 5. The yield obtained from Mahasarakam and Roi-et were significantly different: Tainan 9 and Lampang, the check varieties seem to be the high yielding varieties. Seed size of all varieties tested was accordant to the results of the trials after rice. Seemingly, seed size of peanut from the test before rice was smaller than those from after rice.

Soybean

The results of trial tested at Chai-Nat showed significantly different among yield of varieties tested. Lines, 7507-38-4 and 7521-26-2 which were improved at Chiang-Mai FCRC gave the highest yield of about 1.79 and 1.78 tons/ha respectively. The standard check varieties SJ 4 and SJ 5 yielded only 1.67 and 1.62 tons/ha respectively those highest yielding varieties gave also relatively larger seed than the others (Table 6). The failure of other tested trials is due to the irregularity of stands.

Cowpea

The results of a trial planted before rice at Ubolrachatani FCRC & Mukdaharn were shown in Table 7 and 8. The dry seed yield of trial at Mukdaharn was highly significant differences and TVx 289-4 C gave the highest yield of all both at Mukdaharn and Ubolrachatani of about 2.00 and 1.51 tons/ha respectively. However, when green pod was concerned TVx 467-03 E and locals gave the highest yield at Ubolrachatani and Mukdaharn respectively. The figure could not be obtained from Pitsanulok, due to many missing stands.

Bush Sitao

The trial was carried out at Ubolrachatani. The results were summarized in Table 9 and shown that BS7 gave the highest yield of about 3.95 tons/ha. Concerning about the total fresh weight, the BS3 gave 7.38 tons/ha while the BS7 gave only 3.5 tons/ha.

Corn

The results of trials at Chiang Mai Chai-Nat Pesanulok and Nakornsawan revealed that Suwan 1 was the highest yielding variety at Chian-Mai but not at Nakorn-Sawan Chai-Nat and Pisanulok. The promissing XC 1 appeared to be the highest yielding variety at all locations (Table 10).

Table 1 Seed Yield of mungbean trials after rice at 3 locations in Thailand, 1985 Dry season.

Entry	SEED YIELD (t/ha)			
	Chai-Nat	Pisanulok	Sisumrong	Ave.
1. Pagasa 1	1.23 bc	0.48	0.64 a	0.78
2. Pagasa 2	1.06 cd	0.42	0.61 a	0.70
3. Pagasa 3	1.15 cd	0.38	0.36 b	0.63
4. CES 1T-2	1.26 bc	0.29	0.61 a	0.72
5. CES U-1	1.46 ab	0.37	0.61 a	0.81
6. IPB M 79-9-82	1.18 bcd	0.50	0.58 a	0.76
7. IPB M 79-9-94	1.08 cd	0.42	0.74 a	0.75
8. IPB M 79-13-29	0.88 d	0.40	0.76 a	0.68
9. IPB M 79-13 45	1.00 cd	0.47	0.76 a	0.74
10. IPB M 79-22-11	1.19 bcd	0.46	0.74 a	0.80
11. Uthong 1 (Local checkl)	1.61 a	0.63	0.77 a	1.01
12 Local chick 2	-	0.26	0.62 a	
Mean	1.19	0.42	0.65	0.76
	**	NS	*	
CV (%)	15.0	43.8	.0	

Mean followed by some letter are not significantly different at the 5% level of probability by DMRT

Table 2 The 1,000 Seed weight of 12 mungbean cultivars Mb 2 grown at 3 locations in Thailand after rice, 1985 Dry season.

Intry	SEED WEIGHT (gm/1000 SEED)			
	Chai Nat	Pisanulok	Sisumrong	Ave.
1. Pagasa 1	52	67	53	57
2. Pagasa 2	45	62	49	52
3. Pagasa 3	41	54	51	49
4. CES 1T-2	47	54	49	50
5. CES U-1	55	57	47	53
6. IPB M 79-9-82	55	74	49	59
7. IPB M 79-9-94	54	61	58	58
8. IPB M 79-13-29	59	72	47	59
9. IPB M 79-13-45	57	¢	48	60
10. IPB M 79-22-11	52	65	57	58
11. UT-1 (Local 1)	68	88	56	70
12. Local 2	-	72	44	-
MEAN	53	67	51	57

Table 3 Yield of peanut trials after rice at 3 locations in Thailand, 1985 dry season.

Entry	SEED YIELD (t/ha)			
	Chiangmai	Chai-Nat	Khon-Kean	Ave.
1. CES 101	1.44 ab	2.35	1.33 abc	1.71
2. KIDANG	1.60 ab	1.64	1.24 bc	1.49
3. F 334-33	0.67 d	0.95	1.22 bc	0.95
4. CES 102	1.38 ab	2.15	1.19 cd	1.57
5. UPL PN-2	1.80 a	2.11	1.36 abc	1.75
6. CES 2-25	0.84 cd	1.13	1.33 abc	1.10
7. PI 118200	1.21 bc	1.91	0.87 d	1.33
8. ACC 12	1.81 a	2.30	1.59 ab	1.90
9. M 10	1.63 ab	2.32	1.57 ab	1.84
10. CES 103	1.39 ab	1.75	1.26 abc	1.46
11. Tainan 9 (Local 1)	1.76 a	2.49	1.61 a	1.96
12. Local 2	1.37 ab	0.78	1.59 ab	1.25
Mean	1.41	1.82	1.35	
CV. (%)	18.8	19.6	14.0	

Table 4 The 100 seed weight of peanut grown at 4 locations under after rice condition, 1985 Dry season.

Entry	100 SEED WEIGHT (gm.)			
	Chiangmai	Chai-Nat	Khon Kaen	Ave
1. CES 101	41	47	45	44.3
2. KIDANG	40	48	47	45.0
3. F 334-33	40	46	48	44.7
4. CES 102	37	47	48	44.0
5. UPL PN-2	43	45	58	45.3
6. CES 2-25	37	44	47	42.7
7. PI 118200	34	39	47	42.0
8. ACC 12	36	35	43	38.0
9. M 10	40	48	52	46.7
10. CES 103	41	48	47	45.3
11. TAINAN 9 (Local 1)	41	46	50	45.7
12. LOCAL 2	41	43	52	45.3
MEAN	39	45	48	43.9

Table 5 Yield and seed weight of peanut trials before rice at 3 locations, 1985 Early Rainy season.

ENTRY	GRAIN YIELD			100 SEED WEIGHT
	Khon-Kaen	Maha-Sarakam	Roi-Et	
		t/ha		gm
1. CES 101	0.81	0.60 a-d	0.73 de	38.0
2. KIDANG	1.02	0.47 a-d	0.82 cde	45.8
3. F 334-33	1.16	0.64 abc	1.23 ab	39.4
4. CES 102	1.27	0.77 a	1.39 a	43.0
5. UPL PN-2	1.15	0.32 d	0.98 bcd	41.4
6. CES 2-25	0.93	0.48 a-d	0.60 e	37.5
7. PI 118200	0.73	0.37 cd	0.85 cde	38.5
8. ACC 12	1.01	0.70 ab	1.01 bcd	32.4
9. M10	1.26	0.43 bcd	0.91 b-e	41.3
10. CES 103	1.24	0.69 ab	1.23 ab	43.6
11. TAINAN 9 (LOCAL 1)	1.54	0.64 abc	1.08 abc	45.2
12. LAMPANG (LOCAL 2)	1.61	0.75 a	1.11 abc	44.5
MEAN	1152	572	1101	40.9
	NS	*	**	
CV. (%)	33.0	26.5	17.1	

Table 6 Yield and 100 seed weight of 11 soybean cultivarsevaluated after rice at Chai-Nat 1985 Dry season

ENTRY	SEED YIELD	100 SEED WEIGHT
	t/ha	gm
1. UPL SY 2	1.14 d	18
2. CLARK 63	1.21 cd	21
3. 7207-1	1.43 bc	19
4. 30050-2-17	1.15 d	19
5. GUNTUR	1.28 cd	14
6. 7521-26-2	1.78 a	20
7. 7507-38-4	1.78 a	18
8. AGS 144	1.35 cd	17
9. G 2261	1 15 d	18
10. SJ 4 (LOCAL 1)	1.67 ab	19
11. SJ 5 (LOCAL 2)	1.62 ab	17
MEAN	1.42	
CV. (%)	** 9.4	

Table 7 Seed Yield of cowpea trials after rice at 2 locations in the Northeastern part of Thailand 1985, Dry season

Entry	SEED YIELD (t/ha)		
	Ubolrachatani	Mukdaharn	Ave.
1 TVX 289-4 G	1.51	2.60 a	2.05
2. TVX 3671-14C-01D	1.09	2.49 ab	1.79
3. TVX 4659-03E	0.99	1.67 bcd	1.33
4. TVX 3381 02F	1.05	1.94 abcd	1.50
5. VITA 7	1.16	2.53 ab	1.84
6. TVX 4678-03E	1.33	2.13 abc	1.73
7. TVX 1948-01F	1.01	1.72 abcd	1.36
8. TVX 4661-07D	0.98	2.09 abc	1.54
9. TVX 3410-02J	1.31	2.31 abc	1.81
10. TVX 2724-01F	0.93	2.27 abc	1.60
11. Local 1	0.88	1.19 d	1.03
12. Local 2	0.70	1.43 cd	1.06
MEAN	1.08	2.03	1.55
	NS	*	
CV (%)	32.7	22.3	

Table 8 Pod yield of cowpea trials after rice at 2 locations in the Northeastern part of Thailand, 1985 Dry season

Entry	GREEN POD YIELD (t/ha)		
	Ubolrachatani	Mukdaharn	Ave.
1. TVX 289-46	4.55	8.38 bc	6.46
2. TVX 3671-14C-01D	5.43	9.80 abc	7.61
3. TVX 4659-03E	4.20	7.45 bc	5.83
4. TVX 3381-02F	4.92	9.63 bc	7.28
5. VITA 7	5.15	7.58 bc	6.36
6. TVX 4678-03E	5.74	8.52 bc	7.13
7. TVX 1948-01F	4.14	8.91 bc	6.53
8. TVX 4661-07D	4.86	10.58 ab	7.72
9. TVX 3410-02J	5.57	9.11 bc	7.34
10. TVX 2724-01F	3.95	10.34 ab	7.14
11. Local 1	5.01	6.75 c	5.88
12. Local 2	3.55	12.81 a	8.18
MEAN	4.75	9.16	6.95
	NS	*	
CV. (%)	14.6	18.3	

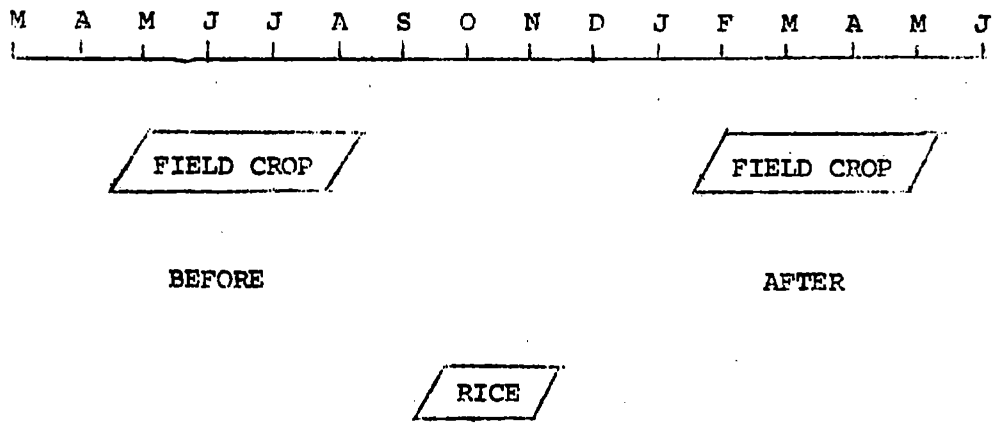
Table 9 Green pod and total fresh weight of bush sitao trial after rice at Ubolrachatani, 1985 Dry season.

ENTRY	GREEN POD YIELD	TOTAL FRESH WEIGHT
	t/ha	
1. BS_1	2.92	6.16 ab
2. BS_3	3.63	7.38 a
3. EG BS # 2	3.00	2.38 c
4. BS_6	3.86	4.77 abc
5. BS_7	3.95	3.50 bc
6. LOS BANOS BS # 1	3.67	3.05 bc
7. LOCAL 1	3.58	5.44 abc
8. LOCAL 2	2.39	2.88 c
MEAN	3.37	4.45
	NS	*
CV. (%)	22.1	37.6

Table 10 Grain yield of corn grown after rice at 4 locations, 1985 Dry season

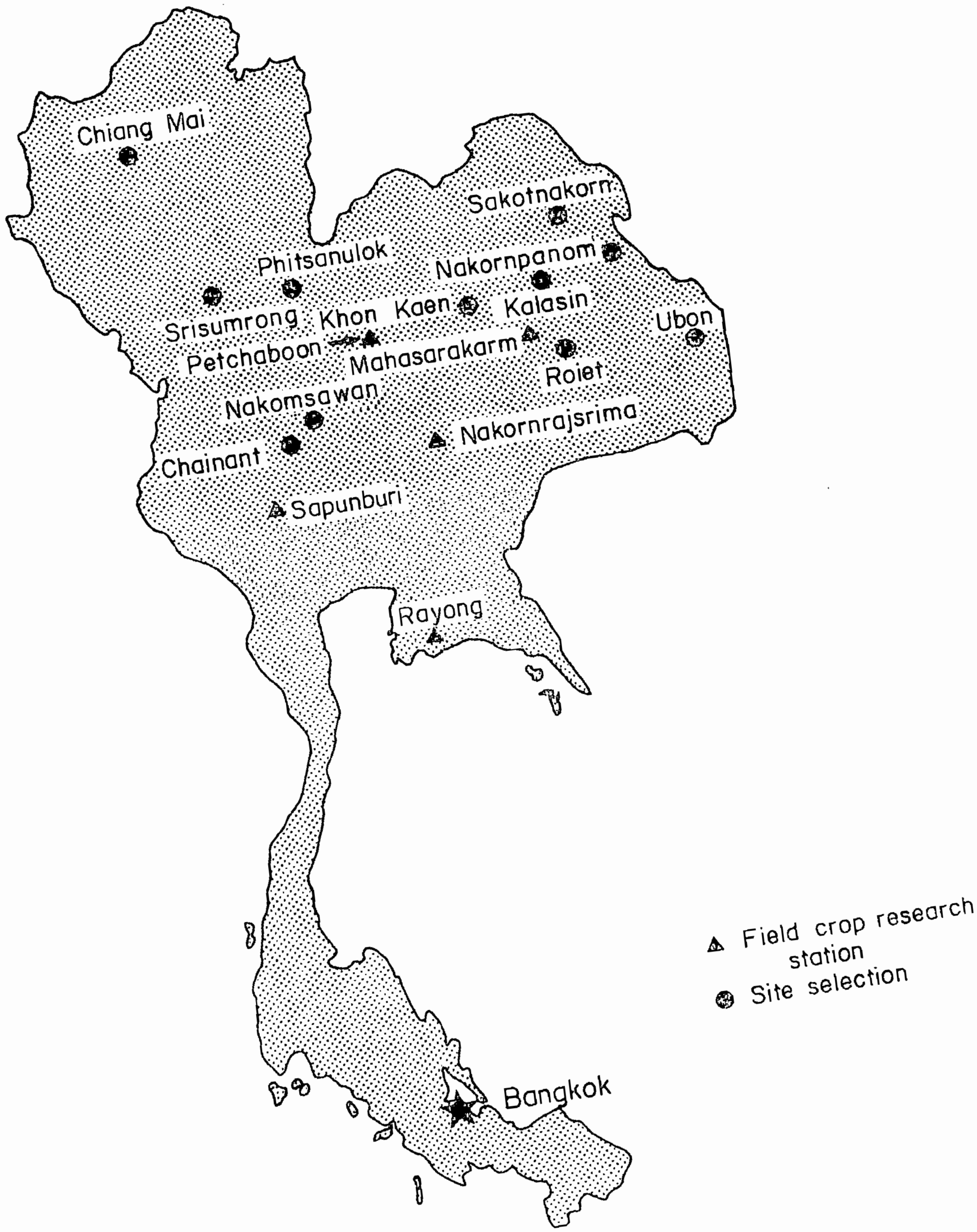
ENTRY	GRAIN YIELD (t/ha)			
	CMI	SNT	PLK	NWN
1. THAI COMP 1	5.51	2.40	1.21	3.76
2. EARLY DMR COMP 1	5.18	2.38	2.09	3.91
3. EARLY DMR COMP 2	4.85	2.41	1.49	3.11
4. ARUN 2	6.54	2.05	1.75	4.68
5. XC 1	6.99	3.04	2.02	5.27
6. RANJUNA	5.09	2.43	1.97	2.96
7. TFE 139	3.58	1.9[illegible]	1.43	1.71
8. POZA RICA 7931	6.63	2.87	1.79	3.28
9. TOCUMEN 7931	6.54	2.70	1.76	3.76
10. PIRSABAK 7930	7.05	2.52	2.16	5.30
11. SUWAN 1	7.66	2.14	0.33	5.24
	-	-	-	4.35
MEAN	6.02	2.44	1.64	3.94
	NS	NS	NS	**
CV. (%)	22.4	20.3	25.1	22.7

Appenttix 1. Cropping pattern of upland crops for rice farming system in Thailand.



Appendix 2 List of upland crops varietal testing conducted in Thailand, 1984/1985.

CROP	LOCATION	
1. MUNGBEAN	Chai Nat	
2.	Pisanulok	
	Sisamrong	
2. PEANUT	Khon-Kaen	after rice condition
	Chiangmai	after rice condition
	Chai Nat	after rice condition
	Pisanulok	after rice condition
	Khon-Kaen	before rice condition
	Roi-Et	before rice condition
	Maha-Sarakam	before rice condition
3. SOYBEAN	Chai Nat	
	Pisanulok	
	Chiangmai	
	Sisamrong	
4. COWPEA	Ubolrachatani	
	Mukdaharn	
5. BUSH SITOA	Ubolrachatani	
6. CORN	Chiangmai	
	Chai Nat	
	Pisanulok	
	Nakorn-Sawan	


Chiang Mai
Sakotnakorn
Phitsanulok
Nakornpanom
Srisumrong
Khon Kaen
Kalasin
Ubon
Petchaboon
Mahasarakarm
Roiet
Nakomsawan
Nakornrajsrima
Chainant
Sapunburi
Rayong
Bangkok
Field crop research station
Site selection

PROGRESS ON VARIETAL DEVELOPMENT AND EVALUATION OF PULSES IN RICE-BASED CROPPING SYSTEMS IN PAKISTAN

Bashir Ahmed Malik and Muhammed Tufail[1]

Development of Food Legume Cultivars for Rice-Based Farming Sytem in Pakistan

There are three rice zones where the pulses are growing or have potential to grow. Starting from the southern part of the country, the rice is grown in northern part of Sind and adjoining districts of Baluchistan. Rice cultivation is based on canal irrigation system. The major food legumes grown in that rice growing zone are chickpea and lathyrus grown as post rice-cropping system on residual moisture. The major rice-based cropping system comprised the following, in order of priority.

1. Rice-chickpea cropping System
2. Rice-wheat cropping system
3. Rice-lathyrus cropping system
4. Rice-corriander or flax cropping system
5. Rice-safflower is the one being newly tried

Breeding Varieties to Overcome Major Constraints in Sind

The major constraints observed and reported by the farmers during our surveys are: a) establishment of chickpea crop due to poor emergence

[1]Coordinator (Pulses), Pakistan Agricultural Research Council and Director (Pulses), Punjab, respectively.

and b) lack of short duration varieties of chickpea. As the fields are vacated by rice by mid November to early December and the optimum maturity varieties suffers at the grain filling stage due to forced maturity, owing to early rice in temperature. Therefore, breeding efforts have been directed to develop short duration chickpea varieties with better emergence capabilities.

The other food legume crops grown in the post rice-based system is lathyrus. The crop is very hardy and is grown after rice by broadcasting its seed in the field by about forthnight before harvesting rice. About 10% of the lathyrus is harvested for grains and 60% of it is fed to cattle as feed.

Chickpea and Lathyrus Utilization by Livestock

The rice straw is the major roughage fed to cattle the dry husk and broken pieces of grain during mailing of chickpea are fed to camel, horses and donkeys.

Lathyrus is used as dual purposes crop. It is fed to lviestock as green fodder 60% percent of the total area is used this way. Remaining 40% is harvested and threshed. It is estimated that 40% of the grains go for human consumption and 60% as livestock feed. The dry straw is also fed to cattle.

Punjab is another potential area, where pre- and post planting of pulses can fit in very well as 80% of area is under Basmati rice, which is transplanted by mid July. Therefore early maturing mungbean and blackgram can well fit into the rice-based cropping system as pre-rice planting crop. The varieties of mung for this system are available.

Trials at three locations have been planned and are being planted within next three days in the Daska area. One trial at NARC rice area has already been planted.

Post Rice Planting of Pulses

The food legumes grown as post rice pulse crop include chickpea, lentil and lathyrus and are called the winter pulses. Chickpea used to be grown in years back, as the area is within blight zone, frequent damages by blight has replaced chickpea, with mainly semi dwarf HYV of wheat. This shift was justified due to nonavailability of blight resistant chickpea varieties. Lentil is still grown by some farmers after rice, but lack of high yielding varieties also reduced its area in favour of wheat.

Breeding of Chickpea and Lentil Varieties Suitable for Post Rice Planting in Punjab

Chickpea cultivars resistant/tolerant to blight with good yield potential are developed and have been planted on six locations in Daska, three after IRRI type and three after Basmati. Early maturing bold seeded lentil material has been developed, which would enable to have one lentil crop followed by mungbean before rice in Punjab. Therefore two more systems would find place in the Punjab rice areas in addition to the already prevailing ones.

Prevailing rice-based systems in rice areas of Punjab

1. Rice-Wheat
2. Rice-Berseem
3. Rice-Watermelon
4. Rice-Fallow

New One

1. Rice-Chickpea-Rice

2. Rice-Lentil-Mungbean-Rice

New Mungbean Cultivars Released for Rice-Based Systems

Increasing population in the country has made it mandatory for the breeders and Agronomist to develop approaches and strategies to increase the production and productivity of pulses per unit area. Since the main resource i.e. land is limited and is also dewindling due to various reasons. Hence the best way to get maximum from this limited resource is to go for intensive cropping systems.

Efforts have therefore been made to identify various genotypes in mungbean like in lentils, which can be profitably grown in the various cropping systems, with major emphasis on rice-based cropping system. Two mungbean mutants namely M-13-1 and M-20-21 have been developed and approved as cultivars in 1985-86, with maturity range of 60-65 days as against their parents 6601 and Pak-22 respectively, which mature in 80-90 days. This material has provided an opportunity to get an extra crop of mungbean by following a system of wheat (after rice)-mungbean (before rice)-rice or wheat-mungbean-maize.

Both the mutants when grown after wheat mature within 55-58 days. They are short statured, insensitive to photoperiod, determinate and have erect growth habit. They produce non-shattering pods which mature uniformly and are borne on the plant top. They have high yield potential and have grains of desirable quality characteristics. They have higher harvest index and per day productivity. They resist lodging and over growth. Due to their synchrony in pod maturity the crop can be harvested in a single operation. They are quite suited also to mechanical harvesting and threshing operations. The early and uniformity in maturity also make these mutants ameable to intercropping with a number of crops such as sugarcane, maize, millets, vegetables and fruit gardens.

The difference between the above two mutants is that NM-20-21 is relatively more short statured (plant height -47 cm), takes about 58 days from sowing to harvest, highly tolernaceto mungbean yellow mosaic virus (MYMV) and gives about 45% higher yield than standard variety 6601 and parent strain Pak-22. The mutant NM-13-1 attains about 56 cm height, takes only 55 days to mature, possess some level of tolerance to MYMV and gives about 40% higher yield than the parent variety 6601.

Two other mungbean cultivars named NIAB mung 19-19 and NIAB mung 121-25 have been developed from a strain Pak-22 with 40 KR Dose and strain RC 71-27 with 20 KR dose respectively. Both the mutants are short statured and have erect determinate growth habit. They mature early and uniformly and bear pods on the top of the plant canopy. They have high yield potential and have desirable grain quality characteristics. They have higher harvest index and per day productivity. Because of their synchronous maturity and non-shattering type of pods the crop can be lifted in single harvest operation. They are amenable to mechanical harvesting and threshing operations. They are more tolerant to mungbean yellow mosaic virus disease and have similar reaction to cercospora leaf spot disease as compared to parental types and standard varieties 6601 and NIAB mung-28.

The difference between the above two mutants is that mutant NM 19-19 is relatively more short statured (Av. plant height 61 cm), takes only 65 days from sowing to harvest and gives 35% and 30% higher yield respectively than variety 6601 and parent strain Pak-22 and is comparatively more tolerant to mungbean yellow mosaic virus. The mutant NM 121-25 attains about 65 cm height, takes 70 days to mature and gives 44% and 34% higher yield respectively than variety 6601 and parent strain RC 71-27.

The four mungbean cultivars have satisfactorily reached the farmers fields in Pakistan and are going to replace the commercial cultivars namely 6601 and M-28. The seed of these genotypes/cultivars and the other promising materials of mung and blackgram is available to the fellow scientists desirous of having it.

Characters of parents and their mutants.

Genotype	Day to* flow no.		Days to** maturity		H. Index (%)	Per day** productivity (kg/ha)		Yield kg/ha** Research Station		Yield kg/ha on farmers field
	Summer	Spring	Summer	Spring		Summer	Spring	Summer	Spring	
NM-19-19	36	44	66	67	31.55	15.37	19.25	1022	1157	921
Parent Pak-22	48	51	87	81	19.12	6.31	14.02	550	856	934
NM-121-25	40	45	70	68	29.62	14.65	20.57	1021	1214	1051
Parent RC71-27	48	50	85	81	20.45	6.89	13.69	588	850	898 (6601)
NM-13-1	-	34-	-	56	28.01	-	24.66	-	1362	555
P-6601	-	43-	-	75	13.16	-	13.00	-	995	428
NM-20-21	-	34-	-	58	31.15	-	25.86	-	1500	591
P-Pak-22	-	44-	-	76	12.89	-	13.24	-	1016	422

*Average yield of 9 locations of NUYT.

**Averages of 4 years.

Net income with various crop planted after rice in rice-based farming systems.

Crop	Av. yield (kg/ha)	Gross income/ha	Cost of produciton/ha	Net profit/ loss
* Rice	1700	4647*	3510	1137
* Wheat (after rice)	1800	4050*	4321	321
* Chickpea (after rice)	900	3850*	2530	1320
* Lentil (after rice)	700	4900	3000	1900
* Mung (after lentil) (i.e. rice-lentil-mung-rice)	First year of experiment crop is in field.			

*Includes straw income

N.B - Yield and cost of production for rice and wheat are taken on the basis of average farmers.

Characters of parents and their mutants.

Genotype	D.FL*		D.M**		H.I. (%)	Per day** productivity kg/ha		Yield** kg/ha Res. Sta.		Yield kg/ha on farmers field
	Summer	Spring	Summer	Spring		Summer	Spring	Summer	Spring	
NM-19-19	36	44	66	67	31.55	15.37	19.25	1022	1157	921
Parent Pak-22	48	51	87	81	19.12	6.31	14.02	550	856	934
NM-121-25	40	45	70	68	29.62	14.65	20.57	1021	1214	1051
Parent RC 71-27	48	50	85	81	20.45	6.89	13.69	588	850	898 (6601)
NM-13-1	-	34-	-	56	28.01	-	24.66	-	1362	555
P-6601	-	43-	-	75	13.16	-	13.00	-	995	428
NM-20-21	-	34-	-	58	31.15	-	25.86	-	1500	591
P-Pak-22	-	44-	-	76	12.89	-	13.24	-	1016	422

*Average yield of 9 locations of NUYT

**Averages of 4 years.

PROGRESS OF THE VARIETAL SCREENING OF ULAND CROPS FOR TOLERANCE TO ACID SOILS IN INDONESIA

Rasidin Azwar[1]

Major part of the lands available in Indonesia are acidic. In Sumatra, for instance, red-yellow podsolic soil are the most common soil type. With the influence ofhumid tropical climate, these soils are in general highly leached, acid, low in nutrients and organic matter, poor in water-holding capacity on highly exposed to erosion (Scholz, 1983).

These soils, however, are a particularly urgent case in view of their vicinity to the overcrowded island of Java and the ambitious transmigration programs of the central government. Most of the agricultural production originates and still continue to be established from smallholders. These smallholders run a dualistic production pattern: one part of their holding is devoted to subsistence food cropping; the remainder is reserved for cash crop production. Under this production system, security of subsistence of a farm family becomes the first priority before further development can be made. Common cropping patterns here are rice in the wet season and upland crops in the dry season and/or combinations among these commodities.

Under these difficult soils, their agricultural value is rather limited. To increase soil production value and their maintenance

[1]Plant Breeder, Sukaramai Research Institute for Food Crops (SARIF), P.O. Box 34, Padang, Indonesia.

requires economically high input and energy. Various studies showed that liming can increase pH and fertility of the soil. Several problems, however, arise in its application due to very fast area and other socioeconomic constraints of the farmers. Therefore, introduction of any production component should be projected toward establishment of stable production system which includes both production and economic aspects. With the stage sufficient rice production, more emphasis is now being given to use these lands for upland crop production. Most of these crops are sensitive to low pH of the soil. Development of improved tolerant varieties at a given management level is very much needed.

Breeding upland crops tolerance to acid soil has recently initiated at Sukarami Research Institute for Food Crops (SARIF). Most of these works have been done in collaboration with other research institutes. In relation to a given mandate, SARIF has been specifically participating to develop varieties suitable for humid upland. This paper is aimed at reviewing recent activities and progress of the varietal screening of upland crops for tolerance to acid soils. These include many crops but only peanut, soybean, cowpea and pigeonpea reported here.

Materials and Method

Most of the screenings were done in Experimental Field of Sitiung Sub-station. The soil characteristics are given in Table 1. Breeding materials used starting from segregating hybrid populations to elite line from various sources. However, only results from replicated yield trials are reported here. More activities were given for peanut, soybean and corn. Some of the materials are still in the process of selection (for corn and soybean) and some have been identified promising and entered multilocation tests. Randomized block design arrangements were generally used in replicated yield trials. A seedboard recommended variety served as check in each set of trials. The soils were treated with minimum input (25 kg N, 45 kg P_2O_5 and 30 kg K_2O) unless there were varietal response trials to liming on peanut. Plant spacings were 40 by 20 cm for peanut and cowpea; 30 by 10 cm for soybean and pigeonpea. Plant protection was made as necessary particularly to keep good plant establishment at early stage.

There were four expeirments for peanuts located at different soil fertility conditions. The first was at latosal soil of Rambatan sub-station with soil pH about 5.5 to 5.8. Other three experiments were put at acid soil (pH = 4.0 to 4.5) Sitiung treated with different levels of lime, namely, 0, 1 and 2 t/ha. Data collected for yield and agronomic traits related to each crop.

Results and Discussion

Peanut

Yield performance of selected lines as compared to Gajah under different soil fertility levels are shown in Table 2. There are two important points that can be found from the results. Firstly, liming has postive effect on grain yield of peanut as can be seen from average yields per location. Seocndly, varieties have different responses to soil fertility status is seen form the average yield over location.

Without liming the crop gave very low yield and genetic differences among varieties could not be signfiicantly expressed. Increasing soil pH with application of 1 t/ha liming improved peanut yield to almost as high as the crop grown under Rambatan condition. The highest yield was obtained with application of two tons liming per hectare indicating that the fertility of the soil could be improved by increasing soil pH.

Considering plant responses to soil acidity we may observe that there was a limitation of crop ability to tolerate soil acidity in which genetic differences could be effectively evaluated. Under the limit of genetic differences among tested varieties there was indication that the closer soil pH to normal the higher genetic variability among genotypes could be observed. However, this conclusion still need verification by having wider genetic resources and analyzing the presence of genotype environment interaction.

Considering average yields over locations we obtained eight varieties which had yields higher check variety Gajah. The result was only consistent with average yeilds on location of acid soil apply with 1 t/ha lime. For that reason, the condition could be considered optimal to do varietal screening tolerant to acid soil. On the average yield we found three lines, namely, H.79-109d-st-9-2, H.79-111d-st-2-2 and H.80-121c-st-22-1 which were tolerant to low soil pH and respond to soil fertility improvement. Multilocation tests for these varieties are now being conducted in preparation for varietal release.

Soybean

Brain yield and agronomic traits of eleven soybean lines as compared to Orba under acid soil is shown in table 3. Statistical analysis indicates that they differed from one trait to another. Data on grain yield showed that soybean has low yield at this location as also found for peanut. However, three of them, namely, 1957/1400e-st-12-2-0, 1400/1343e-st-68-4-0 and 1399/1682d-st-26-1 gave significantly higher yields than Orba. These varieties were selected for further tests for yield and response to liming.

Cowpea

Data for yields and agronomic traits of nine introduced cowpea varieties (via IRRI) as compared to local Kaoang Tunggak are shown in Table 4. Yield differences among varieties were considerably high but yield differences among block were also quite high. Seven varieties gave yields higher than that of local check. On statistical analysis IT82E-3 was the only variety had yield significantly higher than that of local check. The same result is true for fresh pod yield per hectare. Most of the introduced varieties have bigger seed size than that of local check. IT82E-3 was the tallest among entries but it matures 4 days earlier than local check. IT82-3 is now being used as a component in studies on introduced cropping pattern in the farmer's field of Sitiung.

Pigeonpea

Grain yield and some important agronomic traits of the fourteen introduced pigeonpea varieties are shown in Table 5. Data on plant height indicate that most of the entries fairly grow well in this environment. However, from other morphological appearance some of these varieties, particularly QPL-752, QPL-699, QPL-338 and QPL-134 were yellowing, less branching and produced fewer pods. Following these observations, grain yields of the varieties could be associated with the degree of greenness of the leaf canopy during the growth period. QPL-503 which gave the highest yield was also observed as the most vigorous and the most healthy plant.

Data on grai nyield indicate low performance of the crop grain under acid soil condition. Yield variation among varieties (vary from 0.21 to 1.08 t/ha) were very high. Selection of varieties tolerant to acid could be expected to improve crop adaptation into region. Selected varieties together newly introduced materials are now having further testing for adaptation and response to liming.

Conclusions

Among the four tested leguminous crops, cowpea was the most tolerant crop to acid soil. But marketing problem may limit its production because food products from cowpea seed have not been known by consumers. Improvement of the present soil fertility level e.g. through liming or other means might be required for peanut, soybean and pigeonpea production to aicd soils. Selection of peanut varieties tolerance ot acid soil has been effective in reducing level of soil management inputs (e.g. from 2 to 1 ton lime/ha) to obtain target yield. The same progress is also expected, for soybean. Wider genetic base seems to be required to develop more tolerant varieties.

References

Scholz, U. 1983. The natural regions of Sumatra and their agricultural production pattern. A regional analysis. Volume 1. Central Research Institute for Food Crops. Bogor, Indonesia.

Yanuar, C., Z. Zuki and A. Syarifuddin. 1984. Pengarah penggenangan dan pupuk TSP terhadap pH, Al-dd dah P-tersidia pada tanah podsolik merah Kuning Sitiung, Pemberitaan Penelition Sukarami 3:12-15.

Table 1. Chemical analysis of red yellow podsolic soil of Sitiung (Yanuar et al., 1984).

PARAMETER	UNIT	VALUE
pH (H_2O) 1:2.5	-	4.9
pH (KCl)1:2.5	-	4.0
Organic matter	%	2.1
Nitrogen	%	0.03
CEC	me/100g dry soil	17.97
Base saturation	%	38.7
Available P (Bray II)	ppm	2.9
Available Ca	me/100 g dry soil	1.9
Available Mg	"	0.2
Available K	"	0.4
Available Na	"	0.3
P total	%	0.01
Exchangeable Al	me/100 g dry soil	1.6
Available Fe	ppm	16.5
Available Mn	ppm	288.8

Table 2. Yield performance (t/ha dry pod) of twelve peanut varieties grown at different soil conditions, West Sumatra, dry season 1985.

VARIETY	RAMBA-TAN	SITIUNG Lime Rate (t/ha) 0	1	2	AVERAGE
H.79.109d-st-9-2	1.78a	0.84a	1.54a	1.87ab	1.51
H.79.111d-st-2-2	1.67ab	0.86a	1.50ab	1.98a	1.50
H.80.121c-st-22-1	1.43bcd	0.82a	1.47ab	1.98a	1.42
H.80.121c-st-4-1	1.39cd	0.78a	1.27bcd	1.87ab	1.33
H.79.11c-st-6-1	1.46bc	0.85a	1.39abc	1.46d	1.29
H.80.121c-st-5-1	1.36cd	0.86a	1.27bcd	1.60cd	1.27
H.79.111d-st-2-1	1.23cdef	0.82a	1.35abc	1.59cd	1.25
H.79.109d-st-7-1	1.07ef	0.84a	1.35abc	1.69bcd	1.24
Gajah	1.11def	0.78a	1.17cd	1.74bc	1.21
H.79.111d-st-5-2	1.30cde	0.78a	1.02d	1.66bcd	1.49
H.79.111d-st-3-2	1.03f	0.78a	1.07d	1.66bcd	1.14
H.79.111d-st-5-1	1.00f	0.78a	1.14cd	0.96e	0.97
Average	1.319	0.816	1.295	1.672	1.277

Figures followed by common letters in the same column are not significantly different at 5% level by DMRT.

Table 3. Grain yield and agronomic traits of soybean lines grown on acid soil of Sitiung, dry season, 1985.

VARIETY	PLANT HEIGHT (Cm.)	POD NUMBER/ PLANT	DAYS TO MATURITY	GRAIN YIELD (Kg/ha)	100-SEED WEIGHT (Gram)
1957/1400e-St-12-2-0	47.52b	53,175ab	94.50cde	797.8a	9.47cd
1400/1343e-St-68-4-0	49.70b	46,575ab	91.50e	795.6a	8.50cde
1399/1682d-St-26-1	75.20a	63,925ab	98.00abc	755.8ab	8.12e
1343/1611d-St-1-6-986-16	40.40b	52,150ab	97.25bc	698.4abc	9.75c
29/1343e-St-116-0-14-1	47.60b	50,350ab	96.00bcd	677.1abc	9.12cde
CK/LV/2295d-St-30-0-10-1	43.43b	56,750ab	99.25ab	664.1abc	9.52cd
1399/1682d-St-27-1	65.08a	76,275a	99.50ab	655.1abc	8.37de
1399/1682d-St-36-1	48.52b	47,900ab	92.25de	644.3abc	8.00e
CKIV/2295d-St-30-0-13-1	48.30b	61,550ab	101.25a	598.9bc	9.62cd
1343/1611d-St-1-6-986-14	51.52b	61,800ab	98.25abc	590.7bc	11.97ab
A G S 154	43.18b	39,800ab	92.75de	585.3bc	10.87bc
O R B A	40.40b	64,300ab	94.75cde	555.1c	12.57a

Figures followed by common letters in the same column are not significantly different at 5% confidential level by DMRT.

Table 4. Grain yield and agronomic traits of ten cowpea varieties grown under acid soil, Sitiung, dry season, 1985.

VARIETY	DRY SEED YIELD (t/ha)	FRESH POD YIELD (t/ha)	100-SEED WEIGHT (Gr)	PLANT HEIGHT (Cm)	DAYS TO MATURITY
IT 82E-3	2.09a	7.32a	108c	62.4a	74ab
IT 82E-18	1.65ab	6.13ab	156a	52.4ab	71b
IT 82E-13	1.52abc	5.65ab	152ab	56.6ab	77a
TVX4677-88E	1.47abc	6.07ab	137b	58.8ab	74ab
IT 82E-16	1.35abc	4.83ab	137b	47.0bc	77a
IT 82E-25	1.22bc	3.68ab	89d	38.7c	67bc
-70	1.20bc	3.24b	168a	47.5bc	69bc
Kacang Tunggak	1.09bc	3.24b	70c	46.8bc	78a
IT 820-889	0.85bc	3.96ab	120c	47.2bc	68bc
IT 82E-60	0.74c	3.58ab	164a	53.7ab	66c

Figures followed by common letters in the same column are not significantly different at 5% level by DMRT.

Table 5. Grain yield and agronomic traits of introduced pegeonpea varieties at acid upland soil of Sitiung, West Sumatra, wet season, 1985.

VARIETY	YIELD (kg/ha)	100-SEED WEIGHT	DAYS TO FLOWERING	DAYS TO MATURITY	PLANT HEIGHT (Cm)
QPL-503	1084a	11	60	100	106
QPL-58	780ab	10	60	100	130
QPL-130	692abc	10	64	105	105
HUNT	684abc	9	63	105	82
QPL-17	680abc	8	58	96	115
QPL-808	464bcd	10	62	104	101
QPL-690	444bcd	10	62	94	100
QPL-792	442bcd	11	66	107	114
QPL-42	380bcd	10	61	101	79
QPL-634	316cd	10	63	105	101
QPL-134	284cd	9	65	107	105
QPL-338	284d	10	62	105	90
QPL-699	240d	8	62	105	103
QPL-752	212d	10	62	105	76
Average	497.6	9.7	62	102.4	100.5

Figures followed by a common letter in the same column are not significantly different at 5% level by DMRT.

VARIETAL IMPROVEMENT WORK ON GRAIN LEGUMES IN NEPAL

J.R. Joshi[1]

Nepal is an agricultural country with about 94% of its population engaged in agriculture with an average land holding of 0.67 hectare. Their agricultural practices are intensive and most farmers traditionally follow intricate cropping pattern that involves sequence cropping, mixed cropping or relay cropping to meet their subsistance.

Grain legumes are important crops in Nepal both in terms of their contribution to human nutrition and as components of indigineous cropping pattern for improving the fertility of the soil.

The importance of grain legumes mainly lies in this 7 fillings in cropping patterns as a mixed crop, inter crop, catch crop or relay crop. Some of these crops occupy the waste portions of cultivated land such as rice bunds viz. Soybean or black gram in the hills and inner tarai, and pigeon pea in the tarai.

The area, production and average yield per hectare for different major field crops and grain legumes are given in Table 1 and 2.

Varietal Improvement of Grain Legumes:

For the development of the grain legumes program in Nepal to support the farmers to increase per unit production, the following

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[1]Agronomist, Khumaltar Agronomy Farm Nepal.

objectives were visualised.

1. To fit the grain legume into the cropping system program.
2. To have higher yield potential and response to better levels of management.
3. To possess resistance to diseases and insect pests.
4. To have better nutrient content and be acceptable to the consumers.
5. To investigate nutrient requirements of grain legumes.
6. To coordinate with the cropping systems out-reach and extension activities to identify the new area of research by feed back and to recommend the new technologies suited to the farmers socio-economic situation.

With these objectives the Grain Legume Improvement Program was started since 1973 to improve grain legumes in the country through research. The main activities of this program have been concentrated mostly in Soybean, mungbean, lentil and chickpea. Recently research work was emphasized on pigeon pea and cowpea. The potential legume growing areas in the tarai (plain) grow mainly lentil, chickpea pigeon pea and lathyrus while Soybean, blackgram, cowpea and horsegram are mostly cultivated in the hills.

Besides their wide adaptation to the diverse agro-ecological condition grain legumes are highly suited to the various cropping patterns. They are highly demanded by the farmers because of their fitness to grow as the marginal lands even with marginal management. Also they have an important role in upgrading and maintaining the

the native soil fertility. Some of the popular cropping patterns involving grain legumes are:

In Tarai

1. Rice-relay lentil or chickpea.
2. Rice-Rice-lentil or chickpea.
3. Rice-Wheat-Mungbean.
4. Rice-lentil+chickpea+pea.
5. Rice+Pigeonpea in bunds-Wheat.

In Hills

1. Rice-Soybean or blackgram in bund-Wheat.
2. Maize+Soybean-Mustard.

Soybean (Glycine max)

Soybean in Nepal is an ancient crop, however, its cultivation is restricted to the mid hills region of the country ranging from 900 m to 1500 m in altitude. The estimated total production is 10100 m.t. With an average yield of 548 kilogram per hectare. Soybean is mainly cultivated as an inter crop with corn and on the bunds of rice field. Soybean are mainly used for human food locally by roasting the dried seeds, sprouting the seeds or as a green vegetables.

In a country like Nepal where protein malnutrition is common, processed Soybean has great potential as a good source of dietary protein.

Grain Legume Improvement Program has identified and released some high yielding cultivars for growing in the mid-hills and in Tarai. The prevailing market price for Soybean is approximately U.S. 400 per Dnetric ton. It is more economical to grow soybean than corn. Hence there is a great scope to increase the hectarage of soybean and its production thus the GLIP has undertaken varietal improvement work of soybean.

For the improvement of Soybean crop in Nepal, a set of Soybean varietal trial was received from IRRI and the trial was conducted at Khumal Agronomy Farm during 1985-86 season. The variety 7501-26-2 produced the highest grain yield of 2516.16 kg/ha followed by 7507-38-4, 30290-11-1, AGS-144 while the variety G.2261 produced the lowest yield.

<u>Cowpea (Vigna ungviculata)</u>

Cowpea is a potentially valuable legume crop for Nepalese cropping systems. Cowpea is mostly grown during summer in association with corn. In certain areas, cowpea is grown as a mono-crop for green vegetable. Cowpea is a cheap source of protein, phosphorus, iron and vitamin B, and an excellent substitute for animal protein. An indiginous variety of cowpea (treiling type) is cultivated with an average production of 400 kg of the dry beans per hectare. Hence areas of future research activities on cowpea include selection of high yielding short duration strains such as go days cowpea with disease and pests resistance and wide adaptation to existing cropping patterns.

A trial set was received from IRRI during 1985 crop season and the trial was planted at Agronomy Farm Khumaltar. The result showed that the cultivars TVx 4661-07 D produced highest dry bean yield of 1461 kg/ha followed by TVx 1948-01E (1202 kg/ha) and TVx 3410-12 J (1146 kg/ha).

Mungbean (Vigna radiata)

Mungbean is a potentially valuable legume crop for Nepalese cropping systems. One of the introduced strain from India, Pusa Baisakhi, which is early in maturity with shining and medium bold head has found wider acceptance among farmers. Areas of future research activities on mungbean include, developing high yielding strains with uniform maturity, disease resistance and wider adaptation and evolving cultural practices better suited to existing cropping systems.

The cultivars VC 1482 E, VC 2764 D and VC 277 were the best yielder than the local check.

Table 1. Area, production and yield of major food crops in Nepal.

S.No.	Name of the crop	Area (.000 ha)	Production (.000 mt.)	Yield (kg/ha)
1.	Rice	1257	2560	1975
2.	Wheat	400	526	1315
3.	Corn	475	752	1581
4.	Grain legumes	213	84.2	395
5.	Millets	122	122	1000
6.	Oil seeds	114	79	695
7.	Barley	27	23	863

Source: Agricultural statistics of Nepal 1983. Department of Food and Agricultural Marketing Services H.M.G. Nepal.

Table 2. Area, production and yield of major grain legumes crops of Nepal.

S.No.	Name of the crop	Area (.000 ha)	Production (.000 mt.)	Yield (kg/ha)
1.	Lathyrus	49.2	18.7	380
2.	Lentil	44.5	17.0	382
3.	Chickpea	34.3	13.1	381
4.	Horse gram	20.7	7.9	381
5.	Soybean	18.4	10.1	548
6.	Mungbean and black gram	16.0	6.1	381
7.	Pigeon pea	12.7	4.8	377
8.	Field pea	11.2	4.3	383
9.	Others	6.0	2.2	366

Source: Unpublished data of Department of Food and Agricultural Marketing Services, H.M.G. Nepal 1983.

Agronomic data for Soybean Varietal Trial.

S.No.	Variety	Days to Fl.	Days to Mat.	Plant ht. cm.	100 seed wt. (gm)	Grain yield kg/ha
1.	UPLSY-2	60	120	90.33	17.33	1516.66
2.	Clark 63	60	123	80.00	15.66	1027.77
3.	7207-1	78	126	96.66	17.66	1694.43
4.	30290-11-11	64	126	98.00	20.00	2222.21 (3)
5.	30050-2-17	60	130	73.66	17.00	2122.21 (5)
6.	Gunture	78	140	81.33	12.66	1688.88
7.	7501-26-2	64	123	97.66	15.66	2516.16 (1)
8.	7507-38-4	64	128	89.66	15.66	2394.43 (2)
9.	AGS-144	59	125	69.33	20.33	2144.43 (4)
10.	G-2261	55	130	61.33	16.66	727.77
11.	Ramson (check)	55	124	60.66	17.33	1833.32
12.	Hill (check)	55	118	79.00	13.66	1055.32

F Test	H.S.
LSD at 5%	792 kg/ha
C.V.	26.8%

GROUNDNUT IMPROVEMENT WORK IN NEPAL

B. Mishra[1]

Nepal, although a small country has high agroclimatic variations. In the north there are high mountains whereas in the south it possesses plain area which is called Tarai and in between them there are mid hills. Oilseed crops are mostly grown in Tarai but they are also grown in mid hills. These crops are the most important cash crops constituting nearly 4.46 percent of the total crop area and 48.83% of the total cash crop area. The total area under these crops is 1,240,000 hectares and the total production is about 83,000 metric tons. Oil crops ranks sixth in total land use after rice, maize, wheat, pulses and millets. Although large hectarage of land is being used for these crops, the national yield average remains only at 668 kg per hectare. The average per capita consumption of oils and fats is only about 1.7 kg year where as it is 5 kg in developing countries and even more than 20 kg in developed countries. These crops are grown mostly for edible oil, high level protein feed for animals from oil cakes obtained as a by-products, raw material for vegetable oil industries, paints etc. Groundnut cultivation can increase the total oilseed production and per capita consumption of oils and fats.

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[1]Asst. Agronomist, National Oilseed Development Program, Nawalpur, Sarlahi, Nepal.

Groundnut oil may be used as a main raw material for vegetable Ghee factory. Nepal vegetable Ghee factory along with other factories may require 20,800 to 30,000 tons of groundnut per year.

Keeping these points in view, National Oilseed Development Program (NODP) has been established. The main objective of this program is varietal improvement and to generate suitable technology for higher oilseed production and to increase its productivity. To meet this objective NODP is trying hard to develop high yielding cultivars in different oilseed crops. In groundnut, variety B-4 has been released for commercial cultivation which matures in 130-145 days and on an average produces 1.5 tons of pods per hectare. Variety B-4, although very popular among the growers due to its bunchy nature has got some drawbacks such as long duration. The long duration of this variety sometimes does not allow farmers to grow some winter crops such as brassica spp. on the same land. Therefore, NODP is putting its efforts to develop some short duration varieties to fit into the farmers cropping system. NODP has already recognized 4 early lines of groundnut for the last few years.

1. Varietal improvement work in groundnut

1.1. Advanced Varietal Trial

Advanced varietal trials are being conducted at NODP and other locations with 10 entries. It consists of all the three types of groundnut varieties i.e. Virginia, Valencia and Spanish types. The average of three years indicates that varieties

AC-343 (2281.3 kg/ha), AC-15729 (2024.3 kg/ha) and NC-5 (1879.3 kg/ha) gave higher pod yield than check variety B-4 (1436.5 kg/ha). Yearwise and location wise yield data indicated that variety AC-343 gave the highest pod yield of 2357.9 kg/ha which was 56.64% higher than the check variety B-4. Varieties AC-15729 and NC-5 produced 2049.4 kg/ha and 1934.75 kg/ha, respectively giving 36.15% and 28.53% higher pod yield than check variety B-4 (1505.25 kg/ha).

1.2 Varietal trial on ICRISAT materials

These materials are supposed to be early maturing. Hence another set of experiment was established on these materials. This experiment was conducted at NODP and other locations. The 4 year data reveals that ICGS-30 (2149.5 kg/ha), ICGS-36 (1802.5 kg/ha), ICGS-37 (1799.5 kg/ha) and ICGS-35 (1741.5 kg/ha) were found superior than check variety B-4 (1517.5 kg/ha). On the average, varieties ICGS-30, ICGS-36, ICGS-37 and ICGS-35 produced 29.4%, 15.8%, 15.7% and 12.9% higher pod yield than B-4, respectively. These varieties were found to be about 9 days earlier than B-4.

Farmers generally intercrop groundnut with maize. it has been also observed that groundnut when intercropped with eucalyptus trees, increases the vegetative growth of eucalyptus. Not much work has been done in this regard but experiments are being conducted to identify the suitable crops to be intercropped with groundnut and to recommend them for commercial cultivation.

Several sets of groundnut varieties are also being planted in the farmers field to test them under farmers conditions. Promising varieties are also distributed among the farmers in minikit distribution program.

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VARIETAL TESTING OF GRAIN LEGUMES FOR RICE FARMING SYSTEMS IN SRI LANKA

K. Hettiarachchi and K.H. Sarananda[1]

INTRODUCTION

Increasing demand for food caused by the increase in population necessitates that all our agricultural resources be utilized to the full. Grain legumes are as a group of crops continually mentioned where there are attempts made to make the best use of available resources, specially land and irrigation water.

Sri Lanka can be divided into 3 climatic areas, a wetzone of 1.54 M hectares, a dryzone of 4.17 M ha and an intermediate zone of 0.85 M ha based on the rainfall and its distribution. There are two cropping seasons namely Maha and Yala, determined by the two monsoons bringing rain from Northeast and Southwest respectively. The latter limiting its full benefit to the Southwestern part of the island creates the dryzone occupying about two thirds of the country.

Rice being the staple food of Sri Lankans is grown in all three climatic zones. However, it is in the dry and intermediate zones that the potential is high for grain legume cultivation. Traditionally in these areas farmers depended on village tanks (reservoirs) which were filled solely by the runoff from their catchments during the rainy

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[1]Research Officers, Department of Agriculture, Sri Lanka.

season. A major drawback in this system was the tendency of the farmers to delay land preparation for rice until they are satisfied that the tank is full. This is a wasteful practice as the average rainfal of the area is well above the requirement of a rice crop. As such, the existing system was a rice crop frequently followed by a fallow. It has been demonstrated that if the farmers were persuaded to commence cultivation earlier, the cropping intensity could be increased by having two crops of rice or a rice crop followed by an other field crop. Cultivation of other field crops specially grainlegumes in between two seasons is another possibility.

A large area of the dryzone is fed by major irrigation schemes which are dependent on large reservoirs and river dams. Two successful crops of rice are possible in these areas. Pulses are favoured as crops capable of making use of the residual moisture after harvesting rice.

Another area where grain legumes can play an important role in crop intensification is the rainfed rice system where the land is left fallow during the minor rainy season.

There are other aspects than fitting the soil moisture regime that enhance the value of pulses in rice farming systems. They provide a cheap source of protein with an amino acid composition complementing that of the cereal, while improving soil fertility.

CONSTRAINTS OF PRODUCTION

Cowpea, mungbean, soybean, blackgram and peanut are the major grain legumes cultivated in Sri Lanka. Past statistics show increases in both the cultivated area and production of pulses (Tables 1 and 2). However, it is evident that the production is primarily determined by the area under cultivation indicating a failure to achieve comparable increases in yield. This may be attributable to the following constraints on production.

1. Lack of suitable varieties for specified conditions
2. Poor seed quality
3. Poor stand establishment
4. Poor vigor
5. Heavy competition from weeds due to poor vigor and poor stand
6. Pest and disease occurence aggravated by weeds and lack of resistance
7. Storage problems leading to poor quality seeds and market unstability
8. Low input use

It is evident that most of these obstacles are consequent of the others. Due to the interrelated nature of the problems it is necessary that the solutions reach the farmer in a package rather than as individual recommendations.

OBJECTIVES

Major share of the activities are oriented towards surmounting the above mentioned barriers. Varietal means of achieving is being studied. Each crop has an identified set of desirable characteristics (Table 3). It is the objective to identify varieties with the most of these characteristics in combination. Some of these characters are desirable for both upland and rice-based systems. Though it is advantageous to choose varieties for specific conditions it is expected that they have a certain amount of adaptability in order to avoid the need for too many recommendations.

OBSERVATIONS ON VARIETAL EVALUATIONS DURING YALA (DRY SEASON) 1985

Cowpea

Twelve varieties of cowpea including two local cultivars were tested at Maha Illuppallama (Table 4). None of the varieties tested were superior in earliness though all of them exceeded it in yield. Anyhow the days to maturity was found to be statistically non significant while it ranged from 56 to 63 days. Variety TVx 3410-02J performed best outyielding the local checks significantly. TVx 1948-01E, TVx 4659-03E and TVx 4678-03E were the other varieties that had superior yeilds. Cultivar TVx 4659-03E may not be farouved from the market point of view due to its large seed size.

Bush Sitao

Among 8 cultivars of bush sitao evaluated at Maha Illuppallama variety BS_1 has given the highest of 14.7 t/ha of green pods from five pickings (Table 5). However, the yield differences among the varieties have been satistically non significant. Cultivars have shown uniformity in growth duration. Plant height has varied significantly ranging from 64 cm in Los Banos Bush Sitao to 155 cm in BS_7.

Mungbean

Ten cultivars of mungbean received from the Asian Rice Farming Systems Network have been evaluated at Angunakolapelessa. Three cultivars have exceeded the local check-1 in yield, though being not significantly different to it (Table 6). IPB M79-13-29, CES 1T-2, and CES U-1 were the most promising cultivars. Neither the days to maturity nor the growth duration has varied significantly among the cultivars. Plant height has a significance in rice-based systems in that too short a stature may lead to high competition from weeds while too high a stature may lead to lodging. Although the plant height ranged from 47 to 63 cm varietal differences were statistically non significant.

Peanut

Very high yields were obtained in a trial conducted at Maha Illuppallama where 12 cultivars including 2 checks were tested. Though the yields ranged from 2.96 t/ha in Acc. 12 to 4.99 t/ha in CES 103 it was unable to obtain statistically significant differences among the varieties. The local checks showed superiority over the rest in early vigor. Unfortunately none of the varieties manifested earliness which is a highly desirable character for the rice-based system. Cultivar Acc-12 was found to be the most tolerant to rust. Seed size varied significantly with 100 seed weight ranging from 30-52 g. It was also found to be correlated with the pod yield.

Promising varieties of each crop will be tested again to confirm their superiority. Their behavior may be observed under different conditions, along with varieties coming from different programmes in order to find out additional merits of them. Later they may be tested in farmer's field to study their performance under farmer's level of management.

ACKNOWLEDGEMENTS

We wish to thank Dr. M. Sikurajapathy, National Coordinator, Farming Systems Project and Researchers of the Department of Agriculture for their valuable support in the preparation of this manuscript.

Table 1. Area under grain legume cultivation in Sri Lanka.

Unit: 1000 ha.

Crop	1974	1979	1980	1981	1982	1983
Cowpea	3	30	26	38	34	46
Mungbean	11	12	14	18	21	23
Peanut	8	5	11	12	14	14
Soybean	1	1	1	2	17	15

Source: Agricultural Implementation Programme, Ministry of Agricultural Development and Research.

Table 2. Production of grain legumes in Sri Lanka.

Crop	1974	1979	1980	1981	1982	1983
Cowpea	2	19	24	39	38	26
Mungbean	6	10	13	19	19	15
Peanut	7	5	14	15	15	17
Soybean	1	1	1	2	11	11

Source: Agricultural Implementation Programme, Ministry of Agricultural Development and Research.

Table 3. Desirable varietal characteristics for rice-based farming systems in Sri Lanka.

Character	Cowpea	Mungbean	Peanut	Soybean	Blackgram
High yield	x	x	x	x	x
Early maturity	x	x	x	x	x
Uniform maturity	x	x	x	x	x
Seedling vigor	x	x	x	x	x
Drought tolerance	x	x	x	x	x
Water logging tolerance	x	x		x	x
Large seed		x	x	x	x
Small seed	x				
Shiny green seed		x			
Long seed viabilitt			x	x	
Collar rot resistance	x				
Leaf spot resistance		x	x		
Rust resistance			x		
Mosaic virus resistance	x	x		x	x
Bean fly resistance	x	x		x	x
Pod borer resistance	x	x		x	x
Bruchid resistance	x	x			x
High shelling %			x		

Table 4. Yield and other agronomic characteristics of cowpea cultivars evaluated at Maha Illuppallama.

Cultivar	Yield (t/ha)	Days to mature	100-seed wt. (gm)
TVx 3410-02J	1.79	62	139
TVx 1948-01E	1.62	60	120
TVx 4659-03E	1.52	63	193
TVx 4678-03E	1.42	60	141
TVx 289-4G	1.25	61	137
TVx 3671-14C-01D	1.13	60	154
TVx 2724-01F	1.12	59	144
Vita-7	1.11	58	137
Local Check-2	0.80	61	153
TVx 4661-7D	0.71	61	150
TVx 3381-02F	0.71	60	109
Local Check-1	0.58	56	69
Mean	1.15**	60^{ns}	137**
L.S.D. (P=0.05)	0.60	-	10
C.V (%)	0.7	3.7	4.4

ns = not significant at 5% level of probability.
** = significant at 1% level of probability.

Table 5. Yield and other agronomic characteristics of bush sitao cultivars evaluated at Maha Illuppallama.

Cultivar	Yield (t/ha)	Growth duration (days)	Plant height (cm)
BS_1	14.7	88	139
BS_6	13.8	88	153
BS_7	13.6	88	155
Local Check -1	13.3	88	79
Los Banos Bush Sitao	12.8	88	64
BS_3	12.7	88	143
EG BS #2	10.4	88	85
Local Check-2	9.9	88	68
Mean	12.7^{ns}	88	111**

ns = Not significant at 5% level of probability.

** = Significant at 1% level of probability.

Table 6. Yield and other agronomic traits of 12 mungbean cultivars tested at Angunakolapelessa.

Variety	Yield (t/ha)	Days to mature	Growth duration (days)	Plant height(cm)
IPB M79-13-29	1.39	59	68	63
CES 1T-2	1.38	59	68	60
CES U-1	1.34	57	67	63
Local Check-1	1.26	59	69	50
IPB M79-13-45	1.19	58	69	54
IPB M79-22-11	1.12	57	68	53
Pag-asa 1	1.08	58	67	53
IPB M79-9-94	1.04	57	68	63
Pag-asa 2	1.01	59	68	47
IPB M79-9-82	1.00	57	65	56
Pag-asa 3	0.99	56	64	54
Local Check-2	0.98	59	68	52
Mean	1.15**	58^{ns}	67^{ns}	56^{ns}
L.S.D. (P=0.05)	0.16			

** = Significant at 1% level of probability.

ns = Not significant at 5% level of probability.

Table 7. Yield and other agronomic traits of 12 peanut varieties evaluated at Maha Illuppallama.

Variety	Yield (t/ha)	Vigor[a]	Days to mature	Score for rust[b]	100 seed wt (g)
CES 103	4.99	4	109	6	49
UPLB PN-2	4.4	4	109	6	51
F-334-33	4.25	4	109	6	52
Local Check-2	4.09	3	109	5	47
CES 101	3.99	4	109	5	48
Local Check-1	3.92	3	109	5	41
CES 102	3.78	7	109	6	48
M-10	3.58	7	109	5	47
PI 118200	3.57	5	109	5	37
CES 2-25	3.45	5	109	4	44
Kidang	3.27	4	109	5	47
Acc-12	2.96	7	109	2	30
Mean	3.85[ns]		109		45**
L.S.D. (P=0,05)					4.5
C.V. (%)	18.4				6.0

[a] - Score for vigor; 1 = extra vigorous to 9 = very weak plants.

[b] - Score for rust; 0 = no incidence to 9 = highly infected.

ns - Not significant at 5% level of probability.

** - Significant at 1% level of probability.

SELECTION AND TESTING CULTIVARS FOR RICE-BASED CROPPING SYSTEMS

One of the projects in the cropping systems program of IRRI is subproject 805: Selection and testing cultivars for rice-based cropping systems. It involves the testing of rice and other crops as it fits in the cropping pattern testing. It also involves collaboration with national program and other international centers to identify better varieties of crops that fits the different cropping systems.

The most important upland crops grown before and after rice are corn, sorghum, soybean, peanut, mungbean and cowpea. The Institute of Plant Breeding (IPB) at UPLB received a grant from IDRC to develop varieties of upland crops for rice farming systems. The project includes screening of lines and varieties from the international centers (ICRISAT, IITA and AVRDC) and other national breeding programs; hybridization of selected promising varieties and selection. The breeding program concentrates on soybean, peanut and mungbean. Hybridization, selection and screening are done at IPB, preliminary yield trial in IPB and/or Pangasinan State University (PSU) and the general yield trial in PB, PSU and Iloilo. IITA assigned a senior scientist at IRRI to identify varieties of cowpea and soybean that fits the rice farming systems under an IRRI-IITA Grain Legume Project. For corn and sorghum, we are collaborating with IPB, CIMMYT and ICRISAT. The Thailand Field Crops Research Institute (FCRI) and Indonesian Central Research Institute for Food Crops (CRIFC) intensified their work on breeding for rice farming systems and they contribute elite materials to the varietal testing in the Network.

The most promising entries from IPB; Thailand FCRI; Indonesia CRIFC and national programs are submitted to IRRI for seed increase and distribution to countries involved in the ARFSN collaboration on varietal testing of upland crops before and after rice.

Cowpea

Ten early maturing cowpea lines were evaluated before rice. IT82D-891, CES 41-6 and IT82D-889 performed well and produced a seed yield of 0.9-1.0 t/ha in 60 days. These also produced green fodder of 14 to 16 t/ha.

Twelve medium maturing varieties cowpea lines were tested after rainfed lowland rice with zero tillage at IRRI Farm in dry season. Fertilizer was not applied. Crop was protected against insect by use of insecticide three times in whole crop season. Crop grew well on residual moisture. Among 12 cowpea lines, two produced over 1.5 t/ha seed yield and all entries had seed yield over 1.0 t/ha in 70-80 days. The superior performance of TVx 2907-02D and Vita 4 was associated with robust plant type, deep root system and duration of crop growth. These lines also had moderate insect damage, wilt and powdery mildew.

Seven dual purpose cowpea lines were evaluated after lowland rice without fertilizer application. Crop was protected against insects. Among seven genotypes TVx 2724-01F produced good seed yield and fodder yield. This was followed by TVx 1948-01F and TVx 3410-02J.

A sizeable area of tropical Asia has acid soil where cowpea has superior performance over mungbean or soybean. The seed yield of cowpea lines in acid upland ranges from 0.9-1.5 t/ha as compared to 0.2-0.4 t/ha of mungbean or soybean. One hundred fifty lines of early and medium maturing cowpea were screened. Twently lines better than the check (IT82D-889) were selected for yield performance.

Seven hundred forty nine accessions of cowpea were screened for beanfly at IRRI and AVRDC, Taiwan. Out of 749 lines, screened at AVRDC, 45 lines were rated highly resistant to beanfly. At IRRI, 37 lines were found to be resistant to beanfly. In further confirmatory test 5 lines consistently showed resistance to beanfly. These are TVu 2181, TVu 3073, TVu 3296, TVu 652 and P-1.

Mungbean

Two hundred fifty five entries were evaluated after rice in the observation nursery. We selected 80 lines for further evaluation in the preliminary yield trial in 1985. A total of 81 entries were evaluated in simple latice design at UPLB and PSU. The mean yield obtained was 643 kg/ha and 494 kg/ha at UPLB and PSU,respectively. Twenty lines better than the check were selected for the general yield trial after rice. There were 21 IPB lines in the general yield at UPLB, PSU and Iloilo. The after rice plantings consisting of 21 IPB lines were planted in Nov. 1984 at UPLB, PSU and Iloilo. The yields obtained at UPLB and PSU were abnormally low in comparison to the previous years. This result could be attributed to the waterlogging situations that occurred from planting to flowering at UPLB and the drought condition that occurred at PSU. The experiment at Iloilo failed due to drought. The yield range at UPLB was 329 to 665 kg/ha while at PSU, the yield range was 320 to 975 kg/ha. From the combined results of the UPLB and PSU experiments, 5 lines were eventually selected for seed increase and inclusion in the Asian Rice Farming Systems Network (ARFSN) varietal testing. These lines are IPB M79-12-168, IPB M79-20-113, IPB M79-17-91, IPB M79-25-106 and IPB M79-25-115.

In the before rice planting 20 IPB lines were evaluated at UPLB, PSU and Iloilo. The Iloilo experiment is again a complete failure due to waterlogging. The mean yields obtained are 482 and 355 kg at UPLB and PSU, respectively. The yield ranges are 303-788 at UPLB and 168-701 kg/ha at PSU. From the combined results of these experiments, 5 lines were selected for seed increase for the varietal testing in the AFSN. These lines are IPB M81-4-19, IPB M79-13-123, IPB M81-9-90, IPB M81-4-55 and IPB M81-4-34.

Soybean

Soybean varietal improvement for rice-based farming systems are done by IRRI-IITA Grain Legume Project and IPB. In IRRI we screened 1400 soybean lines for their adaptation after rice. Three hundred fifty lines were selected. The promising lines were mostly tropical and medium maturing and have been advanced to preliminary yield test. Another two hundred twenty two unselected populations were evaluated after lowland rice. We selected 400 plants for further evaluation.

Twenty promising soybean lines was evaluated for seed yield after rice on residual moisture. Significant differences among entries were observed for seed yield (488 to 754 kg/ha). The most promising lines were Acc 94, Acc 2120, TGx 536-02D, SJ-5, TGx 442-02D. Better performance of medium maturing cultivars was noted than early and late maturing types in rainfed lowland condition.

Eighteen soybean lines differing in maturity were evaluated after two rice crops planted in March at IRRI. Crop was raised with partial irrigation. The early maturing cultivars produced seed from 1.86 to 2.68 t/ha, respectively.

In another study, sixteen improved soybean lines were evaluated during wet season in Davao under upland conditions. Seed yield ranged from 1.41 to 2.42 t/ha. The top yielding cultivars were SJ-5, TGx 536-02D, TGx 442-02D with yield 2416, 2341, and 2253 kg/ha respectively.

The IPB varietal improvement also includes soybean. In Nov. 1984, 195 lines were planted under post-rice condition at UPLB and PSU. The combined yield data obtained from the two plantings resulted in the selection of 80 lines for further evaluation in the 1985 preliminary yield trial.

In the preliminary yield trial 49 entries involving materials from Asian countries and INTSOY were planted at UPLB and PSU. A satisfactory yield data was obtained at UPLB, however the yield data from PSU is exceptionally low. The mean yield obtained at UPLB was 1.47 t/ha while the mean yield at PSU is 0.50 t/ha. From the combined results of the 2 experiments, 20 lines were selected for inclusion in the general yield trial next year.

Twenty entries including the check variety UPL SY-2 were planted in UPLB and PSU. The materials consisted mainly of AVRDC and IPB lines. The mean yield obtained at UPLB was 1.96 t/ha while at PSU, the mean yield was 0.27 t/ha. The yield ranges were 0-2.99 and 0.09 to 0.54 t/ha. at UPLB and PSU, respectively. From the combined data of the 2 experiments 5 lines were selected for inclusion in the Asian Rice Farming Systems varietal testing. These lines are IPB SY 138-28, GC 60068-9, GC 50193-7-6, Acc 770 and GC 50123-8-6.

Peanut

A total of 609 lines were planted at PSU. From this planting, 123 lines were initially selected. These materials were planted to increase seeds under upland condition during the wet season (1985). From our wet season planting, only 63 lines were finally selected for inclusion in the preliminary yield trial after the following year.

Two separate trials were conducted in PSU, one with 44 IPB breeding lines and 5 accessions and the other with 33 early breeding lines from ICRISAT. The bean yield (shelled) obtained from the experiment involving the IPB breeding lines ranged from 102 to 740 kg/ha with a mean of 359 kg/ha. All entries matured in 107 days. The experiment involving the ICRISAT line gave a mean yield of 461 kg/ha and a yield range of 67-753 kg/ha. Maturity of the ICRISAT materials range from 88 to 102 days. Most of the materials matured in 88 days which is 14 days earlier than the check variety UPL PN-2. From the 2 experiments, 15 lines were selected for further evaluation in the general yield trial after rice.

At IRRI we evaluated 11 lines from Tainan, China. Bean yield ranged from 0.8-2.12 t/ha. UPLB PN-4, one of the check variety used gave the highest bean (2.12 t/ha) and fodder yield (17.9 t/ha). However, all entries except NS 8328, outyielded UPL PN-2, another check variety. The promising varieties were NS 8344, NS 82105 and NS 8304 with 1.73, 1.57 and 1.54 t/ha of shelled bean. Fodder yield of these varieties was 11-12 t/ha. Maturity was 100 days.

Pigeonpea

At IRRI, fifty four pigeonpea varieties from ICRISAT and Queensland, Australia were screened after rice. Grain yield of ICRISAT materials ranged from 0.78-3.25 tons/ha and fodder yield from 6.50-23.8 tons/ha. The most promising varieties in terms of grain and fodder production were ICPL 84060, ICP 909-E3-5EB, ICP 3009-E3-4EB and ICPL 265. Maturity of these varieties was 120 days. Yield levels of varieties from Australia was quite low ranging from 0.8-1.56 t/ha for grain and 1.25-6.83 t/ha for fodder. QPL 72 and Hunt were the most promising varieties.

Chickpea

We evaluated under upland condition chickpea in the last 2 years. IC 78002 was the most promising. In 1984, we again obtained 16 entries from ICRISAT for evaluation. Yield ranged from 0.49-1.38 t/ha. All entries were better than IC 78002. The most promising entries were BND-9 and 81220.

Sorghum

Thirty six early and medium maturing sorghum varieties from ICRISAT were screened after rice. Grain yield of early materials ranged from 0.22-1.01 t/ha and medium maturing varieties from 0.75-1.73 t/ha. Goldfinger and Tropic were the outstanding entries in the early group and M-80200 and SPV 475 in the medium maturing group. Days to maturity of early varieties was 95-100 days and 110-115 days in the medium ones.

Sweet Potato

We evaluated at IRRI 11 sweet potato varieties from IPB and Visayas State College of Agriculture in lowland and upland conditions. The lowland trial was under zero tillage and the upland with tillage. In the lowland the outstanding varieties were CI 693-9, Tinipay and G145 r-4 with marketable tuber yield of 10.1, 9.4 and 8.1 t/ha, respectively. Fodder yield ranged from 2.3-7.0 t/ha. G 53r-17b, G 113-2b and Tinipay were the highest yielders giving yield of 7.0, 6.1 and 6.0 t/ha. respectively. All varieties were harvested in 110 days.

In the upland, tuber yield ranged from 6-14 t/ha. V2-1 from VISCA gave the highest marketable tuber yield (14.1 t/ha) followed by G 145r-4 and G 53r-17b with 13.0 and 12.1 t/ha, respectively. Fodder yield was highest in G 53r-17b with 10.2 t/ha. All varieties were harvested 110 days from planting.

Chemical analysis of promising upland crop varieties used in ARFSN varietal testing

Percent protein in grain and percent crude protein and fiber in fodder of some of the high yielding upland crop varieties grown during the 1984 wet and dry seasons are presented in Table 1. Crude protein and crude fiber content of other crops are however not yet available.

In mungbean, Pag-asa 2 gave the highest protein content in grain (26.0%) and fodder (16.0%) and the lowest crude fiber content (24.1%)

indicating that this variety will be preferred more by animals. The other promising dual purpose varieties were TVx 3671-14C-01D (23.1% protein in grain and 13.2% protein in fodder) in cowpea and BS_6 (3.1% protein in fresh pods and 19.2% protein in fodder) in bush sitao. In other crops, highest protein content in grain was obtained in 7521-26-2 (46.7%) in soybean; CES 2-25 (31.7%) on peanut; CS 116 (9.0%) in sorghum; ICPL-6 (23.1%) in pigeonpea and Early DMR Composite 1 (11.4%) in maize.

Table 1. Percent protein in grain, crude protein and fiber in fodder of different promising upland crop varieties planted before and after wetland rice. IRRI Farm, 1984 wet and dry season.

C r o p	Grain % Protein (N x 6.25)	Fodder % Crude Protein	Fodder % Crude Fiber
Mungbean			
Pag-asa 2	26.0	16.0	24.1
Pag-asa 3	23.2	14.2	30.3
M350	22.4	13.6	26.2
IPB M79-13-60	22.4	14.3	27.4
Pag-asa 1	24.8	15.0	25.2
Cowpea			
TVx 289-4G	22.6	13.2	27.0
TVx 3671-14C-01D	23.1	13.2	24.1
CP 4-2-3-1	21.5	12.8	25.3
TVx 3236-01G	21.7	13.1	25.8
EG #2	23.0	11.1	30.0
Bush Sitao			
BS_1 (6-14R x AS	2.6[1/]	19.2	24.2
BS_3 (6-14R x AS)	3.6	17.2	28.2
BS_6	3.1	15.1	26.1
BS_7	2.5	14.1	30.2
EG BS_2	2.7	15.0	28.3
UPL BS_4	4.4	16.0	33.1
Soybean			
7207-1	37.5		
30290-11-11	39.0		
7521-26-2	46.7		
G2261	40.6		
UPL SY-2	36.4		
Peanut			
CES 101	21.1		
CES 2-25	31.7		
PI 118200	24.4		
UPL PN 4	23.8		
UPL PN 2	30.2		

Table 1. (Cont'd)

C r o p	Grain % Protein (N x 6.25)	Fodder % Crude Protein	Fodder % Crude Fiber
Sorghum			
CS 110	8.6		
CS 116	9.1		
CS 137	8.6		
CS 253	8.8		
UPL SG 5	6.9		
Pigeonpea			
ICPL-6	23.1		
ICPL-81	22.0		
ICPL-87	18.5		
ICPL-142	21.9		
TCF 6-1-1	20.5		
Field Corn			
Thai Comp. 1 Early	9.6		
Arun 2	10.2		
Ranjuna	10.6		
Poza Rica 7931	10.2		
Early DMR Comp. 1	11.4		

1/ Uncorrected for 80% amino acid recovery (about 20% non-protein N, probably non-protein amino acids).

BREEDING TECHNIQUE FOR FIELD LEGUMES FOR THE RICE-BASED CROPPING SYSTEMS IN THE PHILIPPINES

R. S. Navarro[1]

INTRODUCTION

Varietal improvement of field legumes (soybean, mungbean, peanut and cowpea) in the Philippines is initially undertaken in three government agencies i.e.; the Bureau of Plant Industry (BPI), University of the Philippines at Los Baños (UPLB) and the Philippine Atomic Energy Commission (PAEC). Lately, however, the International Institute of Tropical Agriculture has initiated a research undertaking with the International Rice Research Institute (IRRI) on the varietal improvement of soybean and cowpea to augment and support the breeding works of Asian countries for these two crop species.

During the initial period, breeding works were confined under idealized upland monoculture condition. Varieties that were selected from this environment were also utilized for other environments (rice-based and partial shade

In 1975, the UPLB with IRRI started a project to select upland crop varieties for multiple cropping systems. This project was funded by the International Development Research Centre (IDRC) of the Canadian government. Activities of the project were confined to the screening of upland crop varieties under partial shade and lowland rice-based system.

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[1]Researcher, Legume Breeder, Institute of Plant Breeding, UP at Los Banos, College, Laguna.

The research data generated from the project resulted in the reorientation of upland crops breeding strategy at UPLB; hence the initial breeding work under upland monoculture was expanded to include breeding and selection for partial shade and lowland rice-based conditions.

The varietal improvement of dryland legumes (mungbean, soybean and peanut) for the rice-based system was started in 1982 at the Institute of Plant Breeding (IPB) at UPLB. This is a cooperative project between UPLB and IRRI with financial support from IDRC.

The objectives of the project are:

1. To collect advance generation lines and promising varieties of soybean, mungbean and peanut from international institutes, centers and national breeding programs for evaluation for adaptability to rice-based cropping systems;
2. To develop varieties of soybean, mungbean and peanut for intensified production systems for rainfed wetland and partially irrigated rice areas;
3. To evaluate the most promising lines and varieties of the three legume species in several environments at research stations and farmers' fields in Asia through the Asian Farming Systems Network (AFSN) and
4. To cooperate with and make available to national programs promising lines or varieties for use in their own research and/or production programs.

This paper aims to present the breeding technique for the rice-based project.

REVIEW OF LITERATURE

Rice-based environment

There are two environmental conditions that exist under the rice-based system: pre-rice and post-rice (Lantican, 1982 and Villareal et al., 1983). The attendant factors associated with the two environments are:

Pre-rice

* longer photoperiod
* prevailing cloudiness
* drought at seedling establishment and
* excessive wetness at flowering to maturity

Post-rice

* waterlogging at establishment and early vegetative stage
* drought at reproductive stage
* short photoperiod
* high temperature in the tropics and cool temperature in the temperate zone
* poor soil granulation and compaction

Desirable characters for the rice-based system

* drought tolerance
* waterlogging tolerance
* early to medium maturity
* photoperiod insensitive
* early and rapid seedling development
* tolerance to low and high temperature

In addition to these characters, Villareal (1983) emphasized the importance of non-shattering and seed dormancy to prevent seed losses during the hot and dry period and unwanted sprouting in case of rains at maturity. Another alternative is to harvest fresh pods rather than dry beans.

Selection indices for paddy adaptation

In view of the contrasting growing conditions prevailing between the post-rice and pre-rice environment, the selection criteria for the two growing conditions are expected to differ.

For the pre-rice cropping, selection indices such as short plant stature, low leaf area index (LAI) and high harvest index may be useful (Lantican, 1982). Short stature of determinate types as well as low LAI are characters that could reduce the occurrence of lodging during the reproductive stage which normally coincides with rainy days.

Under the post-rice cropping, indeterminate types and resistance to major diseases are important traits to consider.

In mungbean, Pun (1984) working on 144 genotypes under the post-rice environment reported that seedling vigor exerts a direct and positive effect on yield. These two characters are positively correlated. Other traits that exert the same influence on yield are plant vigor, plant height at harvest, number of clusters per plant, number of seeds per pod, number of branches per plant and seed weight. Likewise, Lantican and Catedral (1977) also reported that LAI, total dry matter (TDM) and plant height are positively correlated with bean yield of mungbean under post-rice environment.

For soybeans, several plant characters have been observed to be highly influenced by stress factors under the post-rice cropping. Catedral and Lantican (1977) found that yield components such as pod number per plant and seed weight were markedly affected by moisture stress. Thus, selection for these characters maybe worthwhile. Buajarern (1978) found that varieties with a fast rate of seed filling and shorter time to attain maximum seed weight gave the highest yields. This two characters conferred and advantage - the plant avoided the critical period of moisture stress late in the growing season.

BREEDING STRATEGY

The concept of breeding for a specific condition was based on the occurrence of variety x cropping systems interaction (Francis et al., 1976, Lantican, 1976, and Buajarern, 1978).

This concept, however, is not tenable if we have to consider the consistency of the relative yields and ranking of several upland crops grown across monoculture and mixed cropping systems (Francis et al., 1978 and Francis, 1979). Likewise, results of experiment at UPLB have shown that several varieties of upland crops which were developed and selected under upland monoculture could also yield satisfactorily under paddy condition.

In view of these contrasting evidences and for purposes of economy, a unified multistage breeding and evaluation program for all cropping systems was suggested by Lantican (1982). According to him, the initial stage of breeding such as hybridization and selection phase among the early generations (F_1-F_5) should be done under idealized upland environment.

Selection should exploit varietal characters which could relate to general fitness and greater stability over a wide range of environments. Disease and pest resistance are of prime importance.

The second stage is the series of screening for desirable characters involving a large number of entries by the multidisciplinary team through the unreplicated observational nursery. Selections from the screening work of the different disciplines could be used as parentals in the hybridization work or retested in the first replicated experiment; the preliminary yield trial (PYT). Further evaluation of selected materials from the PYT will be done in the general yield trial (GYT) which uses less number of entries, larger plots and a more precise design. The final stage of evaluation which goes by several names like advance yield trial (AYT), regional performance test (RPT) and national cooperative test (NCT) should be conducted in several locations in the country under different cropping environments. Results from these multi-locational tests will serve as the basis for recommending varieties for specific environment.

The above mentioned strategy with minor modifications is presently being used in the field legume varietal improvement work at IPB.

In the initial stage, planting and selection in the early generations is shuttled between the upland and lowland environment. A common set of entries for the three environments is used starting from the observational nursery until the PYT. Evaluation of condition specific varieties are conducted in the GYT and the NCT.

The flow chart of activities is presented in Figure 1.

METHODOLOGY FOR THE DIFFERENT STAGES OF BREEDING FOR THE RICE-BASED SYSTEM

Background Information

Under the rice-based project, mungbean is evaluated under the post-rice and pre-rice environment. Soybean and peanut are evaluated only in the post-rice environment. Although the post-rice and pre-rice experiments are conducted in similar manner, some differences could not be avoided for practicality and convenience. The difference in conducting the experiments in the two conditions are as follows:

Operation	Post-rice[1/]	Pre-rice
* land preparation	zero tillage	complete
* planting method	hill (dibbling)	drill
* row spacing	25 or 50 cm.	50 cm.

Hybridization

Selections obtained from the multidisciplinary team are utilized in the hybridization activity. The number of crosses produced depended mainly on the output of the several disciplines. In general, high yielding materials which have a wide range of adaptation or condition specific are intercrossed with disease and pest resistant materials selected from the pathology and entomology discipline or to the materials selected under stress environments (tolerant to low pH, drought and waterlogging).

[1/] For mungbean and soybean only; peanut uses the operations under pre-rice.

Advance generation planting and selection

The F_1 generation is planted under the upland condition. All pods are harvested and bulked for the next generation. The F_2 to F_5 generations are then shuttled between the upland and lowland. The F_2 to F_5 generations are planted in a 10-row plot with a length of 10 m. Rows are spaced 50 cm. irregardless of the planting environment. In the F_2 and F_4 generations, a modified bulk method is used for mungbean and soybean. This is done by harvesting 1-5 pods per plant instead of harvesting all the pods from the population. Initial plant selection is done in the F_4 or F_5 generation by harvesting 5-6 pods from each selected plants for mungbean; all pods are harvested for soybean and peanut. These selections are then planted in a plant-to-row method.

Observational nursery

This unreplicated experiment is conducted in two locations during the post-rice and pre-rice conditions. A one-row plot with a length of 1-5 m. long is used. Rows are spaced 50 cm. apart.

For the evaluation of yield data, "a moving plot-check comparison technique" is employed. This is done by interplanting one row of a common check variety for every 10-12 rows of test materials. This method is presented in Figure 2. The yield of the test materials are then compared to the nearest row of the check variety. Selection will be based on the percent of yield against the check variety, disease reaction and overall plant appearance.

Preliminary yield trial

This replicated exp eriment is conducted in two locations for both the lowland conditions. A two-row plot with a length of 5 m. is used. During the first year of the project (1982), this experiment is conducted using an RCB design with two replications. However, in the succeeding years, the simple lattice design is used due to the higher efficiency of this design over the RCB design. Statistical analysis of three post-rice and two pre-rice experiments involving 81 entries showed that the simple lattice design has an efficiency range of 107% to 307% and a mean of 166% over the RCB design.

General yield trial

Depending on the number of entries, this experiment is conducted using a triple lattice design or an RCB design with three replications. A four-row plot with a length of 5 m. is used. This is conducted in one, two and three locations for peanut, soybean, and mungbean, respectively. Results from these experiments serve as the basis for selection of entries for the AFSN and the NCT for the rice-based system.

National cooperative test

This trial is a national undertaking which started in October, 1985 with 6 locations throughout the Philippines. The three legume species included in this trial are mungbean, soybean and cowpea. The maximum number of entry for each crop is 16 including one national check and one local check. Experiments are conducted in a randomized complete block design (RCBD) with four replications. A four-row plot, 5 m. long and row spacing of 25 cm. is used. Zero tillage, mulching and dibbling method is used.

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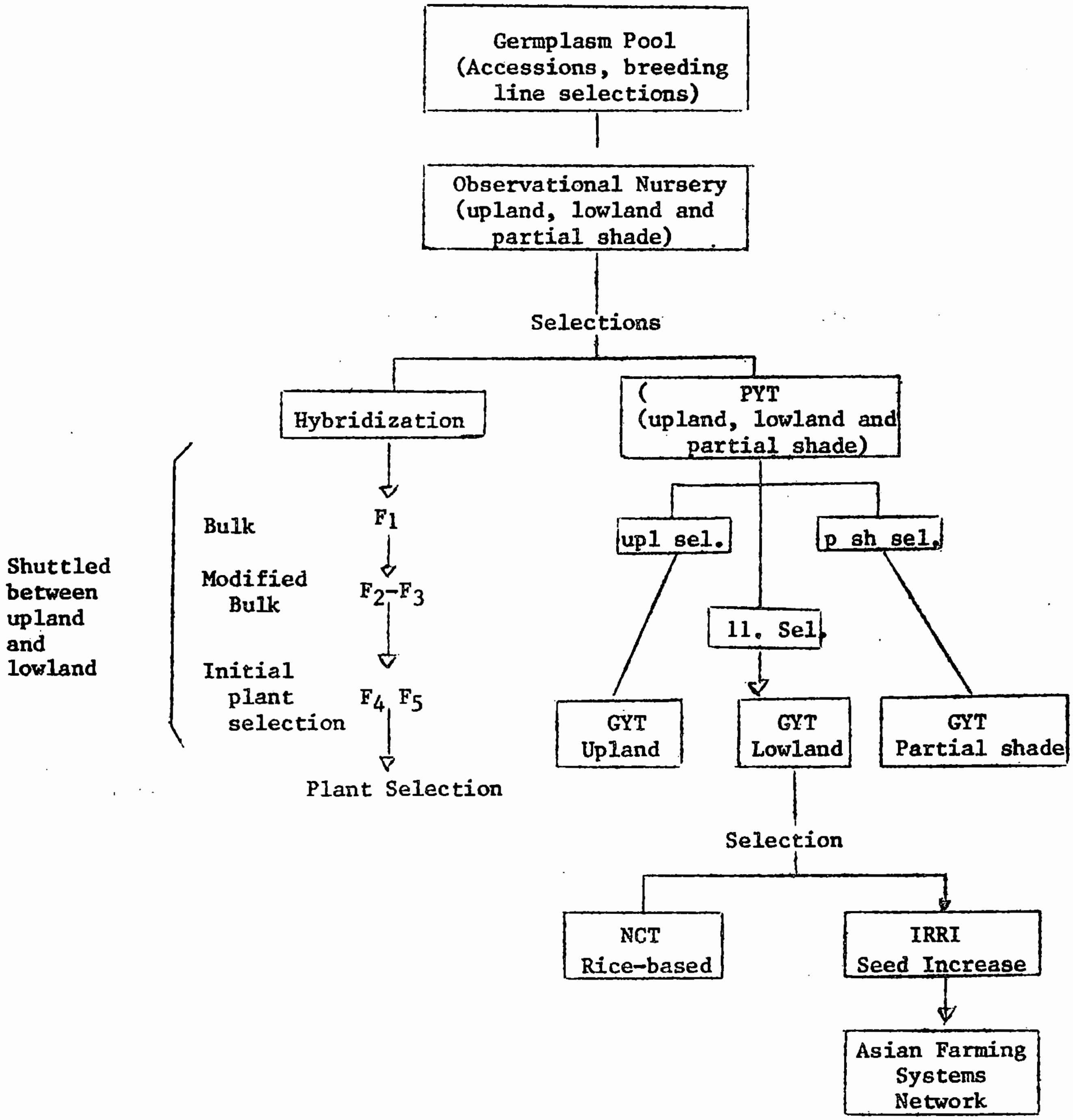

Figure 1. Multistage mungbean breeding scheme in the Institute of Plant Breeding.

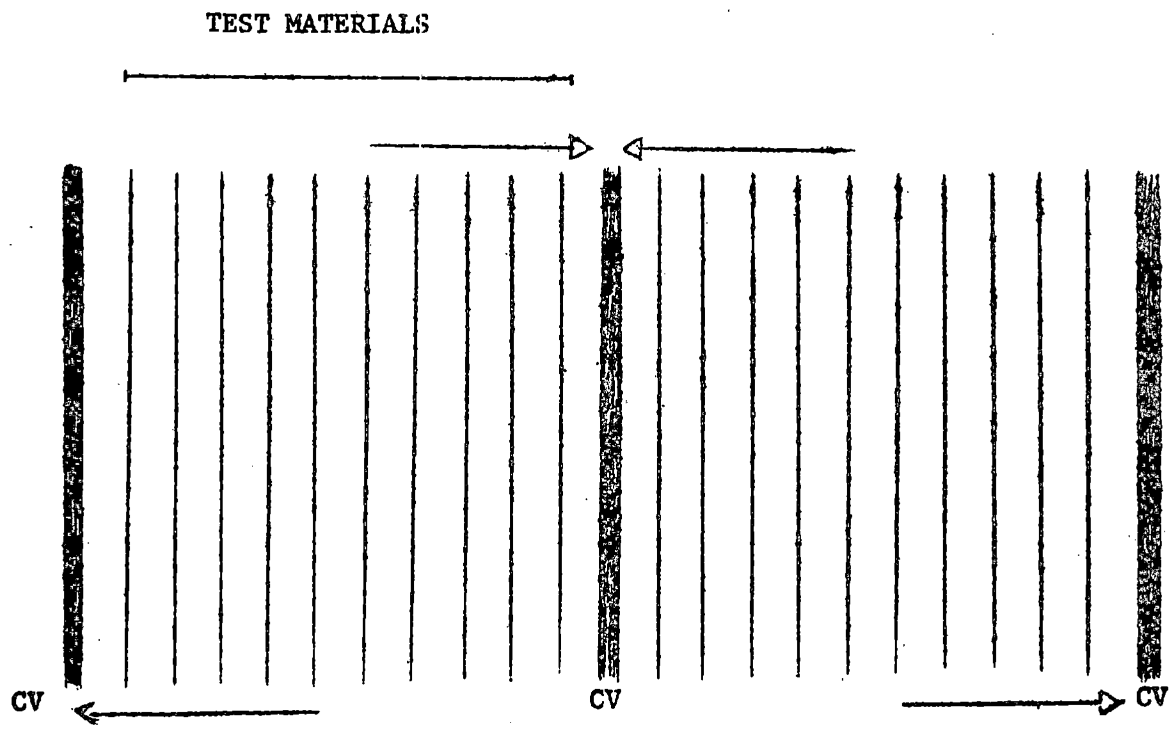

Figure 2. Illustration of the "moving plot, check variety comparison" technique.