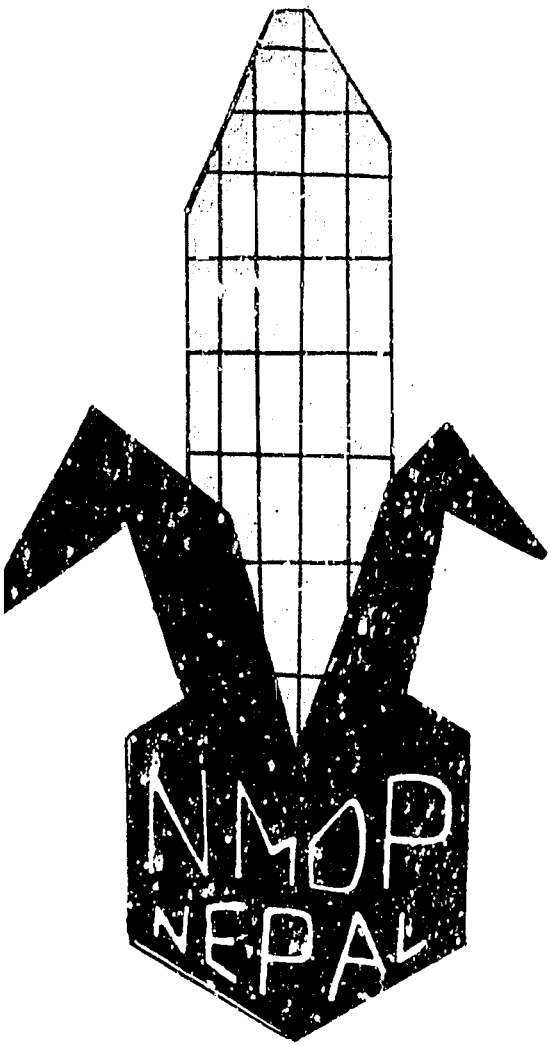
MAIZE AND FINGERMILLET



THE TENTH SUMMER CROPS WORKSHOP 1982

HIS MAJESTY'S GOVERNMENT
DEPARTMENT OF AGRICULTURE
NATIONAL MAIZE DEVELOPMENT PROGRAM
RAMPUR AGRICULTURE STATION
RAMPUR, CHITWAN, NEPAL
January 23 - 28, 1983

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COORDINATOR'S REPORT - 1982

- Gopal R. Rajbhandary*

Maize although being the second most important crop in Nepal and staple crop of hills and high hills (60 percent of Nepal's population and 71.15 percent of the total cultivated area under maize in Nepal except winter maize cultivation) has static production due to numerous reasons. The crop is grown as rainfed in the monsoon season, under varying conditions of moisture, generally subjected to periodic and erratic drought or excess of water, without effective weed and pest control and usually under low fertility conditions. In general, it is grown as a subsistence crop in the marginal land or the land where nothing can be grown except maize with very low levels of management and few inputs.

However, in the sub-tropical regions (Terai and Inner Terai), where maize is grown as an irrigated crop (not entirely dependent on rain) with adequate inputs and management with favourable environment of winter, the production is quite high i.e. 3 to 6 metric ton/ha.

Unfortunately, this year too, we had very bad weather. In most of the areas, maize could not be harvested because of drought. At NMDP Rampur, we planted very few trials, which were not successful. We had to plow most of the area in the seed multiplication block. The winter crop has also been hit by drought especially in Chitwan. We had insect problem at NMDP, especially Field Cricket (Acheta assimilis) during monsoon and Armyworm (Mythimna separata) during winter.

RAINFALL AT NMDP, RAMPUR (IN MM.)

Year/Month	April	May	June	July	August	Sept	Oct	Nov
1980	8	168	325	376	376	256	52	0
1981	137	280	272	677	446	473	1	25
1982	17	24	120	208	119	164	5	17

* - Coordinator, National Maize Development Program (NMDP), Rampur, Chitwan, Nepal.

Besides these, the confidence of farmers' is increasing about the acceptance and effectiveness of minikits and its production. In 1980/1981, a survey was held by APROSC on the request of HMG Ministry of Agriculture, but unfortunately the findings are not yet published. However, a part of it was presented on a Seminar on 'Appropriate Technology for Hill Farming System'. The farmers are optimistic about its quality and production and are even ready to pay for the minikits, if available.

The minikits which have been distributed for the last 5 years i.e. 1978 to 1982 have shown very good impact among the farmers of all the districts and, therefore, there is more demand for minikits every year. Unfortunately, we have to cut down the number of minikits because of an inadequate fund.

AVERAGE YIELD OF MAIZE IN kg/ha OBTAINED FROM MINIKITS*

Year	National Average	Overall Average	Average Production of Minikits			
			Eastern Region	Central Region	Western Region	Mid and Far Western Regions
1978	1664	2862	2854	2804	2960	2830
1979	1281	2804	2658	2648	2637	3271
1980	1611	2807	2845	2775	3080	2528
1981	1612	2507	2261	3039	2896	2330
1982	1542+	2490	2384	2574	2562	2440
Average	1542	2694	2601	2768	2827	2680
Percentage of Increment over National Average		74.4	68.7	79.5	83.4	73.8

* - Average of 2341, 1904, 1325, 1282 and 1050 feedback cards from 1978, 1979, 1980, 1981 and 1982 monsoon seasons respectively.

\+ - Estimated yield.

BREEDING, VARIETAL IMPROVEMENT AND GENETIC UTILIZATION

The farmers' condition usually demands a variety and/or varieties which are having specific adaptability, maturity and grain type etc. Therefore, NMDP is exerting its efforts to develop broad gene pools as functional resources i.e. genetic diversity and variability.

So far, we have developed seven pools - Ganesh-2, Rampur-2, Manakamana-2, Manakamana-1, Rampur-1, Arun-1, and Arun-4. Each pool is grown at more than one ecological region. A modified half-sib method of selection is used for recombination and improvement of gene pools. Superior families are identified by a group of scientists, (keeping all the quantitative and qualitative characteristics in mind) who maintain a high level of genetic variability.

Two hundred and seventy-nine families of Arun-1 were selected from monsoon planting and were advanced during winter. This material can be immediately used if there is urgency. It matures in 85 days during monsoon and 105 days during winter at NMDP Rampur. We are also advancing Arun-2 to Arun-4 for crop hazards and yield.

Three hundred and forty-nine families of Manakamana-1 were selected during monsoon at PAC and advanced during winter at NMDP, Rampur. This material was much liked by the farmers who visited this farm on the 'Rastriya Krishak Bhraman'. This can also be used if there is an urgency. This is a top yielder and is preferred by farmers in FFT. Rampur-1 is also liked by the farmers in Chitwan, but it needs further improvement. Likewise, the improvement work is in progress on Ganesh-2, Manakamana-2 and Rampur-2. Especially Rampur-2 was sent to the Suwan Farm, Thailand, for downy mildew screening and about 1000 best performing lines were selfed for future work.

The demand for hybrid maize is increasing in the Terai during winter. Hence, NMDP is developing the inbred lines from our most adapted population. It takes at least 10 to 12 growing seasons to develop a hybrid and therefore, to meet the immediate demand we are developing varietal crosses. We have tested some of the Pioneer Hybrids (Pioneer 440 - 1786 kg/ha, Pioneer 6875 - 1340 kg/ha, Pioneer 410 - 1354 kg/ha, Pioneer 444A - 689 kg/ha and Pioneer 2216 - 3431 kg/ha). These materials are late and low yielders than the standard check (Rampur Composite - 3484 kg/ha) during monsoon, but Pioneer 6131 seems to be good during winter and needs further testing.

In Fingermillet, 26 best genotypes were selected out of 89 lines which were collected within the country. In the varietal trial, Rampur Local was the best yielder (4580 kg/ha) but it was late by about two weeks than

NE 2101-21 (3453 kg/ha) and NE 1104-13 (3400 kg/ha). In sorghum, M90894 (ICRISAT) has yielded the highest (2704 kg/ha).

PEST AND DISEASES

During monsoon, there was an outbreak of Field Cricket (Acheta assimilis) in the Chitwan Valley and its population was found to be about 6000 crickets/ha. Poison baits at the rate of 15 kg/ha (Maize grit - 1kg, Chlordane dust - 100 g, Mustard oil - 2 teaspoonful, Sugar - 200 g and water as needed) were used to control the insect. Maize borer (Chilo partellus) was not serious but Armyworm (Mythimna separata) caused quite high damage during winter.

In general, the incidence of diseases were very low this year because of prolonged drought. But common rust (Puccinia sorghi) was very severe in certain hilly districts. During winter the invasion of Crazy Top (Sclerophthora macrospora) and Fusarium Stalkrot were very high and the yield reduction was estimated upto 64 percent.

Bacterial Stalkrot (Erwinia carotovora) is the main problem during monsoon and efforts are being made to develop a variety resistant to it. However, we could trace few resistant lines, which were selfed for future work.

In Fingermillet, the blast (Pyricularia spp) is the major disease which is causing the yield reduction.

ON-FARM RESEARCH AND EXTENSION

Location testings are very important to screen the genotypes and to evaluate practices. Hence on-farm research is the main tool for the researchers to judge their variety and/or practices. In other words the farmers' acceptance is a relevant indicator for the success of research findings.

Although, I have mentioned at several occasions that the feedback information both in minikits and FFT are very poor or unreliable and so once again I have the same complaint to you all who are involved. As you know, the feedback information is very important to evaluate our efforts. Hence, I would like to urge my colleagues to please send us reliable information in time.

We have conducted 10 varietal trials and 12 management trials in our command area. Among the varieties, Rampur Composite is still standing first (3886 kg/ha) and in management trial, the seeding behind the plow and with 45 kg of N/ha as a side dressing gave the highest yield of 3276 kg/ha or in other words, 1 kg of Nitrogen to 19 kg of maize grain.

This year, we will be distributing 6400 minikits during monsoon, 2000 minikits during winter and 370 minikits during spring in maize as well as 1500 minikits in fingermillet.

SEED MULTIPLICATION

AIC in collaboration with ADB, ADC and Agriculture Botany Division, has run the seed multiplication program - 244 hectares in Bara, 83 hectares in Parsa, 80 hectares in Chitwan, 40 hectares in Dhanusha and Mahottari and 25 hectares in Morang districts. The crop in Chitwan was not so good because of drought, but in the other locations the crop was very good and I am sure AIC will be able to collect enough seed required for the next year.

This is the first year AIC has imported 150 metric tons of Pioneer Hybrid seeds from India (Pioneer 410 and 440) through Nepal Seed Company (P.) Ltd., Nepal. But unfortunately, the seed could not be consumed because of delayed delivery, price fixation and lastly, lack of publicity.

TOUR AND TRAINING

I visited Suwan Farm, Thailand, to evaluate our material (Rampur-2) against downy mildew. Mr. Gun Bahadur Thapa, Junior Technician went to Thailand for 4 months training in Maize Breeding and is just back.

Dr. B.L. Renfro, Asian Regional Maize Coordinator and Plant Pathologist, Rockefeller Foundation visited Nepal from July 13 to July 27, 1982 to evaluate our work in Maize Diseases and has submitted a report on 'Strategy for the Control of Maize Diseases in Nepal'. We will be adapting his suggestions to combat the maize diseases in our pools.

In the same way, Dr. C.E. Wassam, Professor of Plant Breeding in Kansas State University, USA visited Nepal from July 31 to August 10, 1982 to

evaluate the breeding program and had out lined our future breeding work. He appreciated the procedure being followed at NMDP.

Monitoring tours were organized to evaluate FFT, minikits and breeding materials. There were five teams who visited Dhankuta, Trahthum, Kabhre, Dolakha, Ramechhap, Sindhuli, Gorkha, Tanahun, Lamjung, Palpa, Syangja, Nawalparasi and Makwanpur. Duri ; the tour, the teams also visited several farmers' field to study the situation of maize.

ACKNOWLEDGEMENT

The National Maize Development Program (NMDP) is very much grateful to the Department of Agriculture, Regional Agriculture Directorates, Technical Divisions, Agriculture Stations and Farms, Agriculture Development Offices, Agriculture Development Bank, Agriculture Input Corporation and other agencies for their active cooperation and sincere assistance to run the program smoothly. Last but not the least, the program expresses its sincere thanks to Integrated Cereals Project (ICP) / International Agricultural Development Service (IADS), United States Agency for International Development (USAID), Asian Regional Maize Program CIMMYT and other organizations who in one way or other have helped to run the program successfully.

COORDINATORS REPORT

DISCUSSION:

A.M. Pradhananga : Glad to see the comparative data for Pioneer Hybrid as compared to our recommended varieties. These data are for summer only. When such data for winter season would be available ?

Rajbhandary : We are conducting trials in winter also. We might be able to present comparative in the next workshop.

W.H. Freeman : What is the modified half-sib system of breeding you mentioned ? A complaint from hills is that all the improved varieties except Arun and Locals are all too tall and lodge in the hills. Can this be corrected ?

Rajbhandary : The system mentioned is half-sib, not a modified half-sib. We are selecting for shorter plant height and the recent versions of our recommended varieties are less lodging even at higher hills.

B.K. Baniya : What are the basis of using modified half-sib selection method ?

Rajbhandary : It is simple half-sib selection method being followed based on the facilities available with NMDP.

David Lipinski : You mentioned the use of poison bait to control field crickets. How effective was the pest control measure ?

Rajbhandary : This method was very effective in controlling field crickets. On sampling, over 90% control was observed in the baited fields.

B.K. Gyawali : Why did you use poison baits to control field crickets ? Did it cause loss to the crop ? If yes, can you produce data which justifies the need for the control of this so-called pest ?

Rajbhandary : The pest incidence was severe (which is evident form the slides shown) and almost all the growing seedlings were cut. Based on available literature, the poison baiting was done to control the pest. We could not dare to wait and compute the yield losses caused by this pest and hence can not supply you any yield loss data to support the insect control.

K.L. Manandhar : What is your program against maize rust in hills ?

Rajbhandary : Screening against maize rust is continuing at Khumaltar and Kakani.

B. Upadhyay : What is the causal organism of Crazy Top disease ? What strategy is being followed to control it ?

Rajbhandary : The causal organism is probably Sclerophthora sp. We have not been able to formulate any study against this disease.

Gokarna G.C. : In Western Palpa district, I have observed severe attack of Downy Mildew on local varieties. What is the control measure ?

Rajbhandary : We have Rampur Composite and Sarlahi Seto varieties fairly resistant to DM.

B. Upadhyay : What are further improvements needed in Rampur-1 variety?

Rajbhandary : Plant height, maturity and tolerant level to different cropping hazards are a few aspects of improvement.

A.R. Lohani : Total area and production of maize in Nepal with special reference to improved varieties should have been included in the Coordinator's report.

Rajbhandary : Thank you very much for your suggestion.

NMDP VARIETAL TRIAL - 1982

- Kaushal Lal and
Toya Nath Mishra*

ABSTRACT

The objective of this investigation was to find out superior maize genotypes for different agro-climatic regions of the country. Altogether, nine genotypes were included, including two standard checks and farmer's Variety as a local check. The performance of the entries were not consistent across the locations. A genotype X environment interaction was visualized to some extent. Rampur Composite and Khumal Pahenlo were still the highest yielding at lower and higher elevation respectively. Arun-2 and Arun-4 were the earliest among the group both at higher and lower elevations at Kabhre and Lumle the farmer's variety was found superior to all the entries. A higher percentage of ear rot was reported in most of the entries included in this experiment.

INTRODUCTION:

Agricultural experiments, such as variety tests usually are repeated in various locations for number of years. This is necessary because the effect of most variables or factors vary considerably from location to location as well as from year to year. Under conditions of high locational and seasonal variability it is often extremely difficult to discriminate between varieties when averaged over-all locations. To overcome this difficulty, one has to use more replications at each location and has to stratify the locations on the basis of their average response and their variability of response.

In agronomic crops, most genotype X environment studies have been based upon regional yield tests, often involving locations with diverse climate, soils and production practices and cultivars from different breeding programs. However, Pederson et. al. (1978) have demonstrated that adaptation of some of the above methods may be used earlier in breeding programs.

* - Assistant Maize Breeders, NMDP, Rampur, Chitwan, Nepal.

Our most of the recommended varieties are getting old in respect of traits other than the yield. It is becoming vulnerable to different diseases and pests. So the main objective of the experiment was to find out superior genotypes for different agro-climatic regions in the country.

MATERIALS AND METHODS:

This trial was conducted at 16 locations situated in different agro-climatic conditions within the country. Plots were organized in Randomized Complete Block Design with three replications. Plot size was 15 m^2 in the low and mid altitude areas and 9 m^2 in the high hill locations. Altogether ten entries were included but results have been compiled only for nine entries as one of the entries did not germinate satisfactorily at most of the locations. The rate of fertilizer application was left to the cooperators to decide according to their soil condition and availability of the fertilizer. However, a dose of 120:60:40 kg N:P:K/ha along with all the plant protection measures (as and when necessary) was recommended. The plant populations was supposed to be 53,000 plants/ha (75 X 25 cm spacing).

Statistical analysis was done only for yield as data sheets were received very late. However, the mean of all other important traits are included in various tables. Data had been compiled in two sets one for hills and the other for low and mid altitude area. At Lumle, farmer's variety was Kakani Pahenlo and at Pakhribas, Janaki Seto, Suwan 8075, Guyuta 7632 was included instead of Arun-2, Rampur Composite and Khumal Pahenlo respectively. Genotypes included in this experiment were extracted from the populations developed by the National Maize Development Program (NMDP).

RESULTS AND DISCUSSIONS:

Grain Yield

The mean yield of the individual locations are presented in tables 1 and 2. There was no significant difference in yield of all the nine entries at Rampur, Nepalganj, Surkhet, Dandapakhar, Kabhre and Lumle. However, Manakamana-2, Rampur-2, Arun-4, Rampur-1 and Farmer's local had the highest yield at Nepalganj, Rampur, Surkhet, Dandapakhar, Kabhre and Lumle respectively (Tables 1 and 2). A significant yield difference, among the entries was obtained at Doti, Kankai,

Khumaltar, Parwanipur, Pakhribas and Jumla. At Doti, Ganesh-2 (5387 kg/ha) was superior to all the entries and farmer's local was the lowest in the yield performance. However, there was no significant difference between Ganesh-2 and Rampur Composite, Ganesh-2 and Khumal Pahenlo, (the two standard checks) and in the same manner, Ganesh-2 and Manakamana-2 and Arun-2, Ganesh-2 and Arun-4. Ganesh-2 differed significantly with Rampur-1 and Rampur-2 and Farmer's local. The yield range at this location was (2887 to 5387 kg/ha).

At Kankai (eastern Terai), Manakamana-2 was the highest yielding while the Farmer's variety was the lowest. The standard check Rampur Composite and Khumal Pahenlo was 4th and 8th in the rank respectively. No significant difference was found between Manakamana-2 and Rampur-2, Rampur-2 and Ganesh-2, Ganesh-2 and Khumal Pahenlo, Khumal Pahenlo and Arun-4, Rampur-1 and Arun-2. Manakamana-2 differed significantly from all the entries except Rampur-2. No difference was found between Farmer's variety and Arun-4, Arun-2, Rampur-1 and Rampur Composite. Only Ganesh-2, Manakamana-2, and Rampur-2 were superior to Rampur Composite while rest of the entries were not. Manakamana-2 and Rampur-2 were significantly superior to all the three checks, Khumal Pahenlo, Rampur Pahenlo and Farmer's variety (Table 1).

At Khumaltar, a significant difference was found among the entries, Rampur Composite was the highest and Farmer's variety was the lowest in yield performance. However, there was no significant difference between Rampur Composite and Khumal Pahenlo, Rampur Composite and Ganesh-2, Rampur Composite and Rampur-2, Rampur Composite and Manakamana-2, Rampur Composite and Rampur-1. Arun-2, Arun-4 and Farmer's variety had significantly lower yield than the two checks Rampur Composite and Khumal Pahenlo. There was no significant difference between Farmer's variety and Arun-4 and Farmer's variety and Arun-2 (Table 1).

At Parwanipur, the over-all performance of the entries was lower than the other locations. Arun-2 was the highest yielding among the nine entries and Rampur Composite the lowest. No significant difference was found between Arun-2 and Manakamana-2, Arun-2 and Arun-4, Arun-2 and Rampur-2 while it differed significantly with other entries. Arun-2 had significantly higher

yield than Rampur Composite and Khumal Pahenlo, the two checks. Ganesh-2, Manakamana-2, Rampur-2, Arun-4 and Khumal Pahenlo were at par (Table 1).

At Pakhribas, the standard checks (Rampur Composite and Khumal Pahenlo) were not included in this trial. Suwan 8075 was the highest yielding (2800 kg/h) and the Farmer's variety was the lowest. However, there was no significant difference between Suwan 8075 and Rampur-2, Rampur-2 and Arun-2, Arun-2 and Rampur-1, Cuyuta 7632 and Arun-4, Arun-4 and Ganesh-2 and Farmer's variety. Farmer's variety was at par with Cuyuta 7632, Arun-4 and Ganesh-2 (Table 2).

At Jumla, Khumal Pahenlo (Check) was the highest yielding (2154 kg/ha) and of course, the farmer's variety the lowest (1198 kg/ha). However, there was no significant difference between Khumal Pahenlo and Manakamana-2, Ganesh-2 and Rampur Composite, Rampur-2 and Arun-2 (Table 2).

The mean yield of all the locations are presented in tables 8 and 9. This presents a clear picture that our Check, Rampur Composite and Khumal Pahenlo were superior to all other entries included so far. The level of significance could not be answered at this juncture, since the combined analysis has not been carried out.

Days to 50% Silking:

This is one of the important traits for which the breeders always strive for it. Farmer's variety was the earliest than even Arun-2 by six days at Doti, while at other locations consistency was not maintained. At Kakani, Ganesh-2, Manakamana-2, Rampur-2 and Arun-4, and Arun-2 were 7 to 14 days earlier than the local. Whereas at Khumaltar, it was either at par or 2 - 7 days earlier than other entries. Again at Nepalganj, it was the late maturing in the group. Not much difference was found at Parwanipur and Surkhet locations. Arun-4 and Arun-2 were earliest at most of the locations (Table 3). The mean of all the locations are presented in Tables 8 and 9. The range of flowering was found from 55-61 days at low and mid altitude locations and 95-114 days at high hill locations. Almost all entries took longer period for flowering at higher hill locations than the low and mid altitude areas. Arun-4 and Arun-2 were the earliest even at high locations. A difference of

0-7 days was found between the Farmer's varieties and other entries in the series.

Plant Height

The mean height of individual location is presented in table 4 and the combined mean is presented in tables 8 and 9. A difference of 0-8 cm was reported at low and mid altitudes while at high altitude, all the entries were shorter by 2 to 28 centimetre than the Farmer's variety. Atmost all the experimental varieties were taller at lower elevation than at the higher elevations.

Root and Stalk Lodging

The mean of all the locations (combined), is presented in tables 8 and 9. Arun-2 and Rampur-1 had the highest root lodging at lower elevations while Farmer's variety had the highest at higher location (20%). The stalk lodging of 6-12% was reported at low elevations while at higher locations it was from 0-9% . No stalk lodging was reported in Arun-2 and Rampur Composite so far. There was not much difference among other entries both at low and high elevations.

Diseases

The curvularia leaf spot was reported from most of the locations while diseased ear and rust infection was observed only at higher locations. The data is presented in tables 7 and 9. A high percentage (13-31) of ear rot was found in all the experimental varieties included in this experiment, the lowest in Farmer's variety being 13% only. The highest (31%) ear rot was reported in Rampur-2 (Tables 6 and 9).

The performance of different entries at different locations are quite inconsistent. It certainly shows some Genotype X Environment interactions. This leads us for development of a specific breeding program in those areas. Though we test our families in some locations outside Rampur, but it is not to the extent of breeding standard.

We have observed the taller plant type at lower elevations and shorter plant type at higher elevations which are mainly due to temperature gradient

at different elevation around the country. An inverse relation was found in case of flowering period, which are again due to the effect of chilly whether prevailing during early stage of the vegetative growth period.

We found a higher percentage of cob rot in Rampur-2, which was mainly due to the adaptation of Rampur-2 to the lower elevation areas as it has not been bred for the high hilly areas.

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Table No.1: NMDP VARIETAL TRIAL - 1982 (LOW AND MID ALTITUDE LOCATIONS)

Sl. No.	Entries / Locations	Mean Yield in kg/ha.							
		Doti	Kankai	Khumaltar	Nepalganj	Parwanipur	Rampur	Surkhet	M e a n
1	Ganesh-2	5387	3613	6653	4173	2267	2709	2133	3848 (3)
2	Manakamana-2	5280	5053	6547	5047	2600	2394	2160	3846 (4)
3	Rampur-2	4427	4173	6573	3780	2493	3357	2240	3863 (2)
4	Arun-4	5120	2720	5293	4013	2587	2315	2640	3527 (6)
5	Arun-2	5280	2467	4200	3653	2813	1915	1947	3182 (8)
6	Rampur-1	4427	2347	6400	4700	2133	2739	1693	3491 (7)
7	Rampur Comp(Ch)	5120	2040	7173	4953	1267	2551	1107	4873 (1)
8	Khumal Pahenlo (Ch)	4533	2973	6693	4027	2200	2612	1760	3542 (5)
9	Farmer's Variety	2887	1707	3920	3320	1560	2085	1400	2411 (9)
	F	*	*	*	NS	*	NS	NS	
	CV %	11	21	13	20	12	19	29	
	LSD (0.05)	923	1080	1373	-	467	-	-	

Table No.2: NMDF VARIETAL TRIAL - 1982 (HIGH ALTITUDE LOCATIONS)

Sl. No.	Entries / Locations	Mean Yield in kg/ha					
		Dandapakhar	Kabhre	Lumle	Pakhribas	Jumla	M e a n
1	Ganesh-2	3667	4987	6955	1400	1858	3773 (6)
2	Manakamana-2	3844	4827	7933	1850	2096	4110 (3)
3	Rampur-2	2067	5653	7377	2350	1629	3815 (5)
4	Arun-4	2555	4400	7222	1417	1405	3400 (9)
5*	Arun-2	3733	4027	6267	-	1552	3895 (4)
6	Rampur-1	3911	5760	7222	1833	1736	4192 (2)
7*	Rampur Comp (Ch)	2600	3893	5667	-	1830	3497 (8)
8*	Khumal Pahenlo (Ch)	3022	4960	7600	-	2154	4434 (1)
9*	Farmer's Variety (Ch)	1955	5813	8667	1200	1198	3767 (7)
	F	NS	NS	NS	*	*	
	CV %	34	16	25	19	3	
	LSD (0.05)	-	-	-	483	84	

(5)* - Janaki (White) at Pakhribas - 2133 (3)

(7)* - Suwan 8075 at Pakhribas - 2800 (1)

(8)* - Cuyuta 7632 at Pakhribas - 1467 (6)

(9)* - Kakani Pahenlo at Lumle -

Table No. 3: NMDP VARIETAL TRIAL - 1 9 8 2

Sl. No.	Entries Locations	Days to 50 percent silking														
		Low and Mid Altitude Locations								High Altitude Locations						
		Doti	Kankai	Khumaltar	Nepalganj	Parwanipur	Rampur	Surkhet	Mean	Dandapakhar	Kabhre	Lumle	Pakhribas	Jumla	Kakani	Mean
1	Ganesh-2	60	55	72	64	57	56	54	60	112	84	86	112	123	123	107
2	Manakamana-2	61	57	72	61	54	55	52	59	123	86	85	107	129	123	109
3	Rampur-2	62	55	70	59	53	55	53	58	122	85	83	107	124	122	107
4	Arun-4	60	51	65	63	52	48	50	55	105	79	79	79	120	107	95
5	Arun-2	59	53	67	55	50	49	50	55	103	78	79	-	105	110	95
6	Rampur-1	62	64	77	61	57	60	55	62	120	92	98	118	130	126	114
7	Rampur Comp(Ch)	62	54	72	54	57	60	57	59	127	87	96	-	129	121	112
8	Khumal Pahenlo(Ch)	64	64	70	59	55	56	53	60	126	86	90	-	125	120	109
9	Farmer's Variety	53	65	70	65	58	60	55	61	113	89	88	128	102	124	107

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Table No. 4: NMDP VARIETAL TRIAL - 1 9 8 2

Sl. No.	Entries Locations	Plant Height in Cm													
		Low and Mid Altitude Locations								High Altitude Locations					
		Doti	Kankai	Khumaltar	Nepalganj	Parwanipur	Rampur	Surkhet	Mean	Dandapakhar	Kabhre	Lumle	Pakhribas	Jumla	Mean
1	Ganesh-2	224	190	212	195	201	165	182	195	140	200	228	143	172	177
2	Manakamana-2	245	190	198	220	201	165	178	199	129	208	210	128	181	171
3	Rampur-2	218	177	165	228	209	165	183	192	149	205	212	134	165	173
4	Arun-4	224	190	188	200	176	153	200	190	125	168	219	155	163	166
5	Arun-2	226	173	158	230	194	150	177	187	124	182	208	175	175	173
6	Rampur-1	234	186	194	202	191	163	168	191	149	218	239	167	187	192
7	Rampur Comp (Ch)	255	189	175	218	186	165	190	197	154	203	218	157	175	181
8	Khumal Pahenlo(Ch)	255	190	201	218	203	162	200	204	145	201	234	157	162	184
9	Farmer's Local(Ch)	199	188	180	205	210	162	197	191	193	235	203	123	131	194

Table No. 5:

NMDP VARIETAL TRIAL - 1 9 8 2

Root Lodging and Stalk Lodging (Percent)

Sl. No.	Entries / Locations	Doti	Kankai	Khumaltar	Nepalganj	Parwanipur	Rampur	Surkhet	Mean	Kabhre	Lumle	Pakhribas	Mean
1	Ganesh-2	-	-	6 (-)	-	- (-)	13 (13)	5 (9)	10 (11)	7 (-)	27 (-)	11 (7)	15 (7)
2	Manakamana-2	-	-	3 (-)	-	1 (2)	13 (16)	12 (10)	7 (9)	15 (-)	11 (-)	7 (6)	11 (6)
3	Rampur-2	-	-	- (3)	-	2 (1)	9 (13)	8 (8)	6 (6)	7 (7)	11 (-)	3 (6)	7 (6)
4	Arun-4	-	-	6 (6)	-	2 (1)	10 (16)	23 (5)	10 (7)	7 (7)	20 (-)	7 (7)	11 (7)
5	Arun-2	-	-	- (9)	-	3 (2)	10 (14)	24 (3)	12.23 (7)	8 (-)	15 (-)	(-)	11 (-)
6	Rampur-1	-	-	9 (-)	-	2 (3)	13 (13)	23 (10)	12 (9)	13 (6)	7 (-)	3 (8)	8 (8)
7	Rampur Comp(Ch)	-	-	- (-)	-	- (-)	6 (6)	6 (-)	6.05 (6)	10 (-)	17 (-)	(-)	13.5 (-)
8	Khumal Pahenlo(Ch)	-	-	3 (3)	-	3 (-)	13 (23)	8 (11)	6.67 (12)	6 (6)	24 (-)	(-)	16 (6)
9	Farmer's Local	-	-	3 (9)		3 (-)	13 (16)	23 (9)	10 (11)	11 (6)	24 (3)	26 (19)	20 (9)

( ) Stalk lodging in parenthesis; Ch = Check.

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Table No. 6:

NMDP VARIETAL TRIAL 1982 SUMMER

Percent Diseased Ear

S.No.	Varieties/Loc.	Khumaltar	Kabhre	Pakhribas	Lumle	Mean
1	Ganesh-2	5	40	23	24	23
2	Manakamana-2	10	38	32	36	29
3	Rampur-2	11	43	38	33	31
4	Arun-4	10	28	36	15	22
5	Arun-2	12	50	-	15	26
6	Rampur-1	5	31	30	23	22
7	Rampur Comp(Ch)	11	30	-	29	23
8	Khumal Pahenlo(Ch)	10	44	-	39	31
9	Farmer's Variety	5	17	25	5*	13

* - Kakani Pahenlo at Lumle.

Table No. 7:

NMDP VARIETAL TRIAL - 1982

Rust Rating

Sl.No.	Entries / Locations	Kabhre	Khumaltar	Pakhribas	Jumla	Jumla	Mean
1	Ganesh-2	2.6	1.67	1.75	2	1	1.8
2	Manakamana-2	2.0	2.00	2.25	3	1.3	2.11
3	Rampur-2	1.67	1.67	2.50	5	1	2.37
4	Arun-4	2.0	2.17	3.25	2	0	2.36
5	Arun-2	2.67	2.17	-	2	1	1.96
6	Rampur-1	1.67	1.50	2.75	2	1	1.78
7	Rampur Comp (Ch)	2.33	1.83	-	3	1.3	2.12
8	Khumal Pahenlo (Ch)	3.33	2.67	-	4	1.3	2.83
9	Farmer's Variety (Ch)	3.0	2.50	3.5	3	1.3	2.66

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Table No. 8:

NMDP VARIETAL TRIAL - 1982 SUMMER

Mean of all (Seven) Locations
(Low & Mid Altitudes)

Sl.No.	Entries / Varieties	Yield in kg/ha	Days to 50% Silking	Plant Ht. in Cm	Lodging %	
					Root	Stalk
1	Ganesh-2	3848 (3)	60	19[illegible]	10	11
2	Manakamana-2	3846 (4)	59	19[illegible]	7	9
3	Rampur-2	3863 (2)	58	19[illegible]	0	6
4	Arun-4	3527 (6)	55	19[illegible]	10	7
5	Arun-2	3182 (8)	55	18[illegible]	13	7
6	Rampur-1	3491 (7)	62	19[illegible]	12	9
7	Rampur Comp (Ch)	4873 (1)	59	197	6	6
8	Khumal Pahenlo (Ch)	3542 (5)	60	20[illegible]	7	12
9	Farmer's Local (Ch)	2411 (9)	61	19[illegible]	19	11

Table No. 9:

NMDP VARIETAL TRIAL - 1982 SUMMER

Mean of all locations
(High Hill)

Sl. No.	Varieties/ Locations	Yield in kg/ha	Days to 50% Silking	Plant Ht. in Cm	Lodging %		SDiseased Ears %	Rust * (0.5)
					Root	Stalk		
1	Ganesh-2	3773(6)	107	177	15	7	23	1.8
2	Manakamana-2	4110(3)	109	171	11	6	29	2.1
3	Rampur-2	3815(5)	107	173	7	6	31	2.4
4	Arun-4	3400(9)	95	166	11	7	22	2.36
5	Arun-2	3895(4)	95	173	11	0	26	1.96
6	Rampur-1	4192(2)	114	192	8	8	22	1.78
7	Rampur Comp(Ch)	3497(8)	112	181	13	0	23	2.12
8	Khumal Pahenlo (Ch)	4434(1)	109	184	16	6	31	2,83
9	Farmer's Local (Ch)	3767(7)	107	195	20	9	13	2.66

* - Khumaltar data was also included in averaging this trait.

NMDP VARIETAL TRIAL

DISCUSSION:

K. L. Manandhar : Cob rot appears to be the highest in Arun-2 and Arun-4 (Table 9). This indicates that Arun varieties are susceptible to cob rot infection. What will you do if these are demanded by farmers for cultivation ?

Lal : Arun-2 has been recommended as a spring crop for Terai and mid hills. Farmers, however, are also using this variety as a catch crop and an early crop in mid hills and Terai and the variety is in great demand.

K.B. Rajbhandary: All the varieties except Arun-2 produced the lowest at Rampur, while at Khumaltar, all the varieties produced about 3 times (Table 1). Why is it so ?

K.K. Lal : This is due to soil fertility and micro-climatic effect.

Bhimsen K.C. : Among the recommended varieties, Khumal Yellow has the highest lodging, comment.

K.K. Lal : This is probably due to stem borer damage. S.K. Upadhyay: Could Khumal Yellow be a good substitute for Kakani Yellow in high hills ?

K.K. Lal : No, certainly not. We have to find some suitable aternatives.

AGRICULTURE TECHNOLOGY AND ADAPTATION - MAIZE

Gopal R. Rajbhandary*

Research begins at the farmers' field with a definition of his and/or her situation and practices. We are developing a research program to substitute the variety and/or varieties and agronomical practices and later on which will be tested in the farmers' field. The derivatives will be recommended to the farmers for adaptation and for better production.

Therefore, we embrace the philosophy that development will come through an accelerated series of small steps. To get the concentrate acceptance of package of practices and cultivars, it will depend on the involvement of the extension personnel and farmers during operations

Increasing production is not just a matter of having improved technological practices. Concurrently, we need to increase demand to take up the excess supply i.e. farmers should not be robbed by the middle man because he has produced more. Farmers can and will increase maize production - especially during winter in the Terai and the Inner Terai - if there is an assured market.

However, problem exist in the field and how are we going to identify the nature and extent of the problems? Perhaps, one of the most effective ways to begin with is to interview the farmers, agriculture assistants, junior technical assistants, junior technicians and agriculture development officers of the concerning areas. Let us ask questions such as what they do, how they do it and why they do it that way. We are asking these questions to them, not to try to convince them but to learn the actual situation from them.

Let us not forget that the farmers are the ultimate decision makers and the ultimate integrators or I should say an economist to judge our findings or package of practices of any kind. We also know that the farmers' technology for maize production is not uniform throughout the country. Farmers in certain areas sow maize in lines - especially in Bara, Parsa and other

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part of the Terai during winter - and in certain other areas they broadcast. Some of the farmers sow behind the plow. A few farmers use insecticides to protect against borer or cutworm. Most of the farmers use a high seed rate with the idea that even after the insects/diseases and other pests have taken their toll, there will still be enough undamaged plants left to produce a decent crop. We think of grain as a final product but the farmers think in terms of green fodder, green ears, grain, dry fodder and fuel as well.

We have often heard the saying that "Cleanliness is next to Godlines" but for maize production "Timeliness is next to Godlines" for all the operations from land preparation to storage, and it is not going to yield more although the technology is there. Therefore, a good variety with poor management gets us no where and good management on a poor variety does not get us much further.

As we all know, weather is still the single most influential factor in varying the production. Within the limitation imposed by weather, the market may be a most important variable. However, as an agricultural technician, we have very little influence and expertise.

Further, as a subsistence farmer, he needs to grow sufficient food for the family on a year round basis whether the weather is bad or good. He operates in an environment which is risky as we all do. Therefore, we have developed a variety and/or varieties which should fit to his cropping systems and which will more or less fulfill his or her objectives.

Hence, NMDP has developed the varieties which are differentially more responsive to improved management than the traditional variety. Some of these recommended varieties tested at farmers' field as well as Farms/Stations have yielded 40 percent more than the local landraces with the same package of practices under the same environment.

Our main purpose is to help the farmers in increasing their efficiency of production. Generally, we felt as a maize worker that the reported national average yield of maize is at least 15 to 25 percent lower than the average yield per hectarage actually harvested for grain. The crop cutting

survey especially at Chitwan and Lamjung districts in collaboration with the IAAS economist and the reports we received from different Agriculture Development Offices have indicated that the maize production on an average is more than what has been reported by the Food and Agriculture Marketing Services Department. However, it is determined that the maize yield can be raised by 50 percent or more above the average farmers' practices if the recommended package of technology is adapted.

	Districts	Descriptions	Crop Cutting Yield, kg/Ha	FAMSD, HMG/N Figure, kg/Ha
01.	Chitwan	Surveyed by IAAS & NMDP	2,691	1,720
02.	Lamjung	" " "	2,693	1,590
03.	Taplejung	ADO's Office Ref.No.436 Dated 2038/8/24	1,900	1,720
04.	Syangja	ADO's Office Ref.No.485 Date 2038/8/23	2,054	1,590
05.	Sarlahi	ADO's Office Ref.No.482 Dated 2038/6/16	2,440	1,601
06.	Dadeldhura	ADO's Office Ref.No.838 Dated 2038/8/18	1,860	1,439
07.	Panchthar	ADO's Office Ref.No.504 Dated 2038/8/12	1,700	1,500
08.	Pyuthan	ADO's Office Ref.No.226 Dated 2038/8/8	2,750	1,620
09.	Rukum	ADO's Office Ref.No.454 No date	1,870	1,320
10.	Dolakha	ADO's Office Ref.No.447 Dated 2038/8/9	2,300	1,400
		Average:	2,225.8	1,550

Average crop cutting yield is 43.6 percent more than the yield reported by HMG/N, FAMSD.

Yield Performance of Some of the Recommended Varieties

Year	Locations	Name of the Trials	Yield in Kilogram/Ha			
			Khumal Pahenlo	Rampur Comp.	Rampur Pahenlo	Local
1973	2	High Altitude	3281	3498	-	2646
	8	Low+Mid Altitude	6047	6324	7107	3530
	10	Farmers' Field	3422	3924	4091	3022
1974	5	Low+Mid Altitude	6243	3977	5158	2302
	10	Farmers' Field	4653	5044	-	3098
1975	7	Low+Mid Altitude	-	5099	4171	3024
	3	High Altitude	4820	5710	-	3958
1976	8	Low+Mid Altitude	-	3283	2352	2178
	5	High Altitude	3676	4481	-	3803
1977	5	Low+Mid Altitude	-	4671	-	2414
	5	Farmers' Field	1940	1940	2000	1710
1978	4	Low+Mid Altitude	-	4881	-	2089
	4	Farmers' Field	-	6870	-	4490
1979	4	Farmers' Field	-	4775	-	3477
1980	4	Low+Mid Altitude	4489	5074	-	2383
	14	Farmers' Field	4753	6209	4315	3630
1981	18	Farmers' Field	4220	4458	4275	2932
	7	Low+Mid Altitude	4096	-	-	3275
1982	12	NMDP Varietal Trial	3988	4185	-	3089
	8	Farmers' Field	-	3551	-	2562
		Average :	4069	4105	3990	2862
		Percentage of Increment over local	42.2	43.4	39.4	-

Technology Adaptation at Farmers' Field

Treatments	Grain Yield in Kilogram / Ha			
	Udaypur	Kabhre	Lamjung	Mean
1. Farmers' variety + Farmers' Practices	2073	2328	2864	2422
2. Farmers' variety + Improved Practices (Used 60 kg N/ha)	2656	2930	3382	2989
3. Improved variety (Rampur Comp.) + Farmers' Practices	2287	2785	4712	3261
4. Improved variety + Improved Practices	3132	4224	5354	4237

Further, the production efficiency can be increased by adaptation of improved management practices or varieties responsive to improved management.

Effect of Various Management-A*

Treatments	Grain Yield Kilogram/Ha.		
	1979	1981	Mean
1. Complete (Rampur Composite with 60:30:30 NPK kg/ha Insect Control +Weed Control + Line Sowing)	5504	4251	4878
2. Complete (Local Variety + Rest are as Treatment No. 1)	3377	3130	3254
3. Local Practices (Local Variety+ FYM 10 Ton/Ha + No Insect Control + Weed Control + Broadcast Seeding	2500	2220	2360
4. Local Practices (Rampur Composite + Rest are as Treatment No. 3)	3642	3738	3690

* - 1980 Experiment was damaged by tip dying. Due to long drought and heavy wind the sand was blown and the tender growing shoots were damaged.

Effect of Various Management-B

Location	Grain Yield Kg / Ha (Rampur Composite)			
	Treatment 1	Treatment 2	Treatment 3	Treatment 4
1. Gunja Nagar	1730	2790	2400	2970
2. Gita Nagar	1540	1940	1960	2350
3. Sharda Nagar	0910	1660	1730	1950
4. Mangalpur	2350	2900	3250	3010
Average :	1630	2320	2340	2570

Treatment 1. Farmers' practice and no chemical fertilizer

Treatment 2. Same as treatment 2 + 45 kg N/ha in two split doses

Treatment 3. Same as treatment 2 + hand weeding

Treatment 4. Line sowing at 75 X 25 cm + 45 kg N/ha in two split doses

I am sure, we all are familiar with the minikit program and that NMDP is providing some minikits to most of the districts during monsoon, winter and spring (after winter crop harvest). However, HMG/N is interested to assess its impact and effectiveness as far as production is concerned. Therefore, an evaluation was conducted by APROSC which indicates that 100 percent of the farmers think, it is a good program to disseminate the technology as a variety or practices. Ninety-two percent of the farmers have indicated that it has got good impact to the neighbouring farmers and the production has increased upto 100 percent. The report also indicates that 71 percent of the farmers are even ready to pay the cost for the maize minikits if it is made available.

NMDP is also getting some feed-back information about the performance of minikits and the results are very encouraging.

In the past, maize used to be grown during monsoon only but as you all know, now it can be grown throughout the year from place to place. We have also an opportunity to taste the roasted green cobs even during December and January. In short, maize can be grown very successfully during winter in the Terai, the Inner Terai and the foot - hills and the area is expanding

every year. The major factor which has promoted the expansion in hectarage is the realization of higher grain yield (3 to 6 metric ton/ha depending upon the soil type and management) and superiority over other winter crops. Some of the specific aspects favourable for the winter cultivation of maize are as follows:

1. Better water management - drainage as well as irrigation
2. Mild temperature with clear bright sunshine - more favourable for plant growth and development
3. Better response to major nutrient - high efficiency of nitrogen utilization
4. Minimum damage due to diseases and pests
5. Better weed control
6. Proper plant population can be maintained

Average Yield of Maize in kg/Ha Obtained from Minikits*

Year	National Average	Overall Average	Average Production from Minikits			
			Eastern Region	Central Region	Western Region	Mid + Far Western Regions
1978	1664	2862	2854	2804	2960	2830
1979	1281	2804	2658	2648	2637	3271
1980	1611	2807	2845	2775	3080	2528
1981	1612	2507	2261	3039	2896	2330
1982	1542**	2490	2384	2574	2562	2440
Average:	1542	2694	2601	2768	2837	2680
Percentage of Increment over National Average		74.4	68.7	79.5	83.4	73.8

* - Average of 2341, 1904, 1325, 1282 and 1050 postcards from 1978, 1979, 1980, 1981 and 1982 monsoon season respectively

** - Estimated yield

Performance of Maize During Winter at Farmers' Field

Year	Location	Pedigree	Ave. Yield (kg/ha)
1978	20 (Bara, Parsa, Dhanusha and Mahottari)	Rampur 7433	5873
		Rampur 7433 (Janaki Makai)	7412
		Hi-Starch	7459
		Farmers' Local	3127
1979	6 (Sunsari, Dhanusha and Nawalparasi)	Rampur Composite	5818
		Janaki Makai	6098
		Rampur 7433	6063
		Farmers' Local	4263
1980	5 (Tanahu)	Khumal Pahenlo	3599
		Rampur Pahenlo	4315
		Arun-2	3560
		Farmers' Local	2105
1980	3 (Chitwan)	Rampur Composite	3787
		Arun-2	3723
		Farmers' Local (Improved Local)	3387

Besides full season varieties, NMDP has developed a short season variety called Arun-2. It has got wide diversity of adaptation and desirable characteristics such as: 1) early maturity, 2) higher yield, 3) short plant height, 4) very responsive to high fertility and good management, 5) high shelling percentage, 6) compact cob filling, 7) longer grain filling period and 8) bold grains.

Further it can be fitted to the following cropping pattern:

a) Wheat - Spring maize - Rice
b) Winter planting without irrigation (the Inner Terai and the foot hills)
c) Monsoon Maize - Winter Maize - Wheat
d) In late planting situations

This variety was also tested at the different agriculture farms/stations as well as in the Farmers' Field to find out its adaptability to the adverse condition. Further a sample of 200 gm of seed was provided to the farmers' planting. We received the feed-back data from 25 districts. The average yield is 3093 kg/ha.

Performance of Arun-2 (kg/ha)

A. At the Farmers' Field during Monsoon, 1981

Variety	Lamjung Mean of 4 Loc.*	Kabhre Mean of 5 Loc.*	Pyuthan Mean of 5 Loc.*	Udaypur Mean of 4 Loc.*	Chitwan Mean of 10 Loc.*	Mean
1. Khumal Pahenlo	3945	4465	5425	3054	-	4222
2. Rampur Composite	4330	3935	6438	3127	3594	4285
3. Rampur Pahenlo	4046	4113	5776	3183	-	4275
4. Arun-2	4549	3218	4685	3010	3823	3857
5. Farmers' Local	1774	2684	4617	2690	2426	2831

* - Loc. = Location

B. NMDP Varietal Trials at Different Farms/Stations, 1981

Variety	Rampur	Khumaltar	Kabhre	Jumla	Lumle	Tar-hara	Pakhri-bas	Mean
1. Arun-2	3973	5664	1562	2920	3530	4467	3509	3668
2. Rampur-2	4147	6214	3330	5064	4215	5267	3916	4593
3. Khumal Pahenlo	3840	5486	2578	5176	3555	5400	2636	4096
4. Farmers' Local	2853	3537	3243	2330	3495	3787	3680	3275

Days to 50% silking: 1. Arun-2: 74 days
2. Rampur-2: 84 days
3. Khumal Pahenlo: 92 days
4. Farmers' Local: 84 days

A Review on Various Technological Aspects of Maize

1. VARIETAL DEVELOPMENT:

Till now several varieties of maize have been released for different agro-climatic conditions of the country. All of these varieties have proved superior (around 50 percent or more yield over the local landraces) in yield as compared to local varieties grown by the farmers under the same environment with the same technology.

1. Kakani Pahenlo
2. Khumal Pahenlo
3. Rampur Pahenlo
4. Rampur Composite
5. Hetauda Composite
6. Sarlahi Seto
7. Janaki Makai (for winter only)
8. Arun-2

All the varieties can be grown successfully in all the seasons. These varieties can produced on an average 35 kg/day during winter, 20 kg/day during monsoon and 37 to 40 kg/day during spring (especially Arun-2 variety).

2. DATE OF SEEDING:

Traditionally maize is a monsoon crop. Now it can be grown throughout the year as monsoon, winter and spring crop. But date of seeding is often very critical for the higher yield. A trial was conducted at RAS through 1977 to 1979 and following conclusions were drawn:

a) For monsoon, maize should be planted from Mid-April to Mid-May for maximum grain yield at NMDP environment or similar condition

b) For winter, maize should be planted from first week of September to third week of September for maximum grain yield in Inner Terai. But for Terai, it should be planted within October.

c) For spring, it should be planted immediately after winter crop harvest for rice-wheat-maize cropping pattern and in February for rice-maize cropping pattern.

3. FERTILIZER:

Several on-farm fertilizer trials were conducted at Chitwan, Nawalparasi, Bara, Parsa, Rautahat, Dhanusha, Morang, and Sunsari districts

in monsoon and winter seasons from 1977 to 1980.

There was no response to P and K but response to N was economically favourable.

During monsoon, 45 to 60 kg of N is an economical dose and 1 kg of N can produce 10 to 12 kg of grain but for winter 90 kg of N is an economical dose and 1 kg of N can produce 18 kg of grain at 15 percent moisture. Further two split applications of N were found (50 percent as basal + 50 percent as side-dressing) superior, but if a low to moderate amount of N is to be applied in a single dose, it is an advantage to apply at knee high stage (40 to 60 cm high).

In zinc deficiency area, 20 kg of crude zinc sulfate can be applied every alternate year to solve the problem.

4. WEED MANAGEMENT:

In general, the loss in maize yield due to weed is estimated to be 32 percent. The crop and weed competition was found to be destructive in the earlier stage of crop growth, i.e. upto 30 to 40 days after germination. The weed emerging later than this stage has almost no effect on grain yield. Hence, it is recommended that maize crop should be kept weed free upto first 30 to 40 days by any means.

Pre-emergence spray of Atrazine 80 WP, Tafazine, Siamazine, Lasso and Atrazine (Liquid) at the rate of 1.5 to 2.0 kg actual ingredient in 600 to 800 litre of water/hectare has been found effective in controlling most of the narrow and broad leaved weeds.

Generally, maize is weeded twice in monsoon and the second weeding is done by passing bullock plow. This practice was evaluated at RAS and was not found beneficial, rather massive root prunning and lodging or breaking of the stalk was caused by the operation.

5. INSECTS AND DISEASES:

Around 14 insect pests have been classified as major pests both in the field and at storage condition. In general, the loss is estimated to be 21 to 37 percent, but in severe conditions such as in Army Worm attack the losses might be 80 to 90 percent or more. Among the different granmules available in the market for stem borer control, Sevin 4 G is economical among all. But other granmules also can be applied at the rate of 10 to 15 kg/ha if Sevin 4 G is not available. At storage, 50 ppm Malathion was found to give protection against stored pests for one season.

Among diseases, stalkrot, earrot and downy mildew seem to be very serious. The losses due to stalkrot has been estimated to be 5 to 60 percent but there is no effective measures for controlling this disease. It has been found that use of tolerant varieties, better sanitation, optimum plant population, borer control and balanced nutrient are the only means of minimizing the disease.

The loss due to earrot has been estimated to be 40 to 80 percent or more. However, the disease can be controlled by spraying Diathane M45 at every 4 days interval. NMDP, in collaboration with the Plant Pathology Division, is trying to evolve the variety resistant to this disease.

The losses due to downy mildew has been estimated upto 92 percent in Chitwan. NMDP has developed two varieties - Rampur Composite and Sarlahi Seto which are resistant to this disease. It can also be controlled by treating the maize seed with Apron 35 SD (Ridomil) at the rate of 2 gm for one kg of maize seed.

6. MIXED AND INTER-CROPPING:

Several intercrop combination of maize with soybean, fingermillet peanut and other legumes showed that maize with soybean or other legume has given higher total production and higher profit. Four rows of soybean planted in between paired rows of maize spaced 2 meters apart (maize 50 x 20 cm with 50,000 plant/ha and soybean 50 x 5 cm with 200,000 plant/ha) was found best intercrop combination (gross profit Rs. 12,000/ha).

At Rampur condition, inter-cropping of maize with fingermillet proved to be poor combination. However, further study has to be done to verify it.

7. SEED STORAGE:

NMDP, in collaboration with the Agriculture Botany Division, has developed a technique by which maize seed at 10-13 percent moisture can be stored very safely in 250 gauge polythine liner cloth bag or gunny bag (as NMDP is packing Foundation Seed) from 360 to 630 days without loss in germination. The viability of seed can be retained upto 5 to 6 planting seasons if it is stored at low moisture level but even at 12 percent moisture level, the viability of seeds remained 80 to 85 percent upto 4 planting seasons, i.e. 450 days.

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AGRICULTURAL TECHNOLOGY / ADOPTION

DISCUSSION:

R.P. Chaudhary : You mentioned short and full season varieties. Please define them.

Rajbhandary : Short season variety is one which matures in 85-90 days in Terai and inner Terai in monsoon/summer season. Full season varieties are those which take longer period to mature.

S.P. Chand : You mentioned that winter maize cultivation is becoming popular now-a-days. Is this practice confined around Rampur ? If not, why the farmers of Far-Western Region especially Kailali and Kanchanpur districts are not aware of winter maize cultivation ?

Which one, winter or monsoon maize performs well in terms of grain yield and disease and pest incidence ?

Do you think winter maize is more profitable per unit area than mustard, lentil, wheat etc ?

Rajbhandary : Winter maize is quite popular in Terai districts such as Bara, Parsa, Rautahat, Sarlahi, Dhankuta, Mahottari etc. where irrigation for winter maize is available. NMDP is sending winter maize minikits to Kailali and Kanchanpur every year and the reports received through the respective ADO indicate their acceptance by the farmers. Effort on the part of agri. extension personed is required to spread this technology among a wider group of farmers.

The incidence of diseases and insects, effect of excessive moisture due to rain and weed infestations are minimum in winter crop. These coupled with plenty of sun-shine favor good response to soil fertility and the

ultimate yield is relatively very high as compared to monsoon yield.

The yield potential of winter maize is quite high in comparison to other winter crops. Though sufficient data are not available, the yield levels clearly indicate that winter maize may be profitable over other winter crops under irrigated condition.

N. Sharma : The dose of 2 gm Malathion/kg seed is recommended for seeds but not for grains for food consumption. This needs to be clarified in the report.

Rajbhandary : The rate mentioned is for seed treatment only.

N. Sharma : FAO global survey for pesticide resistance has already shown that many stored grain pests have developed resistance against Malathion in many pockets of Nepal. The dose of 50 ppm is rather high dose. Other insecticides recommended by JMFR (e.g. Fenitrothion) are already available in Nepal. Why no study has been made to find an alternative to Malathion ?

Rajbhandary : It is true that many insect pests have developed resistance to Malathion and hence screening of other insecticides is necessary.

K.L. Manandhar : Arun variety is highly susceptible to cob rot. Is it recommended for hills as well ?

Rajbhandary : This variety has been released for Terai and foot-hills (lower altitudes) as a spring crop.

B.P. Sah : Is there any study made on maize and mungbean intercropping ?

Rajbhandary : NMDP has not done any study in this aspect but Grain Legume Improvement Program (GLIP) is probably working in this direction.

C.P. Ojha : In this high hills, maize takes longer to mature (9-10 months). Do you have plans to develop high yielding varieties that will mature early in the high hills ?

Rajbhandary : We are certainly working in this aspect. Development and breeding of a white material at PAC and yellow material at LAC are a few examples of the effort put forward by NMDP.

R.P. Upreti : In Dolakha district, finger millet is inter-cropped in almost all the maize fields. The farmers have the feeling that improved maize reduces the finger millet production. Please comment.

Rajbhandary : This is because local maize matures about 10-15 days earlier than improved maize and the millet escapes shading effect. But the total yield (maize + finger millet) is higher with improved maize and the farmers are satisfied with this situation.

S.P. Chand : You expressed that maize is a poor man's food. Why the people of Doti and Bajura, being poor, are cultivating maize in small scale as compared to rice ? Is there any scientific reason for this ?

Rajbhandary : My observation is based on the food-habit. In Nepal, farmers in general prefer to grow rice because it fetches later rice wherever possible. Marginal land or unsuitable for rice cultivation goes under maize.

P.S. Rana : We are importing food due to various reasons and yet winter maize has no market in our country. How can this be ? Please comment.

Rajbhandary : In general, food deficity areas are in the hills but the winter maize is cultivated in Terai and hence needs to be transported to the hills. Therefore, agencies involved in food supply should transport the maize

produced to Terai and the hills where it is needed or Govt. has to make free flow to India, especially Bihar State which is highly accepted.

P. S. Rana : In the diamond trial result reported by you , why is the yield in Lamjung so high as compared to other locations ?

Rajbhandary : The yield difference is due to the location effect.

P.P. Regmi : With all these outstanding variety-cum-location performances in the favor of NMDP and ultimately in the favor of the farmers how much, do you think, has been helpful to the farmers to share your feeling, so as to minimize the alleged smuggling of the outside varieties to interfere with our own program ?

Rajbhandary : The demand for our recommended varieties by the dfarmers is increasing every year which itself is a proof of increase in farmers confidence in our own varieties.

A.M. Pradhananga: NMDP is responsible for maize technology development only or overall maize crop improvement and production. Please comment.

Rajbhandary : In my opinion, NMDP's responsibility is only limited upto the technological development, improvement and verification but overall production is extension aspect.

THE SITUATION OF RUST DISEASE OF MAIZE IN NEPAL

- Keshari L. Manandhar*

Introduction:

The rust disease of maize was reported for the first time in Nepal in 1964 (1, 6). The disease was identified as Common Rust caused by Puccinia sorghi Schw. The Southern Rust (Puccinia polysorai) and Tropical Rust (Physopella zeae) have not been observed so far within the country. Southern Rust is more devastating disease than Common Rust, hence we are lucky not to have such disease in Nepal.

Common Rust is distributed throughout the country, however, it is mostly common in the mountains, hills and valleys where the cool and humdi climate conditions prevail. In the Terai and Inner Terai region, rust is generally prevalent in the winter and spring maize. The high incidence of rust disease have been observed in Janakpur and Hetauda during winter season. On the contrary, the incidence of rust is quite low in Chitwan Valley.

The infection of rust usually appeared at the time of tasseling or silking but the early infection has been observed long before tasseling in the high altitude areas. From the studies on host and environment effect of rust, it was found that uredospore germination was not affected by leaf age but it is affected by the increase in dew formation (9). Therefore, at higher elevations, the duration of plant growth is very long and the early infection of rust affects the plant height and ear formation as a result the plants become stunted and eventually die before maturity. Mahindapala (1978) studied the epidemicology of maize rust and found that the spread of the pathogen was always from the inoculated plot which was related to the increase in atmospheric concentration of the rust spores. It was also affected by the temperature and the wind (8). Therefore, the inoculum of rust appears to be high at higher mountains in Nepal and the early infection results in the reduction in yield.

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Symptoms of common rust are small powdery pustules over both surfaces of the leaves. In the early stage of infection the lessions are brown and later on the epidermis ruptures and the pustules turn black.

Our local maize varieties are highly susceptible to the common rust and the disease must have existed in Nepal long before it was reported. Among the recommended / promising varieties Manakamana, Janaki and Sarlahi Seto appeared to be less susceptible to the rust whereas Kakani Pahenlo, Khumal Pahenlo and Rampur Pahenlo are moderately susceptible. Hetauda Composite and Ganesh-2 materials are highly susceptible to the rust disease. Among the other recommended varieties, Rampur Composite and Arun-2 also appeared to be highly susceptible.

The Investigations on Common Rust:

Although the presence of maize rust has been reported long back, the actual work on maize diseases were initiated only since 1968 (4). The screening of maize varieties against rust was the first kind of experiment for the first time in 1968 by the Division of Plant Pathology long before the crop program came into existence (5). The maize germplasm were limited in those days and only 97 different germplasm were screened against rust and most of them were found to be highly susceptible to the disease (10). The varietal screening program was continued for several years (1968-1972). The less susceptible varieties are listed in Appendix I. The varietal screening is a continuous program in the crop development and it has been continued in all the trials conducted by NMDP (15).

The identification and investigation of different maize diseases have been continued. It was only after 1974, when a number of experiments were conducted in relation to rust disease. A different dates of maize sowing trial was conducted at Kakani to find out the time of incidence of the disease. It was found that the rust incidence was higher in the late sown crop (Table 1). This may be because of the fact that the early sown crop situation with high rainfall and humidity is infavourable to the rust development (14).

An experiment was conducted on determination of yield reduction due to foliar diseases and cobrot (11). The trial was conducted at Kakani using various fingicides. The yield reduction due to the diseases was found to be quite substantial (Table 2). However, the yield reduction in this case was not only due to rust disease but also due to cobrot and other leaf diseases. Therefore, it can only be stated the incidence of common rust was there, however, rust infection alone has not been evaluated separately. Mederic and Saekston in 1970 had studied the effect of Zineb on rust incidence and found that Zineb had protected the crop and also prevented the yield loss (17).

Similarly, Kashalappa and Hegde (1970) studied the prevalence and severity of rust on maize varieties and the impact on yield. There was no positive relationship between the severity and yield difference in sprayed and unsprayed plots (7). Probably, the fungicides have no direct controlling effect on rust but indirectly the disease incidence decreased.

A seed treatment trial using different seed dressings was conducted at Kakani where seed-rot and seedling blight occur. The significant result was obtained on plant stand but it did not have remarkable effect on control of foliar diseases (14).

The screening of varieties against rust is a continuous process and the observations were taken in the trials and observation nurseries conducted by NMDP, Khumaltar and Kakani since 1974-1975. Observation nursery II (containing local vars) showed high susceptibility to the rust disease. The screening program was extended to high altitude areas like Lumle, Pakhribas, Jumla, Kabhre and Kakani (16). Some of the varieties were found to be highly susceptible to rust at all the locations (Table 3). Now, it is confirmed that local materials are highly susceptible to common rust in comparison to some of the improved varieties.

The screening against rust should be improved by using artificial inoculations. The screening should be done separately even before the materials reached to the stage of the advanced varietal trial.

As we know, rust disease is difficult to control by any chemical means. The ultimate solution for the disease problem is to find out the resistant varieties. Taking this view into account, a varietal improvement by selection and breeding was initiated in 1978 at Khumaltar (12). The selection of Khumal Pahenlo variety from multiplication block, as mass selection, was made on the basis of rust resistance along with the agronomical characters (plant height, plant stand, cob size, cob placement, husk cover etc). From the repeated selection through selfing and bulking process, a few Khumal Pahenlo lines appeared to be quite resistant and especially 5 Lb line is found to be completely free from rust. Besides that, the agronomical character had also been maintained. Therefore, this Khumal Pahenlo line was incorporated in Manakamana-2 as a rust resistance source in the NMDP breeding program. The further improvement of Khumal Pahenlo lines have been continued and some of the lines (14 L b and 18 L b) were found to be short in plant height along with other agronomical characters and also free from common rust. These materials will be used for further improvement.

Besides the above mentioned maize improvement by selection method, the breeding for resistance were also initiated side by side. Eight rust resistant materials were received in 1978 and were planted at Khumaltar. Somehow, the materials appeared to be highly susceptible to insects and some of them were crossed with our recommended varieties. However, the crossed materials were not doing well. In 1979, some rust resistant materials were received from CIMMYT, out of which only two varieties Linease Illinois (RR_1) and Comp. Hawaii (RR_3) were matched with our recommended varieties. Those were crossed, back crossed and selfed during last few years. Now, we have found that some of these materials (RR_1 X Ganesh-2, Sarlahi Seto X RR_1 RR_3 X Khumal Pahenlo) are quite resistant to the rust disease. Further improvement of these resistant materials will be continued.

In conclusion, the common rust disease is a problem of maize at high elevations and it can be solved only by providing the resistant material for the high altitude areas. In addition, the materials used for winter maize at lower altitude should be looked carefully for the rust incidence. Perhaps common rust may be the big problem of winter maize in near future.

Table 1 Incidence of Rust on Maize Sown on Different Dates - 1975 (Kakani)

Sl.No.	Varieties	1st Week of Baisakh Ave. (0-5) Sc.	3rd Week of Baisakh Ave.	1st Week of Jestha Ave.	Overall Mean
1	Thai Comp.	1.16	1.66	2.33	1.71
2	DMR-2	1.83	2.0	2.33	2.05
3	Ganesh-2	1.66	1.83	2.33	1.94
4	Pd (MS) 6	1.5	1.5	2.16	1.72
5	Co.H.F.	1.0	1.83	2.0	1.61
6	Hetausa Comp.	1.66	2.0	2.0	1.88
7	CIMMYT H.E.O_2	1.83	2.0	2.66	2.16
8	Khumal Pahenlo	1.0	1.33	2.0	1.61

****

Table 2

No. of Obs.	Rust (0-5) Scale		Yield Per Hectare	
	Treated	Control	Treated	Control
1	2	3	5.03	3.89
2	2	3	5.72	4.73
3	1	3	4.03	3.38
4	3	3	3.73	3.27
5	2	3	4.03	4.11
6	3	3	4.93	3.56
7	3	4	4.28	2.82
8	2	2	4.01	3.02
9	3	4	4.91	2.96
10	3	4	4.69	4.04
Mean :	2.4	3.2	4.53	3.57

't' Calculated 5.38 Tabulated 2.262 (when P 0.05)

4.781 (when P .001).

Varietal Screening Against Common Rust Disease of Maize

(0 - 5)

Sl. No.	Pedigree	Rakam			Kabhre		Khumaltar			Lumle	Jumla
		1979	1980	1981	1980	1981	1979	1980	1981	1980	1981
01.	Rampur Comp.	3.0	2.0	3.1	4.0	-	0.5	2.0	2.0	3.5	2.0
02.	Kaskada Comp.	3.5	3.0	3.3	3.0	-	1.0	3.3	2.0	2.5	2.0
03.	Khumal Pahenlo	-	2.0	2.5	3.0	2.0	1.0	1.3	2.0	2.5	2.0
-	Suwan-1	2.5	2.5	-	0	-	0.6	1.3	2.0	-	-
05.	Arniahi Seto	2.5	2.5	-	2.0	-	1.0	2.0	-	2.0	-
06.	[illegible]	3.0	0.0	-	4.0	-	1.5	1.0	-	1.5	-
07.	[illegible]-2	3.5	2.0	-	3.0	-	0.5	2.6	-	3.5	-
08.	Manakamana	-	2.6	2.5	2.0	2.0	-	2.0	3.0	1.0	1.0
09.	Manakamana-2	-	-	-	-	2.0	-	-	-	-	2.0
10.	Janaki	-	2.0	2.1	3.0	-	-	2.0	2.0	2.5	-
11.	Rampur Pahenlo	-	2.0	3.1	4.0	3.0	1.0	2.3	2.0	-	3.1
12.	Rampur 7433	-	-	-	-	-	1.0	-	-	-	-
13.	Rampur 7434	-	-	-	-	-	0.5	-	-	-	-
14.	Amarillo del [illegible]	2.0	1.6	-	2.0	-	1.5	0	-	2.5	-
15.	[illegible] Def.-7	-	-	-	-	-	0.5	-	-	-	-
16.	Pirsabak 7442	2.5	-	-	-	-	1.0	-	-	-	-
17.	Synar 3	-	0	-	3.0	-	-	2.0	-	1.5	-
18.	Shaoling Loc.	-	-	-	-	-	1.0	-	-	-	-
19.	Evo Illinois	-	2.0	-	2.0	-	-	1.3	-	2.0	-
20.	Waico	-	0	-	3.0	-	-	1.3	-	0	-
	[illegible]	-	-	3.2	-	2.0	-	-	3.0	-	3.0
21.	Pakeni Pahenlo	3.0	2.5	2.5	2.0	-	1.0	0	-	1.0	-
22.	Kahani Local	-	0	-	4.0	-	-	0	-	2.0	5.0
23.	Khumal 7633	-	2.0	-	4.0	-	-	3.0	-	1.0	5.0
24.	Local Check	4.0	0	-	4.0	2.0	-	1.0	-	3.0	-
25.	Across 7433	-	2.3	-	0	-	-	0	-	0	-
26.	Across 7442	-	2.0	-	3.0	-	-	0	-	1.5	-
27.	Suwan White	-	-	-	-	2.0	-	-	-	-	1.0
28.	P174 White	-	-	-	-	2.0	-	-	-	-	4.0
29.	Khumal 7633 Y Khyl	-	-	-	-	2.0	-	-	-	-	3.0

- - indicates variety not included.

Appendix I

01. (Comp. Gpo.7 X Antigua Gpo.2) - 1
02. (US Argentina-2 X Cuba V 66)-1-2
03. (North Sikkim 6-1 X Kentucky South Africa Corn Belt Synthetic-1
04. (Puerto Rico Gr. 1 X Iraneko)-1-2
05. (Palung Valley White) X (Pekin-haku-gyokumai) X (CBE X E to)-1-2
06. (" " ") X (Comp. Blanco (AIV)-1-2
07. (Palung Valley White X Iraneko-1)-1
08. (Palung Valley Lekh area white) X Antigua Gpo.2 X Guat)-1-2

(Out of 66 testing materials)

1969

01. (US/Argentina-4 X Waimea Dent.)-1-2-3
02. (US/Argentina-2 X Cuba V66)-1-2-3
03. (Palung Valley Yellow) X (US/Argentina 2 X Jamaica 1J)-1-2
04. (Palung Valley White) X (Pekin-haku-gyokumai) X (CBC X E to)-1-2
05. (Palung Valley White) X Composite Blanco (AIV)-1-2
06. (Palung Valley White X Ivareko-1)-2
07. (Palung Valley Lekh area White X Antigua Gpo.2 X Guatemala)-1
08. (Carocento X Guatemala)-1-2 X Palpa Yellow No. 6.
09. (Chis Gpo.32 X Antigua Gpo.2)-1 Tuxp-eno X New England.
10. Westigua F7
11. Iowatigua F6
12. Tuxpentigua F3
13. Trejan
14. Teyler Evans 6703
15. Funk G 795 W

1970

01. North Sikkim 8 . Nepal
02. (US/Argentina-2 X Waimea Dent)-1-2-3
03. (Flint Comp. Amarillo X US/Argentina
04. (Palung Valley Yellow) X (US/Argentina-2 X Jamaica 1-2 (Palung Valley White) X Irareko 1

05. (Palung Valley White) X Comp. Blanco (AIV)-1-2
06. (Palung Valley White) X (Pekin-haku-gyokumai X (CBC X Eto) Sym.203.
07. Syn. 530
08. Akbar 2
09. Synthetic 200

1971

01. Gemini Composite
02. Flint Comp. Amarillo X US/Argentina-4)-1-2-3
03. (Carocento X Guatemala)-1-2

1972 (Out of 349)

01. Pekin-haku-gyokumai X Narino 330G)-1-2
02. US/Argentina X Waimea Dent
03. Kakani Pahenlo opajue (RMP)
04. ICA # 208 # Composite
05. Pioneer 3911
06. Pioneer
07. Pioneer 3985
08. Yu-Zp-Sc-584/69
09. Yu-Zp-Sc-74
10. Yu-Zp-Tc-62/69
11. Yu-Zp-Sc-46 A/70
12. Yu-Zp-Sc-1 A/69
13. Yu-Zp-448/70
14. Yu-Zp-Sc-48 A/70
15. (Palung Valley Yellow) X (Pekin-haku-gyokumai X Narino 330 G)-1
16. Agaute Makai
17. Seti Makai
18. Kanade Maize
19. Goduhade
20. Zira
21. Pahenlo Makai
22. Red Sathiya
23. Eto Blanco Planta Baja PHU 71-A lot - 1

24. Mix X Col. Gpo. Eto Planta Baja PRU 71 A 25 8 F

25. Modified Opaque Maize Kernel

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SITUATION OF RUST DISEASE

DISCUSSION:

W.H. Freeman : Is selfing necessary as a breeding procedure to identify resistance to common rust ?

Manandhar : Not necessarily, it depends upon the breeding procedure you follow. If you do selfing, progress per cycle of selection will be high. Generally, I prefer S_1 selection scheme.

B.K. Gyawali : Plant Pathology Division is one of the best Divisions, when equipment and physical facilities are considered. In your report you have mentioned that because of lack of physical facilities, the screening was not done under artificial inoculation condition. Please comment.

Manandhar : Although, we have a lot of equipments in the Division of Plant Pathology, we still lack the facility for the storage of rust spores. Because of this, we have not been able to inoculate the disease artificially and hence screening was done under natural condition.

REPORT ON VARIETAL SCREENING OF MAIZE AGAINST MAJOR DISEASES

- Keshari L. Manandhar and *
- Gyanu Gurung

Introduction:

Maize, the staple crop of higher elevation is always under a continuous stress of diseases. Major diseases are cob rot (Fusarium moniliforme Sheld); common rust (Puccinia sorghi Schw) and stalk rot (Erwinia carotovora Jones Holland). Depending upon the nature of different climatic conditions from Terai to high elevation, the occurrence and severity of those diseases varies. In higher altitudes where high rainfall, high humidity and long duration of crop stand prevails, cob rot disease has greatly affected the yield and quality. Rust as foliar destructive pathogen occurs from Terai to higher altitude and stalk rot causes greater loss particularly in Terai region.

The varietal screening trial of maize against these major diseases was conducted at various stations : Rampur, Lumle, Pakhribas, Kabhre, Khumaltar, Jumla and Kakani for the last 4 years. The materials included in the trial were mostly promising and recommended varieties. Screening of varieties were done with the artificial inoculation with the suspension of casual organism of specific disease in specific location. The screening procedure was continuously and regularly conducted at Khumaltar and Kakani.

Materials and Methods:

The trial was laid out in complete randomized block design with the plot size 5 x $3m^2$ and 4 replications. There were eight varieties of maize. The plot size was reduced to $3m^2$ at high hill due to narrow terraces and spacing was 75 x 30 cm^2. The fertilizer dose was 120:60:40 kg N:P:K per hectare of which half the amount of nitrogen was applied as top dressing at knee high stage of the plant.

At Kakani, the most common Fusarium moniliforme among the cob rot

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organism was artificially inoculated in cobs of each plant with the help of syringe. The fungus was isolated from infected grain and was cultured on steamed and sterilized sorghum. The suspension was prepared in water by crushing the cultured crumbs. Suspension of equal inoculum concentration was inoculated in one day. The observation was taken during harvest and infection percentage was estimated.

Results and Discussions:

The results of different locations are presented in tables 1 and 2. At Kakani, among the screened varieties, Kakani Pahenlo was found to be least susceptible (23.2%) to cob rot while high susceptibility was seen in Arun-2 (67.6%). Kakani Pahenlo has been continuously appearing to be resistant from last 3 years and the range of cob rot incidence occurred from 13.4% (1980) to 35.6% (1981). The least infection percentage (15.9%) was also observed in NMDP trial when maximum rot was shown by Sarlahi Seto (71.5%). Besides Kakani, Kakani Pahenlo has also appeared to be the best in the other hilly locations : Pakhribas, Kabhre, Lumle and Khumaltar.

At Khumaltar, Manakamana appeared to be highly susceptible to cob rot (6.2%) and Rampur Composite less susceptible (2.3%). The disease incidence was not much and reached only upto 6%.

At Kakani, stalk rot was almost nil while at Khumaltar more susceptibility was seen in Hetauda Composite and Kakani Pahenlo.

Considering common rust, low susceptibility was seen in Khumal Pahenlo and more susceptibility in Rampur Composite while at Khumaltar, Manakamana appeared to be low susceptible and Arun-2 the most susceptible one.

Thus, the susceptibility of the main diseases in hilly areas is very clear. Hence, the selection of suitable material to fit in one particular climate can be done only by screening.

Acknowledgements:

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Table 1 Disease Observations on Varietal Screening Trial at Kakani '82

Sl.No.	Pedigree	Cob Rot %	Rust (0-5)	Stalk Rot %
1.	Rampur Composite	51.7	2.8	Lodging stalk
2.	Hetauda Composite	33.8	2.3	rot was not
3.	Janaki	47.7	1.8	appeared in
4.	Rampur Pahenlo	48.0	2.1	trial at
5.	Manakamana	49.0	2.1	tasseling
6.	Khumal Pahenlo	32.0	1.6	stage
7.	Arun-2	67.6	1.8	
8.	Kakani Pahenlo	23.2	2.3	

NMDP Varietal Trial at Kakani, 1982

Sl.No.	Pedigree	Cob Rot %
1.	Ganesh-2	44.4
2.	Manakamana	54.0
3.	Rampur-2	41.1
4.	Arun-4	25.0
5.	Arun-2	43.5
6.	Rampur-1	20.4
7.	Rampur Composite	21.0
8.	Khumal Pahenlo	42.8
9.	Sarlahi Seto	71.4
10.	Kakani Local	15.9

Table 2 Disease Observations at Khumaltar

Sl. No.	Pedigree	Cob Rot %	Rust (0-5)	Stalk Rot %
1.	Rampur Composite	2.3	1.5	0
2.	Hetauda Composite	3.8	1.7	2.8
3.	Janaki Makai	5.7	1.3	1.5
4.	Rampur Pahenlo	3.5	1.6	1.3
5.	Manakamana	6.2	1.1	1.8
6.	Khumal Pahenlo	3.8	1.7	1.7
7.	Arun-2	5.9	2.3	1.3
8.	Kakani Pahenlo	4.2	1.5	2.7

PRELIMINARY REPORT ON CRAZY TOP DOWNY MILDEW (SCLEROPHTHORA MACROSPORA (SACC) THIRUM, SHAW AND NARAS) OF MAIZE IN NEPAL**

- Binay K. Batsa*

ABSTRACT

The main objective of this study was to find out the effect of Crazy Top Downy Mildew on yield attributing characters, suitable fungicide for the disease control and to find out the maize genotypes resistant to Downy Mildew (DM). Infected plants were found very short (88 cm) as compared to normal plant (144 cm). Tassels and ears of infected plants produced a leafy bunch of very small size abnormal ears with or withour grains. Seeds obtained from such ears were found poor in viability (60 %) and 1000 grain weight (185 grams) as compared to normal seeds which were 100% viable with 300 grams of 1000 kernel weight. Grain yield reduction up to 64% was assessed in this study.

Apron-35 SD, Vitavax and Thiride @ 4 gram a.i./kg maize seeds were tested against DM, but none of the seed dressants could effectively control the disease. Eight maize genotypes were screened against DM under natural conditions at Rampur but none of them were found tolerant to it. Even varieties Sarlahi Seto and Rampur Composite, which are tolerant to Philippine and Sorghum Downy Mildews, were found susceptible to Crazy Top Downy Mildew.

Review:

Crazy Top Downy Mildew incited by Sclerophthora macrospora (Sacc) Thirum, Shaw and Naras is becoming a severe maize disease in Chitwan and Makwanpur districts in winter. Up to 50% infection was recorded at Rampur in 1981 (1). Since 1980, disease is appearing in epiphytotic form on the same area every year in Chitwan. This year also up to 40% infection in 686 half-sib families

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** - Plant Pathologist, yet to be confirmed.

of Arun-4 was recorded at Rampur. In 1981 winter, some of agronomical experiments totally failed because of the severe attack of DM. This indicates that pathogen has become endemic in these areas. However, the presence of DM disease in hilly areas is not reported in Nepal.

As described by several workers, Crazy Top DM disease is associated with soils that have been flooded after planting and before the plants are in the 4 to 5 leaf stage (2). The same situation holds true in Rampur case also. In September 29, 1981, there was 250 mm rainfall within 5 hours interval and the 10 days old maize plants were totally submerged in water for 24 hours at Rampur. As a result, 25 to 50% DM infection was recorded in Arun and Rampur Composite varieties in the waterlogged areas. The same situation again repeated this year.

A variety of symptoms are expressed by the infected plants. Proliferation of floral and vegetative parts into leafy structures, excess of tillering and stunting are some of the general features of the infected plants (3). Some times the tassel is replaced by a leafy branch of small size ears (1 to 20 in number) which bear very few grains or the ears remain empty (1). The phyllody is recorded in ears also. Seeds obtained from such abnormal ears are comparatively small, deshaped, dull in color, poor in viability and 1000 kernel weight. In brief, the DM infected plants are always deviated from normal morphologically. This results is considerable reduction in yield. The overall aims and objectives of this study was to find out the means by which the yield loss can be minimized.

1. Loss Assessment Studies on Crazy Top Downy Mildew (DM) of Maize

Study on the assessment of loss was done at Rampue, because sufficient data was not available and very little was known about the disease and its relation to yield loss in Nepal.

Materials and Methods:

Three locations (one location considered as one replication) were randomly selected at Rampur. Each block comprising of 120 m^2 area was fertilized with 60:60:30 kg N:P:K/ha at sowing and 60:0:0 kg NPK/ha

was side-dressed at knee high stage of crop. Variety Arun-2 was planted on 12th September 1981. Spacing was 75 cm row to row and 25 cm plant to plant. Weeding and hoeing were done according to need. After silking, disease observation was taken. Infected plants were tagged and the crop was harvested at right stage of maturity. Necessary morphological characters were noted. The result is summarized in tables 1 and 2.

Results and Discussions:

Table 1 shows that even in natural condition, percent DM infection was very high (21 %) at Rampur. It is obvious that sufficient inoculum has already been built up in nature in Chitwan.

Regarding the morphological characters of the infected plants, we can say that even some of the DM plants can be more taller (125 cm) than the normal plants (100 cm). Such plants could bear the normal size ears (8-12 cm long) that were full of normal size grains which were 100% viable and there was no significant reduction in 1000 kernel weight (table 2). But in general, the average height of the systemically infected plants was drastically reduced (88 cm) as compared to normal plant height (table 2).

On the other hand, most of the abnormal DM plants that bore a leafy bunch of small size cobs (recorded up to 15 ears/bunch/plant) were very small in size (2-4 cm in length). Such type of abnormal ear were mostly empty or some time full of kernels (0-20 grains/ear - table 2). Grains obtained from such ears were very poor in viability (0-60%), low in 1000 grain weight (185 grams) as compared to normal grains (300 grams/ 1000 grain weight (table 2).

Healthy plants could produce higher grain yields (75 grams/plant) as compared to crazy top plants (27 grams/plant) (table 1). This indicates that, if the diseased plants produce only abnormal ears and rarely produce normal size cobs there will be 48 grams/plant yield reduction, i.e. 64% total grain yield loss (table 1).

2. Varietal Screening Against Crazy Top

Materials and Methods:

Eight maize genotypes were screened under natural condition at Rampur in a randomized block design with 3 replications. Two rows of 5 metre long plot with 75 cm row to row and 25 cm plant to plant was maintained. Fertilizer was given at sowing time @ 60:60:30 kg N:P:K/ha and 60 kg N/ha was applied at knee high stage of the crop. All the cultural operations were done in time. Disease observation was taken after silking and the result is summarized in table 3.

Results and Discussions:

None of the 8 maize genotypes tested were found free from DM infection. Even Sarlahi Seto and Rampur Composite cultivars which are tolerant to Philippine and Sorghum Downy Mildew were found susceptible to Crazy Top DM.

3. Efficacy of Seed Dressing Fungicides on the Incidence of Crazy Top Downy Mildew of Maize at Rampur, Chitwan

Reports about the chemical control of DM by seed dressing are available from Nepal and abroad. On the basis of last year's finding, this experiment was conducted to evaluate better chemical for DM control.

Materials and Methods:

The experiment was laid out in Randomized Block Design consisting of 5 treatments with 3 replications. Plot size was 3m x 5m with 25 cm plant to plant and 75 cm row to row spacing. Fertilizer was applied @ 60:60:30 kg N:P:K/ha at sowing and 60 kg N/ha side-dressed at knee high stage of crop. Weeding and hoeing was done according to need. Disease observation was taken after silking and the result is summarized in table 4.

Treatments:

1. Apron 35-SD @ 3g a.i./kg seed
2. Apron 35-SD @ 4g a.i./kg seed

3. Vitavax @ 4g a.i./kg seed
4. Thiride @ 4g a.i./kg seed
5. Untreated check - No seed treatment. Seeds of Arun-2 were treated with the above mentioned chemical and planted on September 19, 1982.

Results and Discussions:

Out of 3 chemicals tested none of them were found effective in reducing DM infection at Rampur conditions (table 4). The antifungal activity of APRON was proved successful in controlling Sorghum and Philippine DM in Nepal, but no effect was apparently observed against Crazy Top DM in this case. The other two chemicals (Vitavax and Thiride) were equally ineffective. The data was not analyzed statistically, because the % DM infection in chemical treated plots was apparently at par with that of untreated check (table 4).

Conclusion:

From the above discussions, and one year experiments it is clear that none of our maize varieties are resistant to Crazy Top DM. Even Sarlahi Seto and Rampur Composite are susceptible to it. Crazy Top DM can reduce yield yp to 48 grams/plant (64 % loss) in severe cases. No chemical treatment (seed dressing) was found effective against this disease. Even APRON 35-SD was found ineffective.

Hence, many more local land races must be collected and screened to obtain a better source of resistance.

Acknowledgement:

The author is indebted to Mr. Tirtha Bhattarai (Lab Boy) who devoted his valuable time in helping during this study.

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Table 1 Plant Stand, % of Crazy Top DM Infection, Yield/Plant and % Yield Reduction Obtained From 3 Locations at Rampur in 1981 Winter

Location/Replication	Rep.	Rep.	Rep.	Total		Grain Yield in kg					Yield/	Yield	% Yield
				Plant	Mean	Rep	Rep	Rep			Plant	Reduc-	Reduc-
Plant Population	I	II	III	Stand		I	II	III	Total	Mean	(gm)	tion/ Plant (gm)	tion
Total # of plants	556	461	499	1516	505	-	-	-	-	-	-	-	
# of uninfected plants	411	370	411	1192	397	34.58	25.65	26.42	86.65	28.88	75.0	-	
# of DM infected "	145	91	88	324	108	4.34	2.17	1.97	8.48	2.82	27.0	48.0	64
% of Downy Mildew	26	20	18	64	21	-	-	-	-	-	-	-	-

Planting Date: September 12, 1981.

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Table 2 Comparisons of Some of the Morphological Characters of Crazy Top Infected Plants with the Normal Plants at Rampur in 1981 and 1982 Winter

Morphological Characters	Crazy Top Plants	Normal Plants
01. Plant height in cm	60 - 125	100 - 175
02. No. of normal ears/plant	0 - 1	1 - 2
03. No. of grains/normal ear	100 - 250	400 - 750
04. Length of normal ears in cm	8 - 12	14 - 20
05. Average plant height in cm	88	144
06. No. of abnormal ears/bunch/plant	1 - 15	-
07. Length of abnormal ears in cm	2 - 4	-
08. No. of grains/abnormal ear	0 - 20	-
09. 1000 kernel weight in gram	185	300
*10. Seed viability %	0 - 60	100

* - Viability of seeds within 15 days of harvest.

Table 3 Crazy Top DM Infection on Eight Maize Genotypes Screened Under Natural Condition At Rampur in 1982 Winter

Genotypes/Entries	Replication I		Replication II		Replication III		Total Plants of 3 Reps	Total Crazy Top Plants	% of Crazy Top Plants
	Total Plants	Crazy Top Plant	Total Plants	Crazy Top Plant	Total Plants	Crazy Top Plant			
1. Rampur Composite	22	2	37	3	42	4	101	9	8.99
2. Khumal Pahenlo	24	1	36	5	39	3	99	9	9.09
3. Kakani Pahenlo	18	3	38	1	39	1	95	5	5.26
4. Sarlahi Seto	34	2	39	2	32	4	95	8	8.42
5. Arun-2	37	5	32	6	34	3	103	14	13.59
6. Pop-corn	23	2	26	1	24	2	73	5	6.84
7. Sweet-corn	7	2	4	1	8	1	19	4	21.05
8. Rampur Local	33	2	36	3	37	5	106	10	9.4

Planting Date: September 19, 1982.

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Table 4 Efficacy of Fungicides on the Incidence of Crazy Top DM of Maize at Rampur in 1982 Winter

Treatments/ Fungicides	Replication I		Replication II		Replication III		Total # of Plants	# of DM Plant	% of DM
	Total Plants	# of DM Plants	Total Plants	# of DM Plants	Total Plants	# of DM Plants			
1. Apron 35-SD @3g a.i./kg seed	80	15	70	9	78	9	288	33	14.47
2. Apron 35-SD @4g a.i./" "	78	16	76	16	79	6	233	38	16.30
3. Vitavax @4g a.i./kg seed	76	14	72	11	76	9	224	34	15.17
4. Thiride @4 g a.i./kg seed	79	23	74	14	80	12	233	49	21.03
5. Untreated scheck	80	20	60	6	71	8	211	34	16.11

Planting Date: September 19, 1982

THE BIONOMICS OF THE MAIZE BORER CHILO PARTELLUS (SWINHOE) IN NEPAL

- Fanindra P. Neupane,
Harry C. Coppel, and
R. Keith Chapman*

INTRODUCTION

Maize ranks next to rice as the most important food crop of Nepal. It is basic to the diet of the people in the hilly regions and is grown in the hills, river valleys, inner and other terai. Although various insect pests attack this crop in the field, the maize borer, Chilo partellus (Swinhoe) is the most important. It is serious in all the maize growing areas except at the higher elevations. The maize borer also attacks sorghum (Sorghum vulgare Pers.), rice (Oryza sativa L.), fingermillet (Eleusine coracana Gaertn) and teosinte (Euchlaena mexicana Schrad). In areas where rice is rotated with maize or where both crops are planted side by side C. partellus has been serious in rice as well. In the Chitwan Valley this pest is the most serious of all the lepidopterous stem borers that attack the rice crop. A significant yield loss in maize has been regularly realised by farmers.

The lack of information on C. partellus in Nepal provided the necessary impetus for studies of behavior, biology and development, screening of hosts and host cultivars for susceptibility, insecticidal materials for control and effects of date of planting on the incidence of the pest. The investigations were undertaken at Rampur, Chitwan and Khumaltar, Kathmandu, Nepal during 1977 to 1981, to provide pest management strategies for C. partellus.

SUMMARY OF THE RESULTS

Hosts, Nature and Extent of Damage

In the Chitwan Valley, C. partellus was found primarily in maize, sorghum and rice. Other hosts with light infestation were teosinte, fingermillet, sugarcane and Echinochloa sp. Infestations during the young stages of the

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maize plants produced 'dead hearts' whereas, those during the advanced stages reduced plant growth and in many instances no cobs were formed. The larvae fed in the tassel, stem, peduncle and ear. Stem breakage before harvest often occurred. In some cultivars of maize, the yield reduction up to 60% and stem infestation reached 98%. In rice the borer produced 'dead hearts' early and 'white head' condition later.

Biology, Behavior and Development

The egg incubation period during the summer (June - September) was 4-5 days. Seventy-two percent of the egg masses were laid on the lower surfaces of the leaf blades of maize plants. Their position on the leaf blade was primarily (63%) between the depression of the mid-rib and the leaf margin. Egg masses on young leaves were laid on the whorl leaves but oviposition sites varied on the older plants. During the silking stage of maize, eggs were laid primarily on the leaves at the bases of the ears (26.8%) and the remainder were laid on various other leaves.

Larval emergence took place primarily during the morning hours at which time they migrated to and entered either the leaf whorls or leaf sheaths depending upon the stage of the crop. Approximately 65% of the first instar larvae perished during dispersion. The larvae fed on the leaf whorls or leaf sheaths through their 2nd instar and entered the stems proper as 3rd instar larvae. During the summer the mean length of the larval period was 28.6 days. Pupation took place inside the stem, peduncle or ear. During the summer, the mean pupal period was 6.7 days. Moth emergence was recorded from 4 p.m. through 10 p.m. with a peak between 7 to 9 p.m. Mating started during the evening hours. The pre-oviposition period was less than 1 day and the total oviposition period lasted 1-3 days. The mean number of eggs laid by a female was 262.0 ±162.9.

The moths were attracted to light traps at or after dark with a peak in activity between 8-10 p.m. Blacklight traps were more effective than incandescent-light traps in attracting moths. More females than males were attracted to the traps and most females were gravid. Second, third and fourth generation moths rested among the maize plants. The entire life cycle

took 28-48 days under field conditions during the summer and 192 - 233 days from October to May during which time the larvae went into diapause.

After the maize harvest in August, the borers migrate to the rice crop where 1-2 generations are passed. The mature larvae hibernate in the rice stubble from October onwards. Spring emergence of adult moths takes place in the middle of April when maize plants are available for oviposition. First generation moth peaks occurred during the last week of May, 2nd generation peaks during the last week of June and 3rd generation peaks, the highest of all, occurred toward the end of July and the beginning of August. The small 4th generation of moths peaked during the last week of September. A partial 5th generation moths peaked during the 1st week of October. There was some indication that temperature and rainfall during April-May determined the level of C. partellus population survival during the following season. The heavy rains during July - August might in part be responsible for reducing the 4th generation larval population.

In the laboratory the durations of the egg, larval and pupal stages were shorter at 30 °C than at 25 and 20 °C, but at 35 °C it was slightly longer. The average egg development took 9.6 days at 20 °C, 6 days at 25 °C, 4 days at 30 °C and 4.5 days at 35 °C. The larval period was completed in average of 42.2 days at 20 °C, 24.04 days at 25 °C, 19.2 days at 30 °C and 22.2 days at 35 °C. Pupal development took an average of 14.8 days at 20 °C, 8.72 days at 25 °C, 6.26 days at 30 °C and 7.25 days at 35 °C.

The male and female moths survived, respectively for an average of 7.8 and 8.5 days at 20 °C, 5.10 and 5.25 days at 25 °C, and 3.6 and 3.5 days at 30 °C, and 1.5 and 1.6 days at 35 °C. In general, the optimum temperature for the completion of a generation of C. partellus in the laboratory was 30 °C. Temperatures at 20, 25 and 30 °C showed a linear increase in the rates of egg, larval pupal and complete generation development of C. partellus. The X-intercept estimates of the threshold temperatures for egg, larval, pupal and complete generation development are 13.25, 12.5, 12.75 and 13 °C respectively. Thermal unit summations for the development of the egg, larval, and pupal stages respectively, were calculated as 69.0, 297.7 and 104.9 thermal

units (TU) or day degrees using a 13 °C development base. The development of complete generation took a total of 471.7 TU. In contrast an accumulation of 515 TU were necessary under field conditions for the development of each generation of C. partellus.

Based on the field TU accumulations, light trap catches of moths, and field infestations of larvae, a theoretical model for the different generations of C. partellus in Chitwan, Nepal, has been developed as follows : There are 5 generations of C. partellus in the Chitwan Valley. The spring emergence of moths peaks on April 15. The 1st, 2nd, 3rd, 4th and 5th generation moth peaks are found, respectively, on May 24, June 28, July 31, September 3 and October 10.

The analysis of life tables for C. partellus indicated that the mortality factors during the 2nd generation were larval dispersion and unknown which provided total mortality of 93.04% and a trend of population increase. The mortality factors during the 3rd generations were, again, larval dispersion, unknown, and egg and larval parasitism showing a total mortality of 88.28% and again a trend of population increase. The mortality factors during the 4th generation were egg parasitism, larval dispersion, larval and pupal parasitism, adult mortality and unknown. The total mortality was 97.63%. A trend of population increase was observed but it was much smaller than that in the 2nd and 3rd generation. Of seven hymenopterous parasitoids reared from C. partellus, Trichogramma, was an egg parasitoid; Apanteles, Bracon chinensis, Stenobracon and Trathala were larval parasitoids; and Hyperchalcidia and Xanthopimpla were pupal parasitoids. As T. chilonis was effective in parasitizing the eggs of C. partellus and is easily reared, it could be released (inundation technique) as a strategy for supression.

Host Susceptibility / Resistance

Studies were made on the plant susceptibility/resistance to the maize borer in various crops and maize cultivars. When different host crops were made available in a particular location, sorghum and maize were preferred more than were teosinte, rice, sugarcane and fingermillets in descending order.

In various cultivars and experimental materials of maize, whorl infestation or leaf feeding due to C. partellus did not show any correlation to stalk infestation. There was also a lack of correlation between stalk infestation and tunnel length/plant. Neither a high percent of whorl and stalk infestation nor more damage inside the stem reduced the yield of maize in some cultivars, for example, Arun-2, indicating tolerance to C. partellus.

Of 134 maize entries screened for a susceptibility to C. partellus, either at Rampur, Khumaltar or at both locations, 25 were in replicated trials and the remainder in single trials. When judged against 2 or more criteria of susceptibility to C. partellus, the following entries were regarded as least susceptible when compared to the remainder : D 774 (White), Local, Manakamana-1 (White), Pojarica 7931, Across 7833, Chuquisaca (I) 7842, D 771, Paheli Makai, Pool-32, (L4 X D 74 Sarhad, (Sarhad X L4) Pool-17, (B 73 X Suwan-2) D 771, (Indian Pool-5 X MSPI) D 771, ((ECB X T54) Suwan-2)) D 771, (AICDS-C7 X Suwan-2) D 771, Aru Chaure Seti, and Thulo Chure Seti. The commonly grown cultivars, Rampur Yellow, Khumal Yellow and Rampur Composite were all moderately susceptible to C. partellus and Arun-2 although highly susceptible to stalk infestation, yielded well.

Chemical Control

The efficacy of various insecticides, namely, carbaryl, carbofuran, endosulfan, trichlorfon, bacillus thuringiensis, aldicarb, fenitrothion and phoxim at 1 kg a.i./ha in various formulations was studied against the maize borer, Chilo partellus at Rampur, Chitwan, Nepal, in 1978-1981. Carbofuran and carbaryl in granular formulation were superior to the other treatments. Granular formulations of aldicarb and trichlorfon, and sprays of carbaryl and endosulfan were also effective. The various carbaryl formulation and timed treatments showed that carbaryl bait was better for application to the maize whorl for 3rd generation treatment and that spray was better for the 4th generation of C. partellus. Therefore, the relatively safe carbaryl, in granular form is recommended as a whorl treatment for the 3rd generation of C. partellus in maize.

Effect of Date of Planting on the Incidence

The maize cultivar, Arun, was planted in Rampur, Chitwan, Nepal on April 24, May 4, 14 and 24. The data on the percent infested plants showed an increased infestation of the maize borer, C. partellus on late sowings when compared to early sowings. The tunnel length/plant also showed an increase with later plantings. The latest seeding (May 24) showed significantly greater borer damage than those planted earlier. Earlier planting of maize (prior to May 14) is recommended, therefore, for that area of Nepal.

CONCLUSIONS

For the first time, we have accumulated sufficient data on the maize borer, Chilo partellus, in Nepal to allow certain recommendations for improving crop production. The benefits of utilizing an early planting date are clearly established. The seasonal history of this common pest have been elucidated and thermal unit studies allow predictions of when to expect moth peaks. Experiments show that C. partellus can be effectively suppressed in maize when pesticide treatments are properly synchronized with the vulnerable pest stage. A relatively safe pesticide, such as carbaryl, could be recommended to the growers. There are sufficient potential sources of resistance to C. partellus in various maize germplasm available in Nepal which could be used to develop more resistant cultivars. The C. partellus population in Nepal differs in certain biological properties from most recorded in the literature and thus may be different biotype.

STUDY ON THE FIELD BIOLOGY OF MAIZE BORER (CHILO PARTELLUS SWINHOE)

- B.R. Palikhe*

Abstract

Study on the field biology of maize borer, Chilo partellus, Swinhoe was carried at Nepalganj Agriculture Station, Khajura during monsoon season since 1981. So far as the larval peak is concerned, it occurred more or less at the same time in both years (1981 - 1982), nature of the insect population fluctutation being largely dependable to the weather condition.

Introduction:

Generally speaking, maize is liable to be damaged by different types of insects of which the maize borer (Chilo partellus) is the most destructive and widespread species in cultivated maize. The infestation of this insect varies from location to location depending upon the climatic condition. The eggs are layed in cluster in upper or under side of the leaf. The damaging stage is the larval stage. The young larvae after hatching first of all feed on tender parts of the leaf tissues and mid rib and move towards the central whorl of the plant and start feeding on the tender growing part of the plant and gradually kill the central shoot of the plant, thus creating dead hearts. If plants are grown up, the ears are also liable to be damaged. Dead-heart appears only after the severe damage at the growing point of the maize plant. While entering the shoot, the initial feeding of the larvae on the whorl gives rise to numerous pin-holes on the leaves.
The important symptom to identify the borer larvae is the presence of the of the exit holes, tunnels in the stem and pin-holes on the surface of the leaves. The main objective of the study on the field biology of maize borer is to determine the periodic occurrence and to know the proper time of insecticidal application against the maize borer.

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Materials and Methods:

This trial was planted during monsoon season of 1982 at Nepalganj Agriculture Station, Khajura. Twelve rows per plot (90 m^2) were planted with two kernels per hill having one plant per hill after thinning. Plant to plant and row to row spacing was 25 cm and 75 cm respectively. This trial consisted of 8 plots of 90 m^2. Half the N and all P_2O_5 and K_2O was applied (60:60:40 kg NPK/ha) at the time of planting and rest of the N (60 kg/ha) was top-dressed at knee-high stage of the crop. Seed rate and other cultural practices were used as recommended for normal maize crop. After germination, a regular visit was made in the experimental plots of the maize so as to observe the deposition of the eggs layed inside the leaf sheath and initial attack of the borer. As the infestation was found, 10 plants from each plot were selected randomly and examined carefully in order to determine the number of egg masses and their position (upper or lower surfaces). The plants were dissected to find out larvae, pupae, pupal cases, length of tunnel made by borers in each plants from each plot separately. Observations were taken at an interval of 10 days and 8 such observations were recorded upto the harvesting period.

Results and Discussions:

The oviposition of the borer was found 23 days after planting. The egg masses were layed in clusters overlapped like scale and creamy white coloured when fresh. Larger percent 76.2% of the egg masses were found layed on the upper surface of the leaves at mid rib near the sheath and 23.8% of the egg masses on the lower surface at mid rib and margin of the leaves. But in 1981, the position of the egg masses recorded were 80.7% on the upper surface and 19.3% on the lower surface. Altogether 158 egg masses were observed in the experimental plots. The average number of eggs per egg masses was found to be 15.4 and the range of eggs per mass was 4 to 38. Larval peak period and larval infestation differed at the different stage of the plant growth. Average larvae per plant at the peak were 1.58 and 1.10 and the larval peak reached 45 and 55 days of maize respectively (table 1). In 1981, the average larvae per plant were found to be 1.03 and the peak of the season 52 days (table 1). It reveals that the larval peak period were almost at the same

stage of the plant growth in both the years. In 1981, the larval peak was between 42 - 52 DAS and in 1982 the peak was between 45 - 55 DAS. The number of larvae and the average larvae per plant in the experimental plots were higher in the year 1981 probably because of favourable weather condition. Plant infestation level by borers was 62 - 73% during the peak period. The other larval peak period was also observed at 85 DAS. This peak probably was due to the third generation of the borers.

Pupae were found on 45 DAS and the pupal peak (1.12) was observed 65 DAS (table 1). Larval period in the laboratory condition was recorded 25 - 30 days and pupal period varied from 7 - 10 days. Life-cycle was completed in 6 - 7 weeks but this period may be prolonged in the cold weather.

Summary and Conclusion:

On the basis of observation at Nepalgunj, it is clear that the nature of the insect being dependable to weather condition. Under favourable environmental condition, the sensitive and voracious larvae may cause high infestation to the growing maize plant. Number of egg masses observed on the upper surface were found more compared to the lower surface. The peak of the larvae was found more or less at the same time in both the years.

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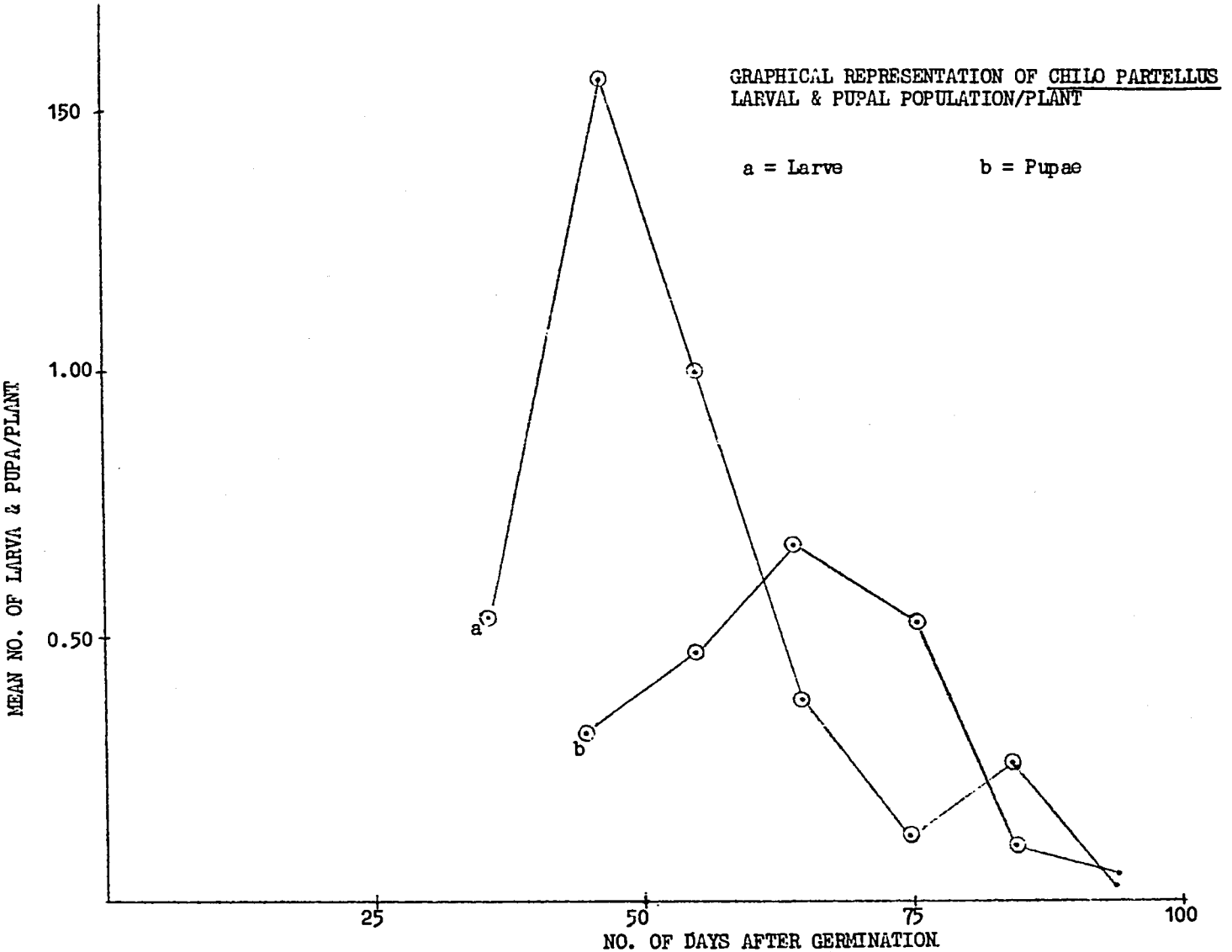
Table 1 Borer Population at Different Stages of Plant Growth of Maize At Nepalganj

Year - 1981			Year - 1982		
Days After Planting	Mean Larvae/ Plant	Mean Pupae/ Plant	Days After Planting	Mean Larvae Per Plant	Mean Pupae Per Plant
22	0	0	25	0	0
32	0.49	0	35	0.51	0
42	0.55	0.05	45	1.58	0.31
52	1.03	0.49	55	1.10	0.50
62	0.44	1.15	65	0.37	0.68
72	0.25	0.88	75	0.13	0.56
82	0.35	0.20	85	0.25	0.12
92	0.02	0.31	95	0.01	0.02


GRAPHICAL REPRESENTATION OF CHILO PARTELLUS
LARVAL & PUPAL POPULATION/PLANT
a = Larve
b = Pupae
150
1.00
0.50
MEAN NO. OF LARVA & PUPA/PLANT
a
b
25
50
75
100
NO. OF DAYS AFTER GERMINATION

FIELD TEST OF MAIZE GERMPLASM AGAINST CHILO PARTELLUS, SWINHOE UNDER NATURAL INFESTATION

- Bhimsen K.C. and
Beena Pant*

Abstract

Two set of trials were conducted at Khumaltar Entomology Research Farm, Khumaltar in summer season of 1982. Arun-2 tested against Khumal Pahenlo, Rampur-1 showed no significant difference so far as borer leaf injury is concerned. But, same variety revealed significant difference with Rampur-1 at tunnel length (11 cm/plant) and grain yield (4031 kg/ha).

Introduction:

It is well-known fact that certain germplasm are less attacked by a given insect-pest than other because of natural resistance on that crop/plant. Hairyness, hardness, thickness of stem / epidermis of leaf, plant vigour, in term of speed of growth, early maturity, unpalatability of the cell-sap etc are some of the characters that are known to contribute resistance (Athwal, 1976).

The present study was carried out to determine the characters related to borer resistance. On identification of gene source, the characters could be transmitted to hybrids / synthetic and further that would be stabilized for their performance.

Materials and Methods:

Field tests were conducted at Khumaltar Entomology Research Farm, during summer season of 1982. Experimental design was paired plot technique. There were two sets of trials with eight (8) paired plots. First one was consisting of three varieties of maize namely Khumal Pahenlo, Rampur-1 and Arun-2 while

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in second set two exotic germplasm obtained from CIMMYT, Mexico were planted. The plot size, row and plant spacings were 5 X 4.5 m^2, 75 cm, and 25 cm respectively. The maize was seeded on May 10, 1982. The fertilizer doses and intercultural operations were given as per the recommendation.

Borer leaf injury were rated by following 1-9 scale. All plants of central 2 rows were taken into consideration. Such rating were recorded on June 15 and June 30, 1982. The grain yield and tunnel length were noted at and after the harvest of the crop (Sep 15, 1982). For noting internal damage of borer (tunnel length), five randomly selected plants from each plot were dissected and tunnel length was measured.

Results and Discussions:

Results on borer infestation and grain yield of three varieties viz Khumal Pahenlo, Rampur-1 and Arun-2 are given in table 1. Table 2 presents the external and internal injury of maize borer on exotic germplasm. The meteorological parameter are given in table 3. It is clear from table 1 that the cumulative mean leaf injury recorded at 30 and 45 days after germination showed no significant difference while Arun-2 showed longer tunnel length (11.4 cm/plant) as compared to Rampur-1 (4.8 cm/plant). However, the grain yield of Rampur-1 was the highest (4031 kg/ha) over Khumal Pahenlo (2982 kg/ha) and Arun-2 (2706 kg/ha). Exotic maize germplasm indicated the differential maize borer attack which was significant at 0.05 probability level. The two variables leaf injury and tunnel length were found higher in TL 81B, 503 # MBL Dent than PR 81 B, 502 # Int. Vet. 181 Flint.

Summary and Conclusion:

The mean leaf injury caused by maize borer, Chilo partellus (Swinhoe) varied from 1.67 in Rampur-1 to 2.06 in Arun-2 received higher damage as compared to other varieties but even this higher value is below 3.0 rating. So, considering this criterion, all the three varieties seem to be less susceptible to borer at Khumal condition.

The tunnel length shows that Arun-2 was susceptible at late stage. The grain yield was the highest in Rampur-1 (4031 kg/ha). The result further confirms the result of Mishra (1981). The exotic germplasm revealed similar borer response as in Khumal Pahenlo, Rampur-1 and Arun-2. PR 81 B, 502 # Ant. Vet 181 Flint found better than TL 81 B, 503 # MBL Dent.

Acknowledgement:

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Table 1 Comparison of Arun-2 with Two Recommended Varieties Against Maize Borer at Khumaltar Under Natural Infestation (1982)

Pair of Plots	Leaf Injury Rating+			Tunnelled Length(cm /plant)			Grain Yield(g/Plot) 22.55 m^2 at 15% M.L.*		
	Khumal Pahenlo	Arun-2	Rampur-1	Khumal Pahenlo	Arun-2	Rampur-1	Khumal Pahenlo	Arun-2	Rampur - 1
1	1.45	2.53	1.90	6.0	15.8	2.0	7.0	8.0	9.7
2	1.63	1.79	1.74	10.6	5.0	0.0	8.0	7.7	11.0
3	1.53	2.29	2.25	2.8	7.6	8.8	5.8	5.5	8.8
4	2.20	2.13	1.35	15.0	6.4	6.6	5.4	6.2	9.5
5	2.36	2.76	1.90	16.8	3.0	5.0	7.2	5.2	7.4
6	1.86	1.60	2.03	7.6	7.6	1.0	6.4	4.5	11.5
7	3.12	1.88	1.75	4.4	28.2	12.0	6.0	5.6	7.2
8	1.93	2.03	1.35	2.8	18.2	3.0	7.9	6.0	7.5
Mean	2.01	2.06	1.67	8.25	11.47	4.8	6.71	6.09	9.07
F-Test	NS	NS	NS	NS	NS	S	NS	NS	S

NS = Non-significant at 0.05 probability level
S = Significant at 0.05 probability level
+ = Leaf Injury Rating was the mean of two observations (early whorl and mid whorl stage)
* = M.L. = Moisture Level.

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Table 2 Mexican maize germplasm tested against maize borer at Khumaltar

Pairs of Plots	Mean Leaf Injury		Tunnel Length (cm/Plant)	
	Germ-A	Germ-B	Germ-A	Germ-B
1	2.13	1.56	13:00	01.60
2	2.67	2.66	7.00	02.00
3	2.11	1.33	11.00	10.70
4	2.20	1.50	11.60	06.40
5	2.33	1.30	06.60	03.00
6	2.33	1.42	22.00	09.00
7	2.16	1.30	18.60	13.20
8	1.96	1.00	16.80	04.00
Mean:	2.23	1.51	13.32	06.23
T-Test	S		S	

Germplasm A = TL 81 B, 503 # NBL Dent
" B = PR 81 B, 502 # Int. Vet. 181 Flint

Meteorological Data at Khumaltar

Year 1982

Month	Week	Temperature (°C) Maximum	Minimum	R.H. %	Rainfall (mm)
April	1st	26.23	10.93	39.75	0
	2nd	26.05	8.30	35.14	0.55
	3rd	24.30	10.82	57.0	2.98
	4th	25.05	11.02	48.62	10.56
May	1st	27.15	12.91	44.00	3.43
	2nd	25.51	18.72	73.57	13.42
	3rd	27.62	18.55	68.57	0.78
	4th	27.27	18.21	69.25	1.66
July	1st	27.71	19.78	72.5	8.13
	2nd	27.45	19.71	73.5	6.00
	3rd	27.7	19.63	69.5	3.37
	4th	26.5	20.50	78.0	10.52
August	1st	26.97	19.53	71.12	15.47
	2nd	27.58	20.25	70.87	8.56
	3rd	27.47	19.78	66.62	7.93
	4th	26.15	19.22	74.28	13.42
September	1st	27.15	18.92	69.50	6.23
	2nd	25.30	18.42	77.25	7.57
	3rd	24.80	17.57	77.85	4.38
	4th	25.98	14.71	57.85	0.0
October	1st	25.07	12.70	55.00	0.0
	2nd	24.56	10.22	54.00	2.56
	3rd	24.03	13.37	57.00	0.17
	4th	24.40	10.65	46.00	0.0

Source: Agronomy Division, Khumaltar

Monthly Average

April	25.40	10.26	45.13	3.52
May	27.30	13.60	45.50	3.9
June	26.99	19.06	68.81	4.73
July	27.34	19.90	73.37	7.00
August	27.04	19.69	70.72	11.33
September	25.80	17.40	70.61	4.54
October	24.51	11.73	53.00	0.68

FIELD TEST OF MAIZE GERMPLASM

M.P. Upadhyay : Have you tested some of the important local germplasm against Chilo partellus ?

Pant : Our previous study has shown that most of the local germplasm are highly susceptible to Chilo partellus and hence our test was limited to Arun-2, Rampur-1 and Khumal Yellow varieties only.

R. Freed : Is the significant yield difference between Rampur-1 and Arun-2 due to Chilo partellus of their genetic yield potential ?

Pant : The difference is the combined effect of insects, genetic yield potential and several other unrecorded factors.

PEST INCIDENCE IN MAIZE AND SOYBEAN INTERCROPPING TRIAL

- Bhimsen K.C., and
Beena Pant*

Introduction:

Bio-ecological practice is one of the practices which has been proved as an important component in pest control strategy. It is more suitable to Nepalese farming systems particularly in remote areas. In the Hills, the population pressure is high while the cultivable land per farm family is far less than required. On the other hand, there are two types of farming systems prevailing in Nepal. The first one is monoculture where one crop is grown over time and space. The second being the mixed farming where more than one crop is being cultivated in the given piece of land. These two types of farming present entirely different agro-ecological situation.

Under monoculture, the same crop is available in a season over large stretches of land. This provides ample food and causes a fast multiplication of pest and the biology of the pest is well adjusted or synchronized with the crop growth. The other biotic and abiotic factors (climate and natural enemies) also determine the population build-up of the given species.

In the mixed farming, the popular maize based cropping patterns were observed as maize-soybean, maize-potato, maize-ginger etc. The companion crop is selected according to the problem. The selection is based upon the common observation about problem and the experience of the farmers. The sole objective of the crop combination is just to increase the production per unit land. Maize-soybean in Khumaltar (Pathic et al., 1980) and maize-fingermillet in Lumle (Sen and Sthapit, 1981) gave higher production over sole crop. Soil fertility improvement, soil and water conservation and crop insurance against pest epidemic are other mentionable advantages of

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suitable cropping pattern for sustained production. The cropping systems program under Agronomy Division is trying to evolve suitable and profitable cropping pattern to particular environment or agro-climatic zone. Due consideration is also given to minimize costly inputs such as the use of fertilizer and pesticides. The Entomology Division is quite aware of the major pest of maize and soybean. The losses caused by the pests (borer along with other insect in maize, hairycaterpillar in soybean) have also been determined in respective crop. This study was planned to understand the effect of different cropping pattern on the major pest of each component crop.

Materials and Methods:

The experiment was conducted in Entomology Research Farm, Khumaltar. It was designed as completely randomized block design with four replications. The plot size was made 6 X 5 m^2 as to fit different types of spacings. The treatment combinations cultivated varieties, fertilizer doses and spacing were as follows:

Treatment Combinations

1. Improved Maize + Improved Soybean
2. Improved Maize + Local Soybean
3. Local Maize + Improved Soybean
4. Local Maize + Local Soybean
5. Improved Maize (Mono crop)
6. Local Soybean (Mono crop)

	Crop	Variety	Seed Rate (kg/ha)
1.	Improved Maize	Khumal Pahenlo	20
2.	Local Maize	Dhapakhel Local	20
3.	Improved Soybean	Hardee	60
4.	Local Soybean	Local Sathiya	60

Fertilizer (Rs/ha)

		N	P_2O_5	K_2O
1.	Maize + Soybean	80	60	40
2.	Maize Improved	100	60	40
3.	Maize Local	80	60	40
4.	Soybean	60	60	40

	Crop Combination		Spacing	Rows/Plot
1.	Improved maize monoculture	=	75 X 25cm	8
2.	Local maize monoculture	=	60 X 25cm	10
3.	Maize+soybean intercropping	=	100 X 20+50 X 5 cm	6

Observation:

Observations were recorded on major pests of maize and soybean. The gross yield and economic return were evaluated against each treatment combination. The data on maize borer and soybean hairycaterpillar were recorded as percentage of infestation.

In addition to these pests, the grasshopper was another target species and found defoliating both maize and soybean. However, in this experiment, attempt was made to count the insect number per plant. The percent insect infestation and insect count were transformed to angular and square root values respectively. The analysis of variance was done as described by Gomez (1976).

Results and Discussions:

Results on maize borer, Chilo partellus (Swinhoe); soybean hairycaterpillar, Spilarctia casignata Koll; grasshopper, Hieroglyphus banian Fabricus, along with absolute yield (Maize+soybean) and gross economic return (Rs/ha) are presented in table 1.

The borer infestation was recorded at 30 and 45 days after germination (DAG) of maize. The first observation showed no significant difference

among the various treatments but overall higher percentage of damage (4.8 - 7.5) was recorded as compared to the second one (2.8 - 6.5). This observation was found to be statistically significant.

Hairy caterpillar defoliated the soybean plant at 60 DAG. The damage percentage ranged from 17.5 (T6) to 25.5 (T2). It was considered as medium type of damage and should have contributed in the reduction of crop yield. Grasshoppers were found more in shady environment (1.99-2.89/plant) than the non-shady places (1.55/plant). However, the statistical analysis revealed no significant difference between two types of environments.

The yield of component crops were added in the plot. They were converted to kg/ha and recorded as absolute yield. The highest (4297 kg/ha) and lowest (411.5 kg/ha) yield were harvested in T1 and T6 respectively. As there was difference in market value of maize (Rs 2/kg) and soybean (Rs 3/kg), the gross economic returns were calculated accordingly. While doing so, the range of economic return were obtained as Rs. 1,240/ha to Rs 8,520/ha (table 1).

Summary and conclusion.

Borer infestation in maize was below 10 percent in both the observations and this could be considered as non-significant infestation so far as economic loss was concerned. Hairy caterpillar and grasshopper chose the shady places as their habitat. Absolute yield was 10 times and 2 times higher in T1 (Improved maize + Improved soybean) as compared to monoculture soybean and improved maize respectively. This result was similar to the result obtained by Pathic et al. (1981).

Acknowledgements:

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Table 1

Maize + Soybean Trial at Khumaltar, 1 9 8 2

Treatment Combination	Borer Infestation(%) 30 DAG	Borer Infestation(%) 45 DAG	Hairy Caterpillar Infestation 60 D.A.G.	Grasshopper Count/Plant Soybean V X+0.4	Maize+Soybean (Kg/ha)	Gross Economic Return (Rs/ha.)
T1 Improved maize+Improved soybean	6.4	2.8 a	26.6	2.89	4279 d	8520 d
T2 " " + Local Soybean	5.7	6.8 c	25.5	2.57	3288 c	7236 cd
T3 Local maize+Improved "	6.0	5.2 bc	21.2	1.97	3251 c	8520 d
T4 " " + Local "	7.5	6.5 c	21.7	1.99	2466 bc	5632 bc
T5 Improved maize	4.8	4.1	-	-	2227 b	4440 b
T6 Local soybean	-	-	17.5	1.55	411 a	1240 a
F-test	NS	HS	NS	NS	HS	HS
CV %	40.6	12.5	20.6	43.0	23.3	29

Means followed by same letter are not significantly different at 0.05 probability level by DMR test.

NS = Non-significant

HS = Highly Significant

Mean of four replications

Sowing Date: May 10, 1982

Harvesting

Date : Sep 15, 1982

DAG = Days After Germination.

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DETERMINATION OF MOISTURE RESISTANT CONTAINERS, SEED MOISTURE CONTENT FOR MAINTAINING THE GERMINABILITY OF MAIZE SEED FOR A PERIOD OF STORAGE UNDER AMBIENT STORAGE CONDITION

- Kamlesh Lata Rajbhandary,*
Binay K. Batsa, and
Devki Shrestha

INTRODUCTION:

Maize is now grown round the year as monsoon, winter and spring crop in Terai, Inner Terai and Foot-Hill. Even for seed, it is produced in winter season because of a number of desirable factors like proper isolation, less incidence of diseases and insects, good yields. However, maize harvested in April-May can hardly be distributed by Agriculture Input Corporation (AIC) for the immediate monsoon crop. Hence, a major portion of the seed has to be stored over wet season under ambient condition when the temperature and humidity are high. Under such circumstances, AIC is facing a major constraint of supplying maize seed with high germination and vigour. It has rather frustrated AIC to expand the seed multiplication in winter. To improve this situation, a number of studies have been initiated by the Agriculture Botany Division, Seed Technology and Improvement Program in collaboration with NMDP since 1975. The present studies were conducted to determine the economical and appropriate gauge of polyethylene and tin cans with lids at different seed moisture level for a period of storage under ambient condition at Rampur and other similar environment.

It has been pointed out that seed moisture content and storage temperature are the most important factors affecting seed longevity, with seed moisture content usually more influential than temperature. Harrington (1959) gives two rules of thumb which are of general validity. It states (i) for each 1 percent increase in seed moisture, the life of the seed is halved (applicable from 5 to 14 percent seed moisture), ii) for each 5 °C increase in seed temperature the life of seed is halved (applicable between 0 °C and 50 °C). Roberts (1960) states that in cereals, a decrease in either

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temperature or moisture, increases the longevity of seed. An ideal condition is maintained in the controlled storage by providing insulation, moisture-proofing, refrigeration and dehumidification. But the cost of building and maintaining such an ideal storage is too high and is not economically feasible even in the well-developed countries except for valuable germplasm. In recent years, more emphasis is given on the control of seed moisture which is influenced by the surrounding relative humidity. The use of moisture-barrier containers to keep seed at a safe moisture level. Oren L. Justice and L.N. Bass (1978) report that there is increasing awareness of savings in time and expense and suitable moisture-barrier containers are used for storing valuable breeding stocks.

Harrington (1963) demonstrated the value of moisture-proof containers in increasing the seed longevity under high humidity conditions and showed the relative resistance of various containers to moisture penetration.

Research has shown that sealed storage prevents the loss of viability of corn seeds provided their moisture is sufficiently low when the seeds are sealed (Kainara, 1951; Barton, 1960b). The result of Oregon Experiment indicated that 10 percent moisture content in corn can be considered safe for 3 years of sealed moisture-proof storage under moderate temperature (Ching, 1959).

Baskins and Deloucke (1970) found polyethylene bags superior to cloth and paper in maintaining longevity in corn (Zea mays L.), wheat and soybean stored at 85 °F and 85 percent relative humidity.

Rajbhandary, K.L. (1969) found cloth bag, paper bag and gunny sacks with 250 gauge polyethylene liner superior to one without lining for carry over of maize seed up to second planting season under Khumaltar condition. Gunny sacks with 250 gauge poly-liner was found to be superior to 100 gauge poly-coated gunny sack and gunny sack in maintaining germinability of maize for a period of storage at Rampur (Rajbhandary, K.L. and R.P. Uprety 1977 and 1979).

MATERIALS AND METHODS:

Two studies were carried out at NMDP, Rampur. The first study was conducted in Chaitra 1, 2036 (March 14, 1980) and continued till Baisakh 2038 (May 1981). The second study was started in Chaitra 12, 2037 (April 1981) and terminated in Bhadra 2039 (August 1982).

Freshly harvested Rampur Pahenlo maize seed was used in the first study whereas Khumal Pahenlo was used in the second study. Percent of moisture level was adjusted to 10.4, 11.2 and 11.7 by sun-drying but in the second study it was adjusted to 10.4, 11.2, 11.8 and 12.7.

The following storage containers and the capacity were used:

Containers	Capacity
1. Gunny sacks with 200 gauge polyethylene liner	10 kg
2. Gunny sacks with 250 " " "	10 kg
3. Gunny sacks with 300 " " "	10 kg
4. Gunny sacks with 350 gauge " "	8 kg
5. Tin cans	6 kg

Container no. 1 to 3 were used in the first study while all the five types of containers were used in the second study. The capacity was only 8 kg. Seeds were treated with Thiram and Cyathion at the rate of 2 gm/kg of maize. Samples were drawn for checking germination, disease and insects. The polyethylene liners were heat sealed and the gunny sacks were tied with a jute thread. The tin cans had a tightly fitted lid. All the treatments were replicated 4 times and were placed at random on the wooden pallet in an ordinary storage. The storage was made up of brick-walls and cement plastered. The size of the room was 6.0 m X 4.5 m X 3.0 m and the plinth was 0.50 m high. It had North-South facing with fitted glass windows. The storage remained closed most of the time except weekly changing graphs in the Hygrothermograph and during sampling at approximately 60 days interval. However, in case of the first study, the storage used to remain opened most of the time and samples were also drawn at 30 days interval and during the storage period, the treatments had been moved from one storage to another one.

The fourth replications in each treatment was sampled only after 365 days in the first study and after 400 days in the second study i.e. only at the time of second monsoon planting.

Germination test and determination of moisture content were done according to ISTA (ISTA rules, 1976) in the Central Seed Testing Laboratory, Khumaltar. Air dry oven method on wet weight basis was followed for moisture testing. Checking for disease and insects were done at Plant Pathology Division and Entomology Division, Khumal respectively besides the visual observations at the seed testing laboratory.

RESULTS:

The results of the first study and the second study are presented separately in Table 1 to 5 to have better picture. For the ease of comparison average moisture in percent are given for every 60 days although they have been checked at 30 days interval in case of first study (Table 1).

In case of Tables 3 to 5, mean temperature in °F and percent relative humidity prevalent in the storage, are also presented for the information on the ambient condition of storage.

It is quite clear from Table 1 that during 390 days of storage, there is fluctuation of +3.4 to -0.4, +2.6 to -0.7 and +2.9 to -0.9 percent moisture and 25%, 50% and 40% reduction in germination in case of the gunny sacks with 200 gauge poly-liner at 10.4, 11.2 and 11.7 initial moisture content respectively. The gain in moisture percentage and fall in germination percentage are obvious after 180 days of storage i.e. after the month of Bhadra (August). The same Table indicates that there is fluctuation of -0.5 to +1.6 percent of moisture content in other two treatments irrespective of the difference in gauge of polyline. Similarly, there is 2 to 7% and 2 to 12% reduction in germination in case of gunny sacks with 250 and 300 gauge liner respectively.

It is obvious from Table 2 that during 390 days of storage, there is variation of -0.7 to +1.2; -0.8 to +0.9 and -0.7 to +0.9 and -0.8 to +0.6 in case of gunny sacks with 200 gauge, 250 gauge, 300 gauge and 350 gauge poly-

liner irrespective of the initial moisture content. Hoever, there is increase of 0.3 to 1.4 percent in moisture content in case of tin cans. It is also clear from the same table that during 510 days of storage, there is variation of -0.9 to +1.0, -0.9 to +0.9 and -1.0 to +1.4 in case of gunny sacks with 300 gauge, 350 gauge polyliner and tin can respectively and in other two treatments, the fluctuation is same as in 390 days of storage.

Table 3 indicates that during 390 days of storage, there is 1 to 6% fall in germination (from 99-98% and from 99-93%) irrespective of the treatments. However, during 510 days of storage, there seems to be maximum 10% fall in germination upto 11.8% initial moisture content irrespective of the gauges of polyliner. Above 12% moisture, there is maximum 14% reduction in germination. In case of tin cans, there is more than 10% fall in germination beyond initial 11.2% moisture.

Table 4 presents the changes in germination and moisture content after 365 days of sealed storage. In case of gunny sacks with 200 gauge polyliner, one at 11.2 initial moisture was torn and completely damaged by rat, other two at 10.4% initial more were also torn and in one of them moisture level has risen to 14% and germination has gone down to 45%. The fourth one at 11.7% moisture level was also slightly torn, however, the moisture has risen by 1% only. The gunny sacks with 250 gauge and 300 gauge polyliner at 11.2 initial moisture were also found to have very few pin holes otherwise rest of the bags were intacted. However, there is 0.5 to 1.1% increase in moisture in the gunny sacks with 250 and 300 gauge polyliner irrespective of the initial moisture. Regarding the retention of the germination in case of gunny sack with 200 gauge polyliner, it dropped down to 90% from 99% while in other treatments it fell down from 99% to 94% only.

In Table 5, germination and moisture content at 400 days of sealed storage and also average storage temperature and relative humidity are also given. Gunny sacks with 200 gauge polyliner at 11.2 initial moisture percentage was damaged by rat. It is clear from the table that during this period there is reduction of 0.2 at 10.4% initial moisture to 0.9% at 12.7% initial moisture

in gunny sacks with 200 gauge polyliner and the germination has dropped down by 4% (maximum). In case of gunny sacks with 250 gauge polyliner, moisture percent is reduced by 0.3% or 10.4% initial moisture level and to 1.1% at 12.7% initial moisture level while the germination percent has dropped by 3%. However, in case of gunny sacks with 300 gauge polyliner the initial moisture content at 10.4% seems to remain constant but there is 1.1 Percent reduction at 12.7% initial moisture content and the germination has dropped by 5% and 4% respectively. But in case of tin cans, there is the slight fluctuation of -0.4% in moisture level over the initial.

Samples were checked for insects and diseaes at the initiation of the studies and were reported to be free from any infestation. They were again checked after 365 days of storage and in the first study, 3 replications of gunny sacks with 200 gauge polyliner were reported to have slight infestation by grain weevil. But no obvious damage to the seed was observed.

DISCUSSIONS:

The ambient storage condition seems to be far from ideal, the temperature in °F and the percent relative humidity added together being minimum 137.8 and maximum 176.17 for 510 days of storage. Harrington's (1960) thumb rule states "the sum of the temperature in °F and the present relative humidity should not exceed 100" and is ideal for storing seeds upto 5 years under such adverse co condition of storage, gunny sacks with 200, 250, 300 and 350 gauges polyliner as well as tin cans and the percent initial moisture level at 10.4, 11.2 and 12.7 seem to be quite satisfactory upto the end of the studies except in case of gunny sacks with 200 gauge polyliner in the first study. The superiority of polyethylene bags have been reported by many in corn*.

When the results of the two studies are compared, it is obvious that in the first study, there is fluctuation on -0.4 to +3.4 moisture in case of gunny sacks with 200 gauge polyliner whereas in the second study, it is observed to be -0.7 to +1.2% only. The big difference might be due to the damage of bags while handling in the first study. Anyway, it seems that they are not strong enough and get torn even in normal handling. If the moisture protection in the gunny sacks with different gauges of polyliner are compared,

* - Harrington, 1963; Baskins and Delouche, 1970; Rajbhandary, K.L. 1969; Rajbhandary, K.L. and R.P. Upreety 1977 and 1979.

the difference seems to be only ±0.5. These gauges of polyliner do not seem to provide very much moisture protection when compared with tin cans sampled only after 400 days of storage. In tin can, the difference in moisture seems to be only ±0.4 from the initial moisture percent although it was not sealed.

Germination percentage seems to remain almost same below 12% moisture level but above 12% moisture, there is a gradual reduction. But above 13.5% moisture there seems to be rapid drop in germination (Table 1). It agrees with former findings (Rajbhandary and Uprety, 1979). Results, thus, clearly indicate that moisture content is more critical than the temperature. It should remain low i.e. below 12% and should not fluctuate more than about ±1.4 for all the period of storage for the retention of germination. It also agrees with the findings (Barton 1961; Harrington 1972). Cyathion dust is observed to be quite effective in all the treatments having moisture percent below 12.5. It was reported by Rajbhandary and Uprety (1979). Lochner (1962) has also reported the same type of effect of malathion dust in maize. Although the germination has dropped in gunny sacks with 200 gauge polyliner beyond 13% moisture no fungal invasion was found. It agrees with Sauer and Christensen (1968) who reported low germination in corn, not consistently associated with high kernel infection by storage fungi. Christensen (1973) also reported loss of germination at the higher humidity level was comparatively more at 30 °C than at 20 °C although fungal invasion was higher in the latter.

One kilogram of polyethylene bag costs Rs30.00 at present at Patan Industrial Estate. Accordingly each bag of 200 gauge, 250 gauge, 300 gauge, and 350 gauge of polyethylene of 10 kg capacity costs Rs0.52, Rs0.60, Rs0.69 and Rs0.77 respectively.

CONCLUSIONS:

Among gunny sacks with 200, 250, 300 and 350 gauge polyethylene liner, gunny sacks with 250 gauge polyethylene liner is found to be economical and appropriate. However, considering the handling during transportation, one with 300 gauge polyliners will be better although it adds about eight paisa more for 10 kg of seed.

Tin cans will be suitable for small handling and for farmers' condition. A number of tin cans can be used instead of an expensive metal bin adjusting to one's own seed requirement. Besides that, seed deterioration in one container won't hamper the whole lot.

Winter maize seed with high germination, dried below 13%, treated with Cyathion dust at the rate of 2 gm/kg of seed, if packaged in gunny sack with minimum 250 gauge polyliner and sealed, can be stored safely upto the second winter crop (510 days) without testing for germination at intervals, provided the packages are intact.

These findings can be recommended for Rampur and for similar and better ambient environments. Furthermore, seeds so packaged can be transported through and into warm humid areas.

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Table 1: Average Germination and Average Moisture Content for Various Period of Storage in Different Gauges of Polylined Gunny Sacks Under Ambient Condition, Rampur (036-038)

Period of Storage Days	* 200 Gauges Polylined Gunny Sacks						250 Gauges Polylined Gunny Sacks						300 Gauges Polylined Gunny Sacks					
	M %	G %	M %	G %	M %	G %	M %	G %	M %	G %	M %	G %	M %	G %	M %	G %	M %	G %
0	10.4	99	11.2	99	11.7	99	10.4	99	11.2	99	11.7	99	10.4	99	11.2	99	11.7	99
60	10.0	99	10.5	100	10.8	98	10.2	99	10.8	99	11.2	98	10.1	99	10.9	99	11.5	98
120	11.0	98	11.2	96	11.6	96	10.8	99	11.3	97	11.5	96	10.6	98	10.9	97	11.2	97
180	12.1	88	12.2	90	13.1	88	10.9	98	11.7	97	12.0	98	11.2	97	11.7	94	12.0	94
300	13.8	76	13.8	65	13.6	81	11.8	97	12.0	94	12.2	94	12.0	96	12.1	93	12.4	87
360	13.0	76	13.2	50	14.2	53	11.4	97	12.1	94	12.0	93	11.8	95	12.5	95	12.5	93
390	12.9	74	13.1	56	13.5	54	11.2	98	12.0	95	11.2	92	11.4	97	11.6	88	12.3	94

N.B.: M = Seed Moisture Content, G = Germination Capacity
* - Most of the bags were torn and changed in September 1980.

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Table 4: Germination and Seed Moisture Content in Percent After 365 Days of Storage in Different Gauges of Polylined Gunny Sacks Under Ambient Storage Condition, Rampur (036-037)

Initial Moisture Percent	Initial Germination Percent	200 Gauge Polylined Gunny Sacks		250 Gauge Polylined Gunny Sacks		300 Gauge Polylined Gunny Sacks	
		Moisture Percent	Germination Percent	Moisture Percent	Germination Percent	Moisture Percent	Germination Percent
10.4	99	+ 12.3	93	11.0	98	11.0	97
11.2	99	——	——	*12.0	94	*12.3	96
11.7	99	12.7	90	12.2	96	12.2	94

* - Few pin holes in the bag
—— Bags completely torn and seed damaged by rat.
+ - Bags completely torn and changed.

Table 2: Average Moisture Contents of Maize Seed Stored at 4 Initial Moisture Levels in Various Containers Under Ambient Storage Conditions for Various Period (037 - 039)

Storage Period	Changes in Moisture Contents After Storage at Indicated Container & Initial Moisture Level																				Mean Max. Temp.	Mean	Mean+
	200 G. Polylined Gunny Sack				250 G. Polylined Gunny Sack				300 G. Polylined Gunny Sack				350 G. Polylined Gunny Sack				Tin						
Days	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	(°F)	R.H.	M.T.+ R.H.
60	10.6	11.2	11.4	12.2	10.5	11.2	11.5	-	10.4	11.0	11.4	12.2	10.4	11.3	11.5	12.3	10.6	11.4	12.0	12.9	91.62	63.14	154.76
120	11.3	11.5	11.8	12.6	11.0	11.3	11.6	12.2	11.2	11.2	11.6	12.4	11.0	11.2	11.5	12.3	11.2	11.8	12.0	12.8	98.96	81.10	170.06
210	11.0	11.4	11.6	12.3	11.1	11.4	11.7	12.3	11.2	11.2	11.6	12.3	11.1	11.2	11.3	12.5	11.3	11.9	12.2	13.0	85.55	69.41	154.96
270	11.6	11.7	11.8	12.4	11.3	11.5	11.6	12.2	11.4	11.6	11.7	12.4	11.3	11.6	11.5	12.4	11.8	11.8	12.5	12.9	69.09	68.76	137.85
330	11.5	11.6	11.7	12.3	11.3	11.4	11.6	12.0	11.3	11.7	11.6	12.2	11.1	11.7	11.5	12.2	11.3	11.5	12.0	12.4	73.87	64.55	138.42
390	11.1	11.4	11.4	12.1	11.3	11.2	11.4	11.9	11.2	11.3	11.3	12.0	11.0	11.2	11.2	11.9	11.0	11.5	11.7	12.0	90.17	47.87	138.04
450	10.9	11.3	11.3	12.0	11.0	11.1	11.3	12.0	10.9	11.2	11.3	11.8	10.9	11.2	11.5	11.8	11.2	11.2	11.6	11.7	91.38	76.18	176.17
510	11.3	11.6	11.6	12.2	11.0	11.4	11.6	12.0	11.2	11.5	11.6	12.0	11.2	11.5	11.5	11.9	11.5	11.6	11.9	12.0	90.35	85.82	176.17

Table 3: Average Germination of Maize Seed at 4 Initial Moisture Levels After Storage in Various Containers Under Ambient Storage Conditions For Various Period (2037 - 2039).

Storage Period Days	Average Germination Percent After Storage at Indicated Container and Initial Moisture Level																				Ave. Max. Temp. (°F)	Ave. Relative Hum. %	Ave. Max. Temp.+ R.H.
	200 G. Polylined Gunny Sack				250 G. Polylined Gunny Sack				300 G. Polylined Gunny Sack				350 G. Polylined Gunny Sack				†in						
	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %	10.4 %	11.2 %	11.8 %	12.7 %			
0	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	85.93	56.50	142.43
60	97	98	97	98	97	97	98	99	97	99	96	99	98	99	99	98	100	99	98	98	91.62	62.14	154.76
120	97	96	97	97	98	97	97	98	99	98	97	97	95	98	98	98	98	97	99	97	88.96	81.10	170.06
210	98	98	96	98	95	98	99	96	96	97	97	96	98	97	98	97	97	97	96	96	85.55	69.41	154.96
270	97	98	99	97	98	96	98	97	98	98	98	98	97	97	98	98	96	97	96	97	69.09	68.76	137.85
330	98	99	97	97	96	99	98	96	99	98	97	97	97	97	98	98	99	97	97	97	73.97	64.55	138.12
390	95	95	93	98	96	94	95	95	97	97	98	95	94	97	98	97	96	96	93	97	90.17	47.87	138.09
450	97	96	96	94	95	96	96	94	94	96	96	96	96	97	95	95	98	97	95	97	91.39	76.18	167.56
510	92	89	94	86	91	90	92	85	89	92	93	85	95	90	94	88	92	90	85	88	90.35	85.82	176.17

Table 4: Germination Percentage of Maize Seed at 4 Initial Moisture Levels After About 400 Days of Storage in Different Container Under Ambient Storage Condition (037-38)

Initial Moisture Percent	Initial Germination %	Moisture Germination After 400 Days of Storage at the Indicated Container										Ave. Max. Temp. (°F) for 400 Days	Ave. R.H. for 400 Days %	Average T + R.H.
		200 G. Polylined Gunny Sack		250 G. Polylined Gunny Sack		300 G. Polylined Gunny Sack		350 G. Polylined Gunny Sack		Tin				
		Moisture %	Germination %	Moisture %	Germination %	Moisture %	Germination %	Moisture %	Germination %	Moisture %	Germination %			
10.4	99	10.2	96	10.1	97	10.4	96	10.4	96	10.0	96	83.59	64.47	148.06
11.2	99	-	-	11.1	97	10.9	94	11.0	96	11.2	97			
11.8	99	11.2	98	10.9	96	11.4	97	-	95	11.7	94			
12.7	99	11.8	95	11.6	97	11.6	97	11.7	96	12.3	98			

Sample damaged by rat.

SUMMER WEEDS IN NEPAL

- P.P. Regmi and
Jwala Bajracharya*

Introduction:

This paper primarily aims to throw some lights on the situation of summer weeds in Nepal with regards to the weeds flora aspect in particular and other related aspects in General. It should really prick our conscience to note that in the 30 years old history of our agricultural development, such an urging issue of weed has been as over-looked as to have not yeat received even a pinch of fully-hearted attention in the line of other plant protection science. It is well evident from the fact that in our something whimsically drawn-up cadre of plant protection schemes, while the other two sister organizations namely Entomology and Plant Pathology have been organized to the divisional status, the ill-fated subject of weed science is still not recognized as humble as in the project level. As far as organization is concerned, we can do whatever we like, whenever we like and in whatever manner we like. But as far as the universally accepted fact of weed science is concerned, we can hardly raise a single straw against it and the fact remains always a fact. After all, it is not the organization that counts but it is the enormity of weed science that matters much. So, any prejudicial or neglectful attitude of a single paisa towards this ever-nagging issue of weeds at present is sure to cost us Rupees in future. In order to work out systematic approach to the science of weeds and weed control, let us first utilize our sense of reasoning to accept that the actual state of affairs with weed science in Nepal just reminds the Churchillian phrase, i.e. the beginning of the beginning. The active development works on weeds and weed control should be based on three preliminary phases, i.e. overall scientific aspects of weeds, problematic aspect of weeds and management aspect of weeds. The first aspect should constitute morphology, anatomy, physiology, ecology,

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taxonomy and geography of weeds. The second aspect should look after the intensity and severity of infestation, the nature and extent of damage and the assessment and expression of losses in terms of quantity and quality of crop production, spoilage and damage to the property and the hazards to the health and life of man and animals etc. The third aspect should take care of managing weeds phyto-pests through experimentally guided safe and economic measures, not forgetting that the present day world is gradually shifting from control to utilization stage.

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Significance of Summer Weeds:

The ever worsening problem of weeds still persists as the most urging but the least appreciated of all the problematic aspects of our agricultural development in particular and others in general. As much as it is interesting to find agriculture in Nepal to account for more than 60 percent of the total national economy, it is in the same way more appealing to note that about 80 percent of the total agricultural output is held by the season-bound crop farming aspect of agriculture. Of the two major crop seasons - summer and winter, the summer season receiving more than 75 percent of the total annual rainfall commands 65-70 percent of the annual agro-horticultural crop types. We already realized that crop farming in a country like ours is usually found to precariously hanging around its production-protection axis, the two equally most deciding phenomena of crop agriculture always lying in the fore-fronts. While the production aspect calls for judicious application of production oriented inputs and improved technical know-hows, the protection aspect on the other hand, demands assurance for safe-guarding against the unfavourable conditions negatively affecting crop production. Such as unfavourable condition is usually brought about by the adverse climatic factors or by the hostile biological agencies such as zoological pests, diseases, and weeds or both of them at the same time. As for these

utilized our common sense to support this fact. Weeds being after all the same but unwantedly prevailing group of plants as a result of their unrestricted management by human agencies or growing and spreading through natural agencies, make use of the same environment surrounding them as their cultivated counterparts. The weeds associated with crop plants in the field in any season are competent enough to utilize the available moisture, nutrients, and light at the cost of crop plants. With a very meagre provision of irrigation, i.e. only to the extent of 20 p.c. of the total national cultivated area and so also only a small fraction of total annual rainfall received, moisture becomes a too limiting factor to make only a little room for crop farming in winter, thus leaving comparatively less scope for contemporary weed flora to compete with the crop. The summer crop season receiving $\frac{3}{4}$ of the total annual rainfall and so also the other environmental factors like temperature, humidity and day length turning out to be quite favourable for plant growth encourage quite a number of weed flora to grow and thrive to their best.

Hence, the summer weeds being lavishly tipped by the more favourable environs than those in the winter season, hold some added significance because of the following reasons:

1. Early summer to late summer annual weeds, enjoying the utmost privileges for their growth, development and dissemination exercise their maximum weedy influences.

2. Many of the perennial weeds, lying almost dormant in the winter season, come to life with the approach of summer and play their part enough to compete with the contemporary crops and pollute the surrounding area.

3. Most of the aquatic weeds, which are usually faded to die along with the drying up of their associated habitants, get enough rain-water accumulated.

4. Several weeds, with the dense tender foliage, serve as alternate hosts to insect pests for feeding, hiding, reproducing, transmitting diseases etc.

5. Quite a number of aquatic weeds at the prime of their lives during summer interfere in irrigation, fish-rearing etc., e.g. Eichhornia, Lemna, Spirodella, and few others.

6. Weeds provide safe lurking place for poisonous snakes like Cobra, Krait, etc.

Situation of Summer Crops in weed:

Summer crops accounts for nearly 70 percent of the total agro-horticultural crops of major importance excluding perennial trees, shrubs and woody climbers. This majority number of crops grown during summer accordingly requires greater area for cultivation of which rice alone occupies about 60 percent of the entire cultivated land. Thus with the greater number of crop types occupying greater area under cultivation, the summer crop season naturally makes easy access to greater variety of weed flora prevailing with greater intensity of infestation. Moreover, it is heartening to note that rice is the worst victimized of all the summer crops in respect of weed infestation such that at least 67 percent of the weed families of the summer season are associated with a single crop of paddy alone.

Table 1 Estimated Situation of Summer Crops

Particulars	Total Estimated No. of Annual Crops	Summer Crops	P.C. of Total	Winter Crops	P.C. of Total
Cereals	3	2	67	1	33
Millets	5	5	100	-	-
Pseudo-cereals	2	1	50	1	50
Pulses	18	11	60	7	40
Vegetables	70	45	65	25	35
Oilseeds	13	9	70	4	30
Fibres	4	4	100	-	-
Total:	115	77	67	38	33

Some Out-standing Features of Summer Crops in Nepal:

1. Averagely 84 percent of major graminaceous food grains covering cereals and millet is grown during summer.

2. Except lentil, chickpea and field pea, all the major pulses are taken care by summer season.

3. Almost all the cucurbits are the monopoly of summer.

4. Because of low temperature frequented by frost incidence, the places like Kathmandu Valley, Jiri Valley in Central Hilly Region are too sensitive to maintain cucurbits and solanaceous crops during their last phases.

5. Although bi-ennials in habit, crops like pigeon-pea, sugarcane, cotton etc. make their best out of summer season.

6. All the trees, shrubs and climbers of decidious nature, which maintain their survival in other season, come into prominence only during summer to gratify us with their rich harvest.

Situation of Weeds in Summer Season:

However, with the prevaillance of summer season, when the agro-ecological factors like temperature, soil, moisture, humidity and photo-periods are favourrable for majority of the crop species to grow and yield better with greater area of land under cultivation, the same may be equally or still more favcurable for the hostile biotic factors like insect pests, diseases and weeds to be at their worse to seriously affect the overall performance of crops associated to ultimately cut down the yield with the same severity. Among these three major hostile factors, the weeds are always on the top to cause the greatest loss. The summer season being more favourable for the cultivation of more number of crops thus, covering more of national cultivated area, creates more hospitable environment for a wide range of weed flora to compete. It is roughly estimated that summer season weeds account for 60 families and 190 genera thus covering 75 percent and 90 percent of total families and genera of weeds in Nepal respectively. Among all the

summer crops rice with wider range of adaptability to agro-ecological conditions is found to be infested with as many as 30 families of weeds.

Table 2 Estimated Situation of Summer Weeds

Particulars	Total Weeds	Summer Weeds	P.C. of Total	Paddy Weeds	P.C. of Summer Weeds
Dicot					
Families	65	50	78	15	30
Genera	150	145	97	20	14
Monokot					
Families	20	15	75	15	100
General	70	65	93	30	46
Pteridophyta					
Families	2	2	100	2	100
Genera	2	2	100	2	100

Table 3: Situation of Summer Weed Flora (Up to Genetic Level)

Families	Common Genera of Summer Weeds	
DICOT		
Acanthaceae	Asteracantha, Justicia, Peristrophe, Rungia	4
Aizoaceae	Mollugo, Trianthema	2
Amarantaceae	Achyranthes, Alternanthera, Amaranthus	3
Berberidaceae	Berberis	1
Boraginaceae	Cynoglossum, Heliotropium	2
Caesalpiniaceae	Caesalpinia, Cassia	2
Campanulaceae	Campanula, Sphenoclea	2
Caryophyllaceae	Cleome, Gynandropsis	2
Ceratophyllaceae	Ceratophyllum	1
Compositae	Ageratum, Anaphalis, Artemesia, Bidens, Blumea, Cassaulia, Circium, Conyza, Crepis, Eclipta, Eupatorium, Galinsoga, Inula, Siemesbeckia, Sphaeranthus, Tithonia, Verninia, Xanthium	18

Convolvulaceae	Evolvulus, Ipomea	2
Crassulaceae	Kalanchoe	1
Cucurbitaceae	Bryonia, Cucumis, Melothria, Momordica, Trichosanthus	5
Euphorbiaceae	Croton, Crozophora, Euphorbia, Jatropha, Phyllanthus, Ricinus	6
Geraniaceae	Geranium	1
Hydrophyllaceae	Hydrochilea	1
Labiateae	Calamintha, Leonatis, Leucas, Mentha, Micromeria, Ocimum, Scutellaria	7
Lytharaceae	Ammania, Cuphia, Rotala	3
Malvaceae	Abutilon, Hibiscus, Malvastrum, Sida, Urena	5
Menispermaceae	Cissampelos, Stephania, Tinospora	3
Mimosaceae	Mimosa	1
Nyctaginaceae	Boerrahavia, Mirablis	2
Nymphaceae	Euryale, Nymphaea, Nelumbo	3
Onagraceae	Jussiaea, Ludwigia, Oenothera	3
Oxalidaceae	Oxalis	1
Papaveraceae	Argemone	1
Papilionaceae	Aeschynomene, Alysicarpus, Crotalaria, Desmodium, Dolichos, Indigofera, Lathyrus, Lotus, Medicago, Melilotus, Parechetus, Phaseolus, Trifolium, Vicia, Zornia	15
Pedaliaceae	Martynia	1
Piperaceae	Peperomia	1
Plantaginaceae	Plantago	1
Polygonaceae	Fagopyrum, Persicaria, Polygonum, Rumex	4
Portulaceae	Portulaca	1
Ranunculaceae	Ranunculus	1
Rosaceae	Fragaria, Potentilla, Princepia, Rubus, Rosa	5
Rubiaceae	Galium, Oldenlandia, Rubia	3
Rutaceae	Boeninghausenia, Murraya	2
Sapindaceae	Cardiospermum.	1

Grophulariaceae	Lindernia, Mazus, Scoparia, Striga, Veronica	5
Solanaceae	Cestrum, Datura, Nicandra, Nicotiana, Physalis, Solanum	6
Sterculiaceae	Malachara	1
Tiliaceae	Corchorus, Triumfetta	2
Trapaceae	Trapa	1
Umbelliferae	Centella, Heracleum, Sium	3
Urticaceae	Boerameria, Geraidinia, Pilia, Pouzolzia, Urtica	5
Violaceae	Viola	1
Vitaceae	Vitis	1

MONOKOT

Agavaceae	Agave, Yucca	2
Alismaceae	Sacitturia	1
Araceae	Acorus, Arisaema, Colocasia, Pistia	4
Butomaceae	Butomus	1
Cannaceae	Canna	1
Commelinaceae	Commelina, Cyanotis	2
Cyperaceae	Carex, Cyperus, Eleocharis, Eriophorum, Fimbristylis, Kyllinga, Scirpus	7
Eriocaulaceae	Eriocaulon	1
Gramineae	Agropyron, Agrostis, Alopecurus, Axonopus, Brachiaria, Canchrus, Chrysopogon, Coix, Cynodon, Dactylis, Dactyloctenium, Desmotachya, Dichanthium, Digitaria, Echinochloa, Eleusine, Eragrostis, Festuca, Hyparrhizia, Imperata, Leptochloa, Oplismenus, Panicum, Paspalum, Pennisetum, Pogonantherum, Polypogon, Saccharum, Setaria, Sorghum, Sporobolus, Themeda	32
Hydrocharitaceae	Elodea, Hydilla, Hydrocharis, Vallisnaria	4
Juncaceae	Juncus	1
Lemnaceae	Lemna	1
Liliaceae	Hypexis	1

Pontenderiaceae	Eichornia, Monochoria	2
Potamogetonaceae	Potamogeton	1
Typhaceae	Typha	1
Zingiberaceae	Cucuma, Zinziber	2

PTERIDOPHYTES

Equisettaceae	Equisettum	1
Marsiliaceae	Marsilia	1

Some Salient Features of Summer Weed Flora:

1. Araceae, Compositae, Cyperaceae, Gramineae, Labiatae, Malvaceae, Papilinaceae are among the leading families of Angiosperms to have the maximum number of weedy genera.

2. Carex, Cassia, Cusuta, Cyperus, Desmodium, Euphorbia, Fimbristylis, Ipomea, Leucas, Mazus, Polygonum are among the leading genera to possess the maximum number of weedy species.

3. Ageratum conyzoides, Amaranthus spinosus, Cyperus rotundus, Desmodium triflorum, Polygonum hydropiper are among the most common summer weed species found all over Terai and central Hills.

4. Ageratum conyzoides, Cynodon dactylon, Cyperus rotundus, Euphorbia hirta, Eichhornia crassipes, Lantana camera can be regarded as some of the notorious weeds of cosmopolitan habit.

5. Bryonia, Cardiospermum, Centella, Convolculus, Ipomea, Melothria, Momordica, Stephania, Vitis are among the common genera of climbing to creeping habits.

6. Achyranthes, Berberis, Caesalpinia, Calotropis, Cestrum, Clerodendrum, Jatropa, Lantana, Murraya, Rubus, Urena are some of the common weedy shrubs.

7. Buddlea, Celtis, Ficus are among the trees usually showing weed characters.

8. Abutilon, Circium, Coix, Leonatis, Micondra, Saccharum, Typha are among the large sized herbaceous genera in the same way as Eriocaulon, Lemna, Mazus Oxalis, Peperomia, Pistia, Rotala are noted for low growing habits.

9. Acorus, Eichhornia, Hydrocharis, Hydrochloa, Jussiea, Lemna, Marsilea, Monochoria, Scirpus are among the leading aquatic weeds of summer season.

10. Cuscuta, Dendropthe, Loranthus, Viscum are some of the genera of parasitic weeds.

11. Arisaema, Bryonia, Calotropis, Datura, Ciradinia, Kalanchoe, Urtica represent the genera of poisonous weeds.

12. Argemone mexicana, Asteracantha longifolia, Berberis aristata, Caesalpinia bonducellam, Circium arvense, Polygonum perfoliatum, Solanum xanthocarpum, Urtica dioica are some of the obnoxious weeds.

13. Amaranthus, Colocasia, Corchorus, Crotalaria, Cucumus, Euphorbia, Nicotiana, Fagopyrum, Hibiscus, Ipomoea, Mazus, Mentha, Momordica, Phaseolus, Phyllanthus, Physalis, Rosa, Rumex, Solanum, Trifolium, Viola, Vitis etc. are already cultivated genera of plants with one or more species belonging to each of them are taken to cultivation while the rest are growing like weeds.

14. Amaranthus caudatus, A. oruentus, Canna indica, Euryale ferox, Lantana camera, Mirablis Jalapa, Nelumbo nucifera, Nymphaea spp, Perilla frutescenes, Ricinus communis, Tagetes patula, Trapa bispinosa and others, which once in the past or till now under cultivation, are to be found growing already as garden escapes.

15. A lilltle of so-called weed plants are believed to have been smuggled from outside whether fortuitously or intentionally just to add more fuel to the fire. Sphaerochlea zeylanica seems to be quite a new-comer in the paddy pests of Bhairahwa and Parwanipur Farms. So also Xanthium strumarium, Ipomoea crassicaulis, (Sainbu, Bungmati roads), Eichhornia crassipes (in the ponds of Lainchkhel, Patan, Gabahal, Nagpokhari and Kamalpokhari) are already heralding their intrusive entry into Kathmandu Valley to find all of us revive them with our gapping mouth. To quote only a minor instance now, time is not very far when Cassia tora (Round leaved senna) also will be added in this list, thus to be followed by others in the same manner.

16. The category of summer weeds are not, at all, incorporated in this paper with minor exception encompass still a wider section of flora mostly belonging to Cryptogamic Division. Many of them have got seriously weedy characters that have so far received less attention in the regular roll call conventional weeds. Some of them as believed to prevail in our country are given below:

1. Bryophytes (Moss):
   Riccia, Marchantia, Pellia, Polytrichum.
2. Pteridophytes:
   Equisettum, Pteris, Dryopteris, Marsilea, Adiatum etc
3. Thallophytes:
   Lichems, Algae, Fungi

17. Within the valley the musky-scented Cestrum parquii (Willow-leaved jessamine) and Clerodendron frograns (Rajbeli), treated as land-scaping ornamentals till not so distant past, have started showing their weedy bout. Next in the line Cestrum nocturnum is to be found in Khumal Farm is likely to make the same bid.

Table 4: Some Beneficial Aspects of Summer Weeds

Aspects	Genera
Food-grains	Amaranthus, Coix, Echinochola, Panicum, Setaria, Typha
Vegetables	Amaranthus, Basella, Eclipta, Fagopyrum, Helothria, Mentha, Nasturtium, Urtica
Miscellaneous - Food	Acorus, Cleome, Cyperus, Euryale, Nelumbo, Nymphaca, Rubus, Sagittaria, Scirpus
Fibres	Abutilon, Aeschynomene, Boehmetia, Crotalaria, Girardinia, Hibiscus, Imperate, Sida, Urtica
Thatching	Eupatarium, Saccharum, Themeda, Typha
Medicinal Values	Achyranthus, Acorus, Arisaema, Artimesia, Centella, Datura, Dryneria, Mentha, Oxalis, Rubia, Rubus, Tinospora, Urtica
Manurial Values:	Acorus, Artemisia, Boeninchusenia, Croton, Leonatis, Tagetes
Grass Fodders	Alopecurus, Axonopus, Brachiaria, Coix, Cynodon, Dicanthium, Digitaria, Echinochloa, Eleusine, Eragrostis, Panicum, Paspalum, Pennisetum, Pogonantherum, Setaria
Fodder Values:	

Legume Fodders	Alysicarpus, Desmodium, Lotus, Medicago, Melilotus, Trifolium, Vicia
Miscellaneous - Fodders	Amaranthus, Carex, Commelina, Cyperus, Drymeria, Ipomoea,
Fish Poisons	Agave, Artemesia, Budden, Dioscoria, Euphorbia, Polygonum
Ornamental Values	Abutilon, Ageratum, Anaphalia, Bidens, Cestrum, Clerodendrum, Cuphea, Datura, Eichhornia, Hibiscus, Ipomoea, Kalanchoe, Lotus, Monochoria, Mirablis, Nelumbo, Nymphaea, Rosa, Sacittaria, Scutellaria, Tithinia, Viola
Foliage Ornamental	Acorus, Amaranthus, Boehmeria, Carex, Colocasia, Cyperus, Jatropha, Mentha, Trapa, Typha
Religious - Importance	Achyranthus, Boeminghausenia, Curcuma, Datura, Desmotachya, Eclipta, Eurvale, Ficus, Imperata, Nelumbo, Nymphaea, Sida

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Controlling Summer Weeds:

In this ill-fated age of continuously deteriorating environment and exhausting natural resources, we have enough capacity to adjudge and adjust the plant whether as an individual or as an entire community, always in the light of its multiferous virtues meant for human welfare far more than for its so-called needy aspects. Let it also be well remembered that it is not actually the plant born to be a weed or unwanted which we are so misconceived to call it so, but it is infact our unwanted attitude toward the plants that is getting weedy and worthless. Whatever plants, we are suffering from at present, are the resulting out-puts of our own follies of the past and whatever follies we are mistaken to repeat at present, will certainly find our future generations suffer and cursing us with tears in their eyes. The plants like Cestrum, Clerodendrum, Lantana which once upon a time graced the beauty of the garden are now behaving like weeds in the same way as some of the vigorously multiplying plants at present like Canna, Cosmos, Mirablis, Perilla, are very much likely to do in the future. On the other side of the picture, which is still more exciting, it is learnt that the leaf of Vinca rosea, a half heartedly treated ornamental, very common in Terai and less so in central hills has been found to be very useful in the

treatment of child blood cancer. The seed oil of Ricinus communis growing in Nepal with cultivated as well as uncultivated varieties, is in much demand for Jet Aviation Industry. The wild ornamental Holmskioldia sanguinea (Cup and Saucer plant), richly growing in lower hills of Nepal, is observed to have been entertained in the gardens of Kathmandu Valley. So in this context if some plants tend to be multiplying and spreading unrestrictedly let us try to utilize them to the best we can. Only when we can not utilize them immediately, let us utilize our sense twice. If it does not help we may look for any method involving cropping scheme or cultural techniques. Also, let us see, if we have some bio-agents to help us minimize them. If it does not help, still we see, if any one of the above does, before we jump out to any drastic, hazardous and costly methods of control, i.e. something like chemical control. Hence to well realize the demanding situation of conserving and mobilizing our under-exploited green resources, in stead of tunning on the same harp for weed control. It is highly suggestible to mind over the following management techniques in order of preference, to the ultimate interest of our under-developed farming and farmer's condition.

1. Control by utilization: When we find our house-holds being frequently haunted by wolves, we realize the very moment what our lambs are worth for and thereby keep vigilant to spare the animals. Control by utilization render weeds gratifying the mankind by themselves and reduce to minimization.

2. Control by cropping and cultural methods:

Table 4 Biological Control of Local Weeds by Insects and Diseases Mostly Observed Under Local Conditions

Weeds	Bio-agents
	Insect
Urtica dioca	Hairy caterpillars (Vanessa cardui; V. kashmirensis)
Ludwigia perennis	Steel blue-beetle (Haltica and Synae)
Jussiaea frutescens	
J. repens	

Ricinus communis	Horny caterpillars - (Amsacta spp.)
Eupatorium adenophorum	Gall-fly - (Procecidochoris utilis stone) and grazed by sheep
Cistrum parnuii	Aphis fabae (Coilonella)
Eichhornia crassipes	Water-hyacinth weevil (Neochetina eichhorniae)
	Hyacinth moth (Arzama densa)
	Water hyacinth mite (Orthogaluma terebrantis)
Ageratum conyzoides	Alternate hosts to white flies (Bemisia tabacina) transmitting leaf curl virus disease
Eupatorium praerans	
Sceparia dulcis	
Solanum nigrum	
	Herbivorous Animals
Hydrilla verticiliata	
Potamogeton sp.	Grass carp
Monochoria vaginallis	
Ipomoea crassicaulis	
Eupatorium adenophorum	Grazed by sheep
Equisettum arvense	
	Diseases
Xanthium strumarium	Powdery mildews
Croton sparsiflorus	Virus

3. Control by bio-agencies: It consists of introducing suitable organism that will either feed upon the weeds or otherwise damage them in their new habitats without any interference to associated crops or other existing conditions

4. Control by chemical herbicides: In an under-privileged farming condition like ours, the use of chemicals to control weeds is too hazardous and too costly a proposition so its scope in Nepal still lies some-where far in the offing at least for this Bickram Century.

Some Suggestions:

1. By the time the out-side World is positively looking forward to make the best out of the waste through the extensive studies of weeds in their multiple aspect, we in Nepal have not yet learnt how to know and count the weeds. So, let the Department of Agriculture take care of this clinching issue of weed problem by organizing at least the preliminary phase of weed and weed control science, just to show the out-side World that Nepal has weed problems too and that it is in the way to tackle them.

2. Let the Department believe the fact that it has on its roll call quite a number of young energetic scientists, who appear to be highly interested, dedicated and receptive in the letter and spirit. In order to utilize and encourage the talents of these precious young technical man-powers to the best it can, the Department should organize to get them to work either under the able guidance of its senior but sincere and deserving scientists sufficiently qualified in weed science or by organizing in well authorized and well privileged weed studies taken directly under the Department.

3. So long as we do not have our own experimental findings to fully justify the case, it is too early to jump out to make chemical weed control the regular code of our conduct to solve our weed problems by dittoing the borrowed informations.

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SUMMER WEEDS IN NEPAL

DISCUSSION

K.B. Rajbhandary : How do you define weed ? Can you say that all the plants grown in our garden are weeds ?

Regmi : To be very brief, any plant growing where it is not wanted may be termed as weed. It is not exactly the plant that makes it a weed, but it is the man-made management or nature created circumstances that render it weedy.

David Lipinski : Emerson has defined weed as "a plant whose virtue has not yet been found". Please comment.

Regmi : Every individual plant is sue to have some virtue. With those already being exploited there are still to be further exploited, those unexploited to be explored and accordingly exploited.

N. Sharma : Ricinus communis is not a weed in proper sense. The fact is that we have not properly utilized it. Eri silk worms are being reared in India, China and other countries to produce high quality solk. So is Euphorbia sp.

REPORT ON FARMER'S FIELD VARIETAL AND MANAGEMENT TRIALS ON MAIZE

- K. Adhikari and
I.B. Chaudhary*

I. Varietal Trial

Farmer field trial plays a key role in the adoption process of an "innovation". Thus, during the monsoon season of 1982, a number of farmers' field varietal trials on maize were conducted in Chitwan, Nawalparasi, Gorkha, Kabhre, Dandapakhar and Pakhribas Agriculture Centre (PAC) with the following objectives:

a. To compare the grain yield performance of recommended and promising varieties with farmer's existing races

b. To enable farmer's to be familiar with different improved varieties and to express their varietal preference

c. To recommend the best yielding variety for a particular agro-ecological region

Materials and Methods

Four sets of trial were conducted on farmer's field in Chitwan, Gorkha and Nawalpur at four locations but results were obtained from two locations from Chitwan, three from Gorkha and none from Nawalpur because of severe drought during tasseling to grain filling stage.

Besides this, one set of trial each comprising of different varieties were supplied to Kabhre, IHDP Dandapakhar, Lumle Agriculture Centre, Pakhribas Agriculture Centre, Doti Agriculture Farm, Nepalgunj Agriculture Station, Kakani Agriculture Farm, Khumal Farm and Surkhet Agriculture Farm

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but results were obtained only from Kabhre, IHDP Dandapakhar, and Pakhribas Agriculture Centre (PAC).

A randomized complete block design replicated twice was used. In case of Chitwan and Gorkha Districts there were six treatments, three yellow grain and recommended varieties and two white grain promising lines with a farmer's variety. But at Kabhre, IHDP and PAC the treatments were seven. They were randomly arranged in each block. Individual plots were 4.5 X 3 m or 5 X 3 m, spaced 75 cm X 25 cm apart. Two seeds per hill were sown and thinning was done at 3 to 4 leaf stage.

The level of N:P:K applied was 60:30:0 kg/ha. Half N and all P_2O_5 were applied as a basal dose in 4-5 cm deep furrow sole, followed by planting and remaining half N was side-dressed after 30-35 days of planting.

At all locations, a considerable amount of FYM was applied by the farmers and at some locations herd of cattle were kept for manuring purpose for about 10-15 nights. The point is that all of the experiments were at ideal soil fertility condition.

Results and Discussions

Mean grain yield of five locations (3 locations in the mid-hill of Gorkha and 2 in Chitwan)and averaged over all locations are given in Table 1. Out of five locations, significant differences among the varieties were found only at two locations, i.e. at Ranishwara and Taple of Gorkha district.

The varieties at Ranishwara differed significantly. The highest yield was obtained from Rampur Composite (3918 kg/ha) followed by Khumal Pahenlo (3850 kg/ha) and lowest yield was from farmer's variety (2312 kg/ha) but it differed only with Rampur Composite and Khumal Pahenlo. Farmer's variety was found at par with Rawan-1 (3285 kg/ha), Rampur-1 (2910 kg/ha) and Arun-2 (2833 kg/ha).

At Taple also the tested maize varieties differed significantly. The highest yielder was Khumal Pahenlo (4328 kg/ha) followed by Rampur-1 (4084 kg/ha) and Rampur Composite (3786 kg/ha) but they were at par

in respect of grain yield. Farmer's variety (1612 kg/ha) was the lowest yielder and differed significantly with all the varieties except Arun-2.

At Nawalpur, the analysis of variance showed that the varieties did not differ significantly, however, Rampur Composite, Khumal Pahenlo, Arun-2, Rampur-1 and Rawan-1 gave 56%, 32%, 15%, 11% and 6% increased grain yield over farmer's variety.

The overall mean grain yield of Gorkha district indicated that Rampur Composite (3886 kg/ha) produced the highest yield and showed a good yield stability over the three different locations and Khumal Pahenlo was almost equal to it. In this regard, at all the three locations, farmers' with their experiences selected Rampur Composite the best variety but, their second best variety was Arun-2 because of its early maturity and short plant type.

At two locations in Chitwan district, the varieties did not differ significantly, however, the average mean of two locations indicated that Rampur Composite (4254 kg/ha) was the highest yielder followed by Arun-2 (4068 kg/ha), Khumal Pahenlo (3788 kg/ha), Rawan-1. The promising genotype Rampur-1 yielded 2% less than farmer's variety. In Chitwan, farmer's varieties Khumal Pahenlo or Rampur Composite are locally maintained.

Summary of grain yield produced at Kabhre, IHDP Dandapakhar and Pakhribas is given in Table 3. The varieties did not show statistical yield differences at Kabhre and IHDP Dandapakhar but at Pakhribas it was found significant. Both at Kabhre and Dandapakhar the promising variety Rampur-2 (3149 and 3083 kg/ha respectively) produced the highest yields than the improved check (Rampur Composite) (2279 and 2070 kg/ha respectively) and the local check (farmer's variety 2115 and 1463 kg/ha respectively).

At Pakhribas, the varieties differed significantly and the highest yield was from farmer's local (4472 kg/ha) followed by Ganesh-2 (4138 kg/ha), Janaki Seto and Hetauda Composite but they were at par with each other as with Rampur-2 (3593 kg/ha), Rampur-1 and Rampur Composite.

Kabhre Agriculture Farm conducted a second set of varietal trial at two locations repeating only once with different planting dates. The summary of results are given in Table 3. In this set also the varieties did not differ significantly. However, the promising variety Manakamana-1 (4927 kg/ha) produced highest yield followed by Rampur Composite (4157 kg/ha) and Arun-2 (4018 kg/ha). The farmer's first choice here was early maturing and shorter plant type variety Arun-2 and second was Manakamana-1.

Conclusion

Based on the five set of varietal trials conducted in Gorkha and Chitwan districts, the recommended variety Rampur Composite produced the highest yield followed by Khumal Pahenlo with 59 and 49% increase over local respectively. The promising lines, Rampur-1 and Rawan-1 were found the lowest yielder, however, they yielded 21% and 20% more grain than farmer's local. The five improved maize varieties under test showed that Arun-2 was the earliest and shorter in plant height and Rawan-1 and Rampur-1 were late, tall and poor in husk cover.

The farmers at the time of harvest chose their first best variety as Rampur Composite and their second best Arun-2.

II. Management Trials

In general, maize yield in Nepal from the farmer's field is low. The cause of low production may be either low yielding potentiality of the farmer's variety or poor management practices adopted by the farmer's. So, to tackle the problem to some extent, a comparative study on farmer's existing varieties and crop management practices is a felt need. Thus, a few sets of management trials were conducted in Gorkha (mid-hill) and Chitwan districts (Inner Terai) with the following objectives:

a) To compare the farmer's technology with the intermediate technology (moderate inputs)

b) To compare the economical response of each technology

c) To enable the farmers to observe and choose the suitable technology

Treatment Definition for First 4 Sets

1. Farmer's Variety (FV) = A variety that the farmer is growing
2. Farmer's Practice (FP) = The manuring practices that the farmer is using for his own maize crop (FYM/ Compost approximately @ 8-10 Tons/ha)
3. Improved Variety (IV) = Variety selected and released from NMDP for general cultivation (Rampur Composite)
4. Improved Practice (IP) = Application of moderate level of chemical fertilizer (45 kg N/ha all side-dressed + Farmer level of FYM/Compost)

Treatment Definition for Second 2 Sets

1. Farmer's traditional method of planting plus 45 kg N/ha side-dressed
2. Same as treatment 1 but no N
3. Behind plough planting leaving two alternate plough passage (spaced approximately 70 X 25 cm) plus 45 kg N/ha side-dressed
4. Same as treatment 3 but no N
5. Line sowing (spaced 75 X 25 cm) plus 45 kg N/ha side-dressed
6. Same as treatment 5 but no N

Materials and Methods

First 4 sets of trial were conducted two each in Gorkha and Chitwan districts. The second sets were in Gorkha only. Both sets were non-replicated consisting of 50 m^2 to 100 m^2 plot size. In the first type planting was done by the farmer behind the plough for all treatments as his usual method. But in the second type, treatment 1 only was planted by the farmers. For each planting method, equal amount of seed was used and the variety was Rampur Composite for all treatments of second type.

In both the types, 45 kg N/ha (source Urea) was side-dressed by localized method after 35-40 days of planting. Plants were thinned out by the farmer as his usual ways for all treatments of first type and treatment 1 of second type.

Results and Discussions

For the first type of trials, the mean grain yields of each location and average of all are given in Table-1. In all four locations, improved variety plus improved practice (4097 kg/ha) produced the highest yield and the lowest was from farmer's variety plus farmer's practice.

Following observations are evident in relation to these results:

A. Farmer's variety and his practices showed leat yield advantage
B. Farmer's variety and improved practice yielded 16% more grain than FV - FP with 9 kg grain per kg N applied
C. Improved variety plus farmer's practice yielded 15% more grain than FV + IP
D. Improved variety plus improved practices produced 62, 41 and 23% more grain yield than FV + FP, FV + IP and IV + FP respectively

Table 2 presents the yield data for the second type of trials conducted in Gorkha district. The results indicated that there is an economical response to a moderate level of N application irrespective of three different planting methods. Among the three planting methods, planting behind the plough leaving every two alternate plough passage yielded the highest. More clearly, the grain yield data (Table 2) showed that planting maize with line orientation proved superior to the farmers traditional method of planting.

Conclusions

These simple non-replicated trials vividly pointed out application of 45 kg N/ha is economically viable investment and more advantageous with improved variety.

Planting maize in rows either behind the plough leaving two alternate plough passage or furrow (spaced approximately 70 X 25 cm) or exact line arrangement, (75 X 25 cm) was found better than the traditional method.

Acknowledgements

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Table 1:

Varieties	Gorkha District			Chitwan District		Mean	Overall Means of 2 Dist.	% Yield Increase Over Local
	Raniswara (Foot-hill)	Nareshwor (Mid-hill)	Taple (Mid-hill)	Panch-Kanya	Jut-pani			
Khumal Pahenlo	3850	3335	4328	3144	4431		3813	49
Rampur Composite	3918	3954	3786	3789	4718		4070	59
Arun-2	2833	2899	2016	3662	4473		3326	30
Rampur-2	2910	2813	4084	2641	3234		3104	21
Rawan-1	3285	2652	2491	3041	3618		3077	20
Farmer's Variety	2312	2532	1612	2503	3496		2562	-
F-test	*	NS	*	NS	NS			
LSD 0.05 kg/ha	1076	-	670	-	-			
CV %	13	12	9	18	16			
Date of Sowing	038/12/9	038/12/6	038/12/14	039/1/9	039/1/21	(Note *Significant at 0.05%		
Date of Harvest	039/4/25	039/4/27	039/4/26	039/5/2	039/5/2	probability level		
Cooperator	I. Khatri	T. Shrestha	KB Shrestha	KB Ghimire	P.B. Thapa	NS = Non-significant.)		

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Table 2: SUMMARY OF GRAIN YIELD CONTRIBUTING CHARACTERISTICS OF MAIZE GENOTYPES

Locations	Khumal Pahenlo	Rampur Comp.	Arun-2	Rampur - 1	Rawan - 1	Farmer's Variety	
	Harvested Plants 000/ha.						
Raniswara	48	44	38	47	38	40	
Nareshwor	43	38	45	39	35	41	
Taple	39	38	36	33	37	40	
Panchkanya	32	41	44	42	42	33	
Jutpani	49	41	49	41	42	40	
Means	42	40	42	40	39	39	
	Ear Number as Percentage of Plant Number						
Raniswara	110	109	106	103	102	101	
Nareshwor	105	98	104	97	95	94	
Taple	103	108	98	101	98	97	
Panchkanya	98	91	92	86	87	109	
Jutpani	79	85	91	70	71	83	
Mean	99	98	98	91	91	97	
	Moisture Percentage at Harvest						
Raniswara	22.8	23.5	20.4	26.3	25.0	21.0	Harvested
Nareshwor	32.0	31.0	24.0	37.0	35.0	27.0	
Taple	31.0	28.5	26.5	32.0	37.0	24.5	8 - 12 Days
Panchkanya	21.7	22.0	28.2	23.0	33.2	20.5	Earlier
Jutpani	26.0	28.3	31.35	29.2	29.2	27.75	
Mean	26.7	26.6	26.0	30.0	32.0	24.0	

Table 3: SUMMARY OF MEAN GRAIN YIELD FROM 3 LOCATIONS AND AVERAGE OF MONSOON, 1982

Varieties	Kabhre	Dandepakhar	Pakhribas	M e a n
Ganesh	2254	2720	4138	3037
Manakamana-2	2194	2837	3181	2737
Rampur-2	3149	3083	3593	3275
Rampur-1	2797	2482	3541	2940
Arun-2	2439	2433	2464	2445
Rampur Composite	2279	2070	2924	2424
Farmer's Variety	2115	1463	4472	2683
Hetauda Composite	-	-	3852	3852
Janaki Seto	-	-	4026	4026
F-test	NS	NS	*	
CV %	22	5	23	
LSD 0.05 kg/ha.	-	-	1220	

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Table 4: SUMMARY OF MEAN GRAIN YIELD FROM THE FFT CONDUCTED BY KABHRE AGRI. FARM MONSOON, 1982

Varieties	Kabhre Agriculture Farm			
	Mean Grain Yield kg/ha (Ave. of 2 replications)	% Yield Increase Over Local	Days to 50% Silking	Farmer's Reaction
Manakamana-1	4927	66	82	Second choice by the farmers
Arun-2	4018	36	74	First choice by the farmers
Opaque	3279	11	87	
Kakani Yellow	3152	7	87	
Rampur Composite	4157	41	81	
Farmer's Variety	2959	-	80	
F-test	NS	-	-	
CV %	35	-	-	

Table 5: EFFECT OF DIFFERENT MANAGEMENT LEVELS ON THE GRAIN YIELD OF MAIZE IN GORKHA AND CHITWAN DISTRICTS

Treatments	Gorkha District		Chitwan District		Overall Mean of 2 Dists.	Grain Yield Per kg N Applied (kg)	% Yield Increase Over Local
	Nare-shwor	Taple	Panch-kanya	Jutpani			
1. Farmer's Variety + Farmer's Practice	1009	1566	3708	3741	2506	-	-
2. Farmer's Variety + Improved Practice	1334	1478	3755	5096	2916	9	-
3. Improved Variety + Farmer's Practice	1970	2350	4021	4999	3335	-	33
4. Improved Variety + Improved Practice	2761	3121	4501	6005	4097	17	40
Date of Planting	038/12/16	038/12/14	039/1/19	039/1/21			
Date of Harvesting	039/4/27	039/4/26	039/5/2	039/5/2			
			Harvested Plants 000/ha.				
1. Farmer's Variety + Farmer's Practice	38	41	47	43	42		
2. Farmer's Variety + Farmer's Practice	40	43	43	50	43		
3. Improved Variety + Farmer's Practice	36	34	50	43	40		
4. Improved Variety + Improved Practice	37	42	47	53	44		

Note: Improved Practice (Ip) = 45 kg N/ha Side dressed Improved Variety = Rampur Composite.

Table 6: EFFECT OF DIFFERENT PLANTING METHODS CUM N SIDE DRESSING ON MAIZE GRAIN YIELD IN GORKHA DISTRICT, MONSOON 1982

Treatments	Taple	Nareshwor	Means	Grain Yield Per Kg N Applied
1. Farmer's traditional method of planting + 45 kg N/ha side dressed	3180	2394	2787	15
2. Same as treatment no. 1 but no N	2210	1948	2079	-
3. Behind the plough planting leaving two plough passage + 45 kg N/ha side dressed (spaced approx. 70 x 25 cms)	3678	2873	3276	19
4. Same as treatment no. 3 but no N	2765	2055	2410	-
5. Line sowing + 45 kg N/ha side dressed	3445	2609	3027	15
6. Same as treatment no. 5 but no N	2575	2090	2333	-

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Table 7: SUMMARY OF PLANT POPULATIONS AT HARVEST (000/Ha)

Treatments	Taple	Nareshwor	Means
1. Farmer's traditional method of planting + 45 kg N side dressed	37	39	38.0
2. Same as treatment no. 1 but no N.	34	36	35.0
3. Behind the plough planting leaving two plough passage without seeds + 45 kg N/ha side dressed	52	50	51.0
4. Same as treatment No. 3 but no N.	48	53	50.5
5. Line sowing + 45 kg N/ha side dressed	46	48	47.0
6. Same as tretment no. 5 but no N	45	43	44.0

A REPORT ON MAIZE SEED PRODUCTION AND DISTRIBUTION PROGRAM

S.K. Upadhyaya and
B.N. Kayastha*

The pivotal role of maize crop in the economic life of Nepalese people is evident and has been discussed frequently. It is also clear that use of high yielding improved variety seeds is one of the most important aspects of increasing productivity of a crop. However, Nepalese farmers were a bit late to start using improved seeds. The distribution of improved maize seeds in the country at institutional level was started, for the first time, in the F.Y. 1967/1968 when the Agriculture Supply Corporation (ASC), which was set up during the first year of the Third Five Year plan, procured improved maize seeds from various sources and distributed it among Nepalese farmers. Later on this public corporation began seed multiplication program on contract farmer's field. At present, Agriculture Inputs Corporation (the final survivor of ASC) has a well defined seed production and distribution system which produces enough maize seed to meet the existing demand of Nepalese farmers. It should, however, be stated that the amount of improved maize seed produced and sold by AIC is still very low as to cover any significant portion of total maize acreage of the country.

Seed Multiplication

It was pointed out during the last seminar that while formulating maize seed production program a stress would be made on centralizing such program in those areas where basic facilities for seed drying, processing, and storage are already available. Out of the total seed multiplication program of 625 hectares in 1982/1983, 560 hectares have been placed on Terai regions and the remaining 65 hectares are on the hills (including also such hills where SPIS Project has been working). On this F.Y. 1982/1983 an attempt has been made to

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* - Ag. Officer and Chief, respectively; Seed Division, AIC.

introduce a pocket-approach on major seed production areas (see table 1). The main purpose of this approach is to carry out seed production and collection works in an efficient manner. The following major criteria would be considered while selecting a seed production pocket.

Seed production centres to be centralized on:

1. Areas where active supervision is possible
2. Areas where facilities for seed collection are available
3. Areas having irrigation facilities

It has been proposed that there should be a minimum of five inspection visits on all seed production fields by the concerned technicians. Those inspection visits would be made at the following stages of seed production.

1. At the time of sowing
2. At first weeding
3. At tasseling stage
4. At the time of harvesting
5. At the time of shelling

The indication so far, has shown that maize seed production program would achieve a considerable progress this year.

Seed Collection

Collection of maize seeds is another difficult aspect of maize seed production system. But, during the recent years there has been some improvements in seed collection process, too. A total of about 297 metric tons of improved maize seeds was made available for sale during the year 1981/1982. During this fiscal year about 345 metric tons of composite varieties and 150 tons hybrid maize seeds (imported from India) are available for sale.

Seed Storage

Storage of maize seed is a burning problem for AIC. A significant amount of maize seed is subjected to germination drop every year. In the F.Y. 1981/1982, also, a total of 87.465 metric tons of maize seeds stored in Janakpur

and Itahari received a germination drop. This year a major amount of maize seeds were transported to Daman and Kathmandu and have been stored there to avoid high heat and high humidity of Terai. Recent check on germination capacity of those maize seeds has shown that the seeds are in a good condition up to this time. A godown of 125 metric ton capacity for storing maize seeds is being constructed at Daman very soon under Seed Production and Inputs Storage Project (SPISP). Other hilly centres like Ilam and Dhankuta in Eastern Development Region, Palpa and Pokhara in Western Development Region, Dang and Surkhet in Mid-Western Development Region are being considered for the storage of maize seeds.

Seed Sale

The sales record of improved maize seed through institutional level is rather discouraging (table 2). The figures on table 2 indicate that the average annual sale of maize seeds through AIC during the last 15 years has been only about 82.88 metric ton. Out of 296.707 metric ton maize seeds which was available for sale last year only 132.066 metric ton was sold, 87.465 metric ton received a germination drop and about 77.176 metric ton of the functional stock was left unsold at the end of season (table 3). This clearly indicates that although the amount of maize seeds collected by AIC was not up to the target, it was adequate enough to meet the existing demand of the farmers. Besides the popular farmer to farmer diffusion, other common reasons attributed to the poor sale of maize seeds are the poor quality and high cost of maize seeds produced by AIC. However, it should be kept in mind that seed quality standards of a country should be judged against the available technology and infrastructures. Still more, it could be said safely that the seeds produced by AIC are of much better quality than ordinary seeds that the farmers are using, in genetic as well as in all other seed quality considerations. A careful analysis of the causes would reveal that there is still a lack of seed consciousness in Nepalese farmers and this could be the reason why our farmers are more conscious of seed price. The hybrid maize seeds imported recently from India, though of a good name and quality, is not selling properly and the reported reasons for this state of low sale are high seed price and lack of proper extension. Often, it has also

been observed that our seed dealers are not much enthusiastic in dealing with seeds. The next prominent reason for the poor sale of maize seeds is that same varieties are being used for a long time. The development of a new variety, like Arun, is very important to stir farmer's curiosity and sales promotion.

Conclusions

AIC has a very little sales promotion activities of its own. During the last seminar it was pointed out that sales promotion (creating demand) and seed storage were the major problems in maize seed production and distribution process. They remain so this year also. Although the problem of seed storage has been solved temporarily by storing maize seeds in Daman and Kathmandu, researches should be undertaken on developing a much strong seed bag which would resist the breakage during transportation. Studies should also be made on other aspects of seed storage. A vigorous extension measure through the joint effort of Department of Agriculture, Agriculture Development Bank and Agriculture Inputs Corporation may be more desirable in order to arise seed consciousness among Nepalese farmers. This year, there was a problem of foundation seed for conducting seed multiplication program as the drought hampered foundation seed production in Rampur. Measures may have to be adopted to ensure timely supply of foundation seeds. Regarding the hybrid maize it may be proper to adopt uniform policy measures on procurement and distribution of such seeds. There is a very good demand of Arun variety among farmers. But the farmers are less interested to take part in the seed multiplication program of this variety. The farmers who participated in seed multiplication program in Chitwan last year have complained that the yield of this variety is some what lower than that of other varieties and hence it is less desirable to cultivate it as a main season crop. Hence, some extra premium may have to be given to encourage farmers to take part in the seed multiplication of this variety.

Table 1: Maize Seed Multiplication Program During F.Y. 1982/1983, AIC

(Farmer's Level)

Production Centres	Area (Ha.)	No. of Pockets
A. Winter Program		
1. Morang, Sunsari	50	2
2. Chitwan	200	2
3. Bara, Parsa	195	4
4. Dhanusha	40	2
5. Dang	25	2
6. Nawalparasi	50	2
Total:	560	14
B. Summer Program		
1. Dhading	5	-
2. Kathmandu	10	-
3. Bhaktapur	10	-
4. Kaski	10	-
5. Trishuli	50	-
6. Charikot	10	-
7. Lamjung	5	-
8. Surkhet	10	-
Total:	65	-

Maize Seed Multiplication Program (Proposed), F.Y. 1983 / 1984 (Farmer's Level)

A. Winter Program

Production Centres	Area (ha)	Rampur Composite	Rampur Pahenlo	Khumal Pahenlo	Arun	Sarlahi Seto
1. Mornag, Sunsari	50	-	50	-	-	-
2. Chitwan	225	75	-	100	50	-
3. Bara, Parsa	300	150	50	100		
4. Dhanusha	50	25	-	-	-	25
5. Nawalparasi	75	50	-	-	25	-
6. Rupandehi	20	-	20	-	-	-
7. Dang	20	20	-	-	-	-
Total:	740	320	120	200	75	25

B. Summer Program

01. Dhankuta	10	-	-	10	-	-
02. Kathmandu	15	-	-	15	-	-
03. Trishuli	5	-	-	5	-	-
04. Dhading	5	-	-	5	-	-
05. Charikot	5	-	-	5	-	-
06. Gorkha	5	-	-	5	-	-
07. Lamjung	5	-	-	5	-	-
08. Parbat	5	-	-	5	-	-
09. Baglung	5	-	-	5	-	-
10. Pyuthan	10	-	-	-	-	-
11. Surkhet	10	-	-	10	10	-
Total:	80	-	-	70	10	-
Grand Total:	820	320	120	270	85	25

Table 2: Sales of Maize Seed, AIC

Quantity M. Ton

Year	Quantity Sold
01. 1965/1966	-
02. 1966/1967	-
03. 1967/1968	30.000
04. 1968/1969	49.430
05. 1969/1970	40.467
05. 1970/1971	47.000
07. 1971/1972	56.000
08. 1972/1973	50.000
09. 1973/1974	46.000
10. 1974/1975	51.000
11. 1975/1976	144.552
12. 1976/1977	105.607
13. 1977/1978	144.930
14. 1978/1979	92.990
15. 1979/1980	149.139
16. 1980/1981	104.040
17. 1981/1982	132.066

Table 3: Regionwise Sales and Stock of Maize Seeds During 1981 / 1982

Region	Target M. Ton	Q'ty Sold M. Ton	Q'ty Left Unsold M. Ton	Quantity which receigermination drop (M. Ton)
1. Easter Region	138.00	28.661	16.721	19.520
2. Central Region	200.00	62.951	34.676	67.945
3. Western Region	94.00	29.453	17.147	-
4. Mid-Western Region	40.00	8.830	4.578	-
5. Far-Western Region	28.00	2.171	4.046	-
Total:	500.00	132.066	77.176	87.465

THE TRAINING AND VISIT (T & V) SYSTEM OF EXTENSION AND RESEARCH OUTREACH

Wayne H. Freeman

A. Background

1. Review of the T and V Extension System and Some Results of On-Farm Research and Production Programs

The Agricultural Extension and Research Project (AERP) seeks, during the life of the project (1981-82 to 1984-85), further implement the T and V system in eight more districts. Four regional research stations and one sub-station have been identified by HMG and the World Bank as research stations to be strengthened under the project. At the same time the Department of Agriculture is seeking to make research staff more directly involved in conducting research in farmers' fields.

In an effort to make extension more effective by the T and V system Benor and Harrison* recognized that a vigorous research program addressing farmer problems was necessary if new technologies were to continue to be forthcoming in order for the extension system to remain effective. They state "Without a network of field trials upon which new recommendations can be based and without continuous feed-back to research from the fields, the extension service will soon have nothing to offer farmers, and research institutions will lose touch with the real problems farmers face". - - - - - "Field trials carried out in farmers' fields are a testing ground for research findings before they are recommended by extension on a large scale. They also provide a mechanism for close continuous working relationships between research and extension staff".

To be effective in influencing farmers and their practices to affect production Benor and Harrison further state "At the

* - Benor, Daniel and James Q. Harrison, Agricultural Extension, The Training and Visit System, World Bank, 1977.

initial stage it is very important to achieve an immediate impact which will give farmers confidence in the extension agents and the extension agents confidence in themselves". The product of the linkage with research and an active extension system is the impact on production to increase food supplies and farmers' welfare.

These objectives or ramifications of them are generally stated in various agricultural and rural development projects in Nepal. This paper will seek to put extension by the T and V system (or any system), research support to extension through research outreach, and impact production programs into perspective to make them mutually complementary and effective. The research stations receiving support from the AERP and the districts in their "command" areas where the T and V system is being implemented are those to which this report is addressed.

The Cropping Systems Program of the ICP established, in 1977, a system of research trials in farmers' fields to provide farmer recommendations based on adaptive research. The program was designed to serve small subsistence farmers whose parcels were scattered and without the same land-water classification by directing research to cropping patterns, in these various parcels, rather than individual crops without relevance to the patterns in which farmers were growing these crops.

The field trials concept of Benor and Harrison was pursued in a systematic way both agronomically and socio-economically by the cropping systems team. The research included not only agronomic trials but survey information and secondary information were pooled to get a better understanding of the farmer situation in a given area. Cropping patterns were studied and the more predominant ones selected as a basis for research <u>within</u> these patterns or for the generation of alternate patterns.

As a result of these on-farm trials, pattern technologies were developed which were suited to several different agroclimatic

situations. These patterns showed promise both agronomically and economically and reached a level for farmer recommendation in 1980. To achieve the results upon which recommendations to other farmers could be based it was necessary that research and extension work together with farmers in their fields. These field trials were putting into practice the "close continuous working relationships between researchers and extension staff" (Benor and Harrison).

To achieve the impact phase that Benor and Harrison mention, farmers in Pumdi Bhumdi were enlisted in a maize production program in February 1980, as a part of the Maize/Finger Millet-Wheat pattern. During the wheat season that same year similar production programs were launched at Pumdi Bhumdi and other sites. Common features were that production was pattern-based and the parcels were scattered. Farmers and parcels were not an identifiable group or area. The ingredients of an "impact area" were not achieved until the following wheat season, 1981-82. The earlier attempts at impact were largely unsuccessful because the parcels were small and scattered and the results, even though impressive, were not dramatic so as to provide "impact" on neighboring farmers, extension personnel, administrative officers, or production itself.

In 1981-82 impact areas were deliberately organized involving farmers who had contiguous parcels who were growing crops in the same pattern and who agreed to try the crop varieties and practices that had been developed as a result of research trials on their or their neighbors' fields. This required farmer "organization" in that all agreed to participate. Blocks of 2 to 6 hectares were achieved in five of the six cropping systems sites involving as few as 7 farmers in the Terai and as many as 47 farmers in Lele.

The same impact on crop performance and yield was obtained in 1981-82 as existed in 1980-81 but the real impact was a dramatic

difference between the crop in the production area and neighbors' fields. The "contact" farmers were deliberately selected because of the relationship of their parcels with each other in order to achieve "The impact which is needed to spread the practice to the majority of farmers most quickly" (Benor and Harrison). As a consequence of this impact in 1981-82, production areas expanded during the rice season of 1982 to as much as 50 ha in some sites.

The Cropping Systems Program utilized research staff from Khumaltar and district extension personnel in those districts where field trial work was conducted. The technologies tested were those already available with research stations such as improved varieties of crops in the patterns, recommendations for fertilizer, insect control, etc. These were in most cases fitted into the farmers' predominant patterns. New patterns were tested wherever it appeared that there was potential for increasing cropping intensity.

2. Research Support to Extension - Research Outreach

In the document from the Department of Agriculture on the Research Programs, 1980-81 (2038/39), the concept of extension support activities was promulgated as a means of getting a closer linkage between extension and research in order to accelerate the adoption of technologies at the farmer level. The document states that it is mandatory for all stations and farms to compose a team to work with farmers in close cooperation with extension within assigned areas. The stations of the AERP and areas assigned for research outreach are as follows:

Region and Station	District	Team Composition	Additional Manpowe
Eastern Region			
1. Tarahara	Morang	All staff	Class II from AERP
	Sunsari	"	
	Saptari	"	
2. Kankai	Jhapa	All staff	
	Illam	"	

Contd.../...

Region and Station	District	Team Composition	Additional Manpower
Central Region			
3. Hardinath	Dhanusha	All staff	
	Mahottari	"	
	Siraha	"	
4. Parwanipur, NRIP	Bara, Parsa, Rautahat	1 Cl. III, Gaz. 1 Cl. I, Non-Gaz	Class II from AERP
5. Nawalpur Oilseed Centre	Sarlahi	1 CL. III GO 1 CL. I, NGO	
6. Rampur	Chitwan	2 Cl. III, GO	
	Makwanpur	1 Cl. I, NGO	
	Gorkha		
Western Region			
7. Bhairahwa, NMDP	Kapilvastu	1 Cl. III GO	Class II from AERP
	Nawalparasi	1 Cl. I, NGO	
	Rupandehi		
	Palpa		
Mid-Western Region			
8. Nepalgunj	Banke, Bardia	1 Cl. III, GO	Class II from AERP
	Dang	1 Cl. I, NGO	
	(Kailali & Kanchanpur in future)		

The document recognized that Farmers' Field Trials (started in the early 1970s), clusters of trials in maize, production demonstrations in maize, minikits in rice, maize, wheat, and pulses, and cropping systems programs in selected areas were activities in which research staffs have been involved. The assessment was that these programs have been highly beneficial in extending the adoption of new technologies rather than the blanket country-wide recommendations coming from the research

stations and national centers. By concentrating these on-farm activities, in cooperation with extension agencies, localized recommendations could be developed.

To implement these expanded on-farm activities, each station was to assign some existing staff and, in addition four centers (Tarahara, Parwanipur, Bhairahwa and Nepalgunj) were designated as regional centers and were to recruit additional class II officers to be specifically responsible for research outreach.

To achieve a balance between research on the research station and on farmers' fields it was envisioned that, by the end of 4 to 5 years, perhaps as much as 40% of the activities of a research station would be in the nature of "extension support activities", as research outreach was called. It was recognized that this was a ratio that would require review and possible adjustment.

It is significant to note that the specifically stated that research outreach would be conducted in "cooperation with local extension activities". (A relationship also stressed by Benor and Harrison. They further stated "Field trials carried out in farmers' fields are a vital feature of the extension operations".)

Aside from these brief statements from the DOA directives regarding research outreach have not been elaborated. With research outreach activities gradually being expanded as research supports extension, it is time that more specific directives are developed. Since the Agricultural Extension and Research Project is involved in essentially all of the Terai stations, and the several districts of their command areas, the objectives of research outreach and implementation could be applied to these situations and to other stations wishing to initiate research outreach activities in their command areas.

B. Research Station Activities

Research station activities might be classified according to the way they are serving farmers. These could include:

a. Station research to develop new technologies and learn more scientific truths that could be useful in developing technologies of use to farmers.

b. On-station service functions - Plant protection diagnostic service, soil testing, seed testing, training, seed production, and extension information services.

c. Research outreach - This activity includes all trials etc. organized by researchers and extension personnel to be conducted in farmers' fields.

d. Direct participation in extension activities. This would range from a Subject Matter Specialist based at a research station who devotes 100% of his time to on-farm research and extension activities to the administrator who may participate in field days and other activities on farmers' fields. Intermediate activities include training programs for farmers and extension workers where the research staff function as resource persons and trainers.

1. Service Functions Other Than Research Outreach

Experiment Stations provide on-station services which support extension that could well be attributed as a component of the 40% of station time toward serving farmers. These are true service functions of a research station and include seed multiplication, training, soil testing, seed testing, plant disease and insect diagnostic services, farmer field days, and extension information.

Seed multiplication has been considered an important role for experiment stations and should not be underestimated as a service function of the station. Policies governing numbers of varieties, number of crops, which varieties and volume targets have been established by central committees. With the development of a more regional approach to seed requirements more local control needs to be exercised in this area in order for the stations to be of better service.

Training has long been a service of the research stations and now training officers are assuming an ever more important

role as a component of the T and V system. The specialists also will be called on to be resource persons as training is given to SMSs and even to farmers, JT/JTAs and others.

The other service components mentioned are not so well established and, therefore, are not of so great value at the moment but could become useful services to farmers in command of those centers which have these capabilities.

The experiment station is the technological base for the Subject Matter Specialist. As such, the linkage between the SMS and the station should be a strong one. This linkage is being fostered through the bimonthly meetings and the semiannual workshops. Benor and Harrison recommend that initially SMSs should spend one third of their time at research stations, wherever the relevant technology is being generated.

Experiment stations also provide services by becoming directly involved in extension activities. In addition to serving as trainers in training programs and technical resource persons in semiannual and bimonthly meetings research staff involved in Farmer Field Days in farmers' fields can contribute to the effectiveness of the extension program.

2. Research Outreach as a Support to Extension

Research in research stations is for the purpose of developing technologies which farmers can use on their farms to increase their production, improve their nutritional balance, their incomes or any combination of these three goals. Then why is research on farmers' farms necessary?

Perhaps the basic predominant reason is that small subsistence farmers are not accepting *in toto* the recommended technologies that have been developed by researchers and which are being promoted in extension programs. Socio-economic research has indicated that farmers do not adopt technologies because these technologies are not suited to their conditions or their resources or

the risks are too great. In other words, the technologies do not fit the circumstances of farmers. Circumstances of small farmers not recognized by researchers include the level of his resources, the cropping patterns used, mixed cropping instead of sole cropping, the discontinuous scattered arrangement of his farm parcels, other enterprises of his system, and the subsistence nature of these farms which greatly influence decisions farmers make. Byerlee et al* from CIMMYT have elaborated on farmers' circumstances as a basis for planning research as follows:

"Farmers' circumstances are those factors that affect farmers' decisions about what technologies to use in growing a crop. Expressed this way, farmers' circumstances explain both a farmer's current technology as well as his decisions about changes in that technology. They include natural and economic circumstances. Economic circumstances can be divided into those that are internal to the farmer, and over which he has some control (e.g. his goals and resources), and those that are external (e.g. markets).

Almost all farmers wish to increase their income - broadly defined to increase production for home consumption. Generally, too, small farmers want security in meeting subsistence requirements of their preferred foods. Most also want to avoid taking risks that might endanger their subsistence supplies or sources of cash income.

Farmers have relatively fixed quantities of resources - land, family labor, and capital - that they can allocate to meet these goals. (Capital resources here include both durable equipment and cash.) Farmers may allocate these resources to different uses. Within limits, they may also adjust the amount of a resource - for example, they may use some of their cash to rent more land or hire more labor.

Many circumstances also shape the economic environment in which farmers make decisions. These include the prices and price

* - Byerlee, Derek, Michael Collinson et al, Planning Technologies Appropriate to Farmers - Concepts and Procedures, CIMMYT, Mexico, 1980.

variability for inputs and products, access to inputs and product markets, land tenure systems, credit facilities, physical infrastructures (roads, dams, irrigation channels, and so on). While this economic environment is largely outside of the farmer's control, it is influenced by many policy decisions about distribution of inputs, price supports, infrastructure development, and so forth. A large number of natural circumstances also condition the farmer's decision making such as soil slope and depth, climate, weeds, and pests.

In making decisions, the farmer generally accepts as fixed external natural factors, like rainfall, and economic factors, like prices, though he may be able to modify their effects. A farmer may know, for example, that he has soils of different fertility so he may decide to plant crops that meet his subsistence food preferences on the best soils to meet his goal of food security. Many external factors, particularly rainfall and prices, are variable and unknown to the farmer when he makes decisions. They provide an element of risk, which may have important effects on farmers' decision-making. For example, although a farmer may not be able to predict rainfall, he is aware of its likely variability and therefore he may plant a crop at several dates to spread the risk of a dry period striking at a critical stage in the crop cycle.

Most of these factors have direct effects on farmers' decisions about a technology for an individual crop. Late-season frosts might cause farmers to seek an early maturing variety to reduce risks. Expensive labor encourages farmers to use a less labor-intensive weeding method such as herbicides.

Many factors affect the choice of a technology for the target crop indirectly because of interactions in the farming system. The farming system is the totality of production and consumption decisions of the farm household, including the choice of crop, livestock, and off-farm enterprises, and food consumed by the household. For example, a farmer may choose to plant maize late because he is planting beans early to avoid late-season disease

problems in beans. Or he may plant an early variety of maize in order to have food early in the season before other crops mature. The point is that crop technologies often result from decisions made for the farming system as a whole. Consequently planning technologies for one crop requires knowledge of important interactions in the farming system, which potentially influence that crop. These are system interactions.

The environment in which farmers make decisions changes over time. In particular, the external economic env onment is characterized by changes in the ratios of input prices to product prices, which affect farmers' decisions. Changes in the external economic environment may also directly affect farmers' goals and resources. As the market for food staples expands, farmers usually become more willing to depend on it for food supplies and hence food preferences decline in influence on production decisions. Likewise, a new credit program may increase farmers' cash availability.

In the same way that farmers' circumstances determine a current crop technology, they are also important in a farmer's decision to change his technology. If a change in a technology conflicts with any of the circumstances of farmers, that technology may be rejected. For example, new varieties may be rejected because they are not suited to the soil conditions or because they ripen too late for the planting of the next crop. Fertilizer recommendations that aim for maximum yields may be rejected because they are not consistent with either the farmer's income-increasing or risk-avoiding objectives.

When farmers reject technologies it is not because they are conservative or ignorant. Rather, they rationally weigh the likely changes in incomes and risks associated with the technologies under their natural and economic circumstances and decide that for them the technology does not pay. The researchers' task is to incorporate knowledge of farmers' circumstances into the design of technologies so that they are consistent with those circumstances".

Zandstra et al* at IRRI have set forth the requirements for an on-farm research system as follows:

"1. The type of research has to be related to a specific production environment. In this way a close fit of technology to the physical and socio-economic limitations and opportunities can be achieved. Understanding of the environment aids the extrapolation of research results.

2. Farmers have to participate in the design and testing of new multiple cropping technologies. This ensures early feedback from farmers about input management, equipment, and market-related constraints to the adoption of promising production alternatives.

3. The research team has to cover several commodities and crop-to-crop interactions and be multidisciplinary in nature. A team that combines abilities in soil and crop sciences, crop protection, and agricultural economics is required to study several crops within a cropping system.

4. The methodology has to provide a clear identification of different tasks and the responsibility of the different team members for each task.

5. The research has to emphasize the formulation of cropping patterns that increase cropping intensity and that are acceptable to farmers".

To effectively develop technology, research on farmers' fields must be with participation of farmers themselves. They become a part of the research team. Otherwise, the question of what is appropriate to his conditions, or his goals may not be answered.

A few of the reasons for conducting research on farmers' fields can be listed as follows:

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* - Zandstra, H.G., E.C. Price, J.A. Litsinger, and R.A. Morris, 1981. The International Rice Research Institute, Box 933, Manila, Philippines.

1. Determine the comparative performance of experiment station technology with what the farmers are already doing.

2. Determine how the experiment station technology fits agronomically and socio-economically with the farmers and their enterprises, patterns, and systems.

3. Learn farmer conditions and in so doing develop an understanding of these circumstances and problems so that on-farm experiments can be judiciously designed.

4. Use this knowledge to guide problem solving research in the research stations.

5. Establish linkages between research and extension.

6. Close the gap between existing agricultural practices and research findings by developing and disseminating technologies from farmers' fields. (Studies in Nepal indicate that there is a lack of knowledge on the part of farmers about the new technologies. It is not a case of rejection but one of knowledge upon which farmers can make a decision to accept or reject a technology.)

7. On-farm research is an initial step in the transfer of technology from research station to farmers. It is a beginning, not the end, of the technology diffusion process.

8. Get farmers' assessment of the technology.

9. To develop farmer recommendations for farmer conditions. On-farm research will develop recommendations under conditions similar to those where they will be applied in farmers' fields.

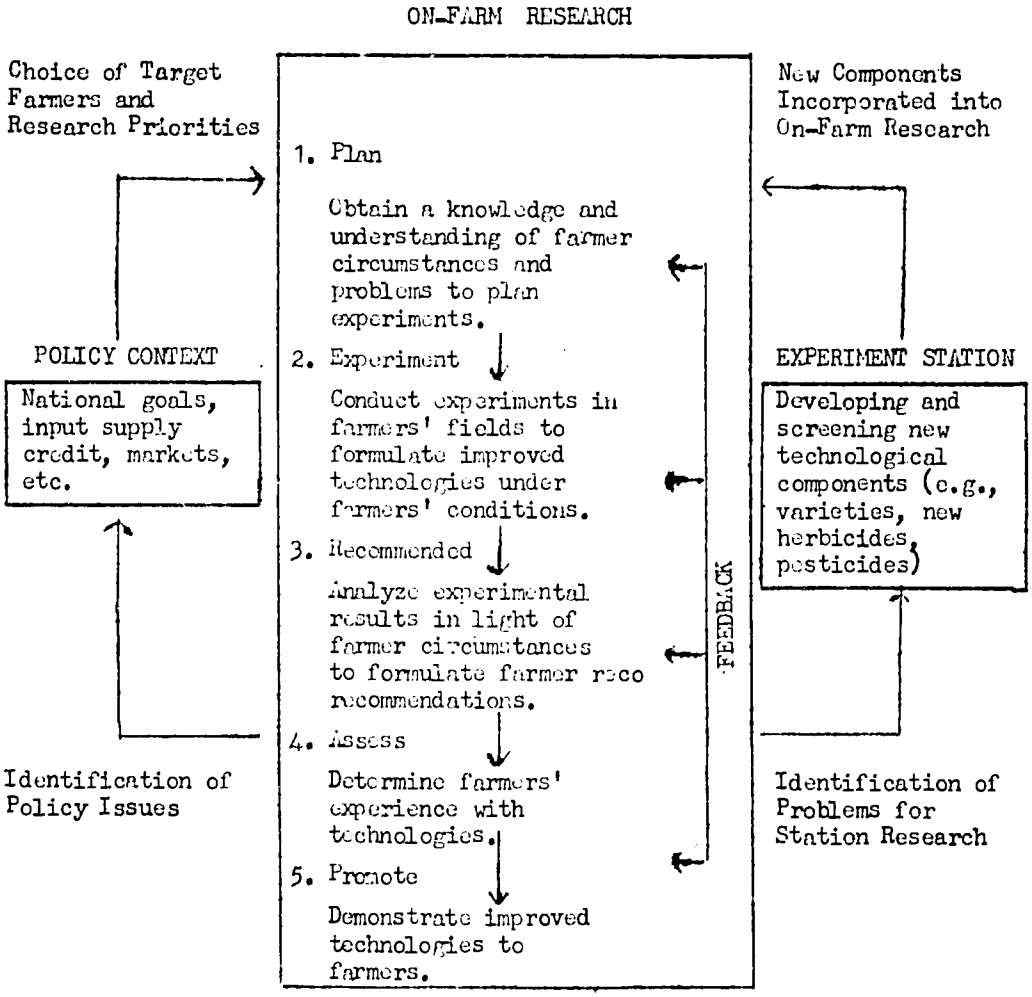
10. To serve as a training for extension and research personnel involved or to be involved in production since it provides a linkage to new technology developments.

11. Another important set of recommendations to come from on-farm research are those which will go to policy makers to enable them to consider policy issues that could have a profound effect on the trends in production.

After listing these reasons for research outreach one might conclude that experiment station research is not necessary. On the contrary, experiment station has a specific role in the development of component technology such as new varieties. Conditions can be more precisely controlled in a research station and this is required in order for the breeder to make effective selections for varietal improvement. Once these populations are stabilized or selections made from among larger numbers they are ready for evaluation in farmers' fields under adaptive trial conditions. The feedback from adaptive research in farmers' fields can and should be a valuable guide to station research, for example, farmer preference for a variety of specific maturity that will fit his cropping pattern, or one which is better suited to threshing or storage conditions that prevail.

CIMMYT has provided a diagram (Figure 1) of the various relationships that exist between research station, on-farm research and national policy issues. On-farm research as outlined covers a 5-stage process from planning to demonstration phase.

Figure 1. Overview of an Integrated Research Program (From Byerlee et al)



C. Types of Research Outreach Trials in Farmers' Fields

Research can include Farmer Field Trials which have been generally considered to be only variety trials. However, a more broad designation could be component technology trials. The National Maize Development Program has clusters of simple trials which include variety trials, fertilizer trials, perhaps insect control experiments, or population density or other experiments in clusters, all component technology trials in farmers' fields.

Minikits are both research and extension. They are a part of assessment, stage (4) of CIMMYT's diagram. They have a wide dissemination so that farmers who like a variety within a group of varieties in the minikit can save seed and use it for further crop production and for dissemination to their neighbors. If farmers are adequately sampled, feedback from minikits can provide good information to guide research. As a guide for seed production, minikits are better than FFTs, especially if there are regional preferences or adaptations of a variety.

Management minikits can be considered "diamond" trials. These minikits include at least four comparative practices which could include the local variety-local practices (what the farmer is presently using); local variety - improved practices; improved variety - local practices; and improved variety - improved practices.

Cropping Systems research has been a more comprehensive on-farm research. A series of logical steps established in cropping systems research are essential to serving objectives and serving farmers by an on-farm research program. These include:

a. Reconnaissance
b. Site Survey
c. Determining patterns to test
d. Determine trials to be superimposed on the pattern(s)
e. Establishment of trials:
    i) Pattern trials
    ii) Component technology trials
    iii) Researcher-managed trials
f. Pre-Production Verification or Pilot Production
g. Production.

These steps have been presented in diagram form by IRRI (Fig. 2). It will be noted that the activity extends to production. In other words, the end product of the on-farm research is production - not research per se.

This research system has evolved as a system to improve pattern performance of cropping patterns of small farmers. Crops compete with one another in systems not only biologically as an interculture situation but for the farmers' resources of land, labor, and capital. Pattern studies seek to provide better component technologies that fit or improve existing patterns. This type of research can best be done in farming situations under farm conditions.

Extension personnel may be concerned about the role of the traditional extension methods in a dynamic research-extension system. Although terminologies differ, types of plots may change, and numbers of farmers reached may differ, the end objective of helping farmers increase production is the same. The minikit or preproduction verification trials become "result demonstrations" of traditional terminology. New practices in these trials become "methods demonstrations".

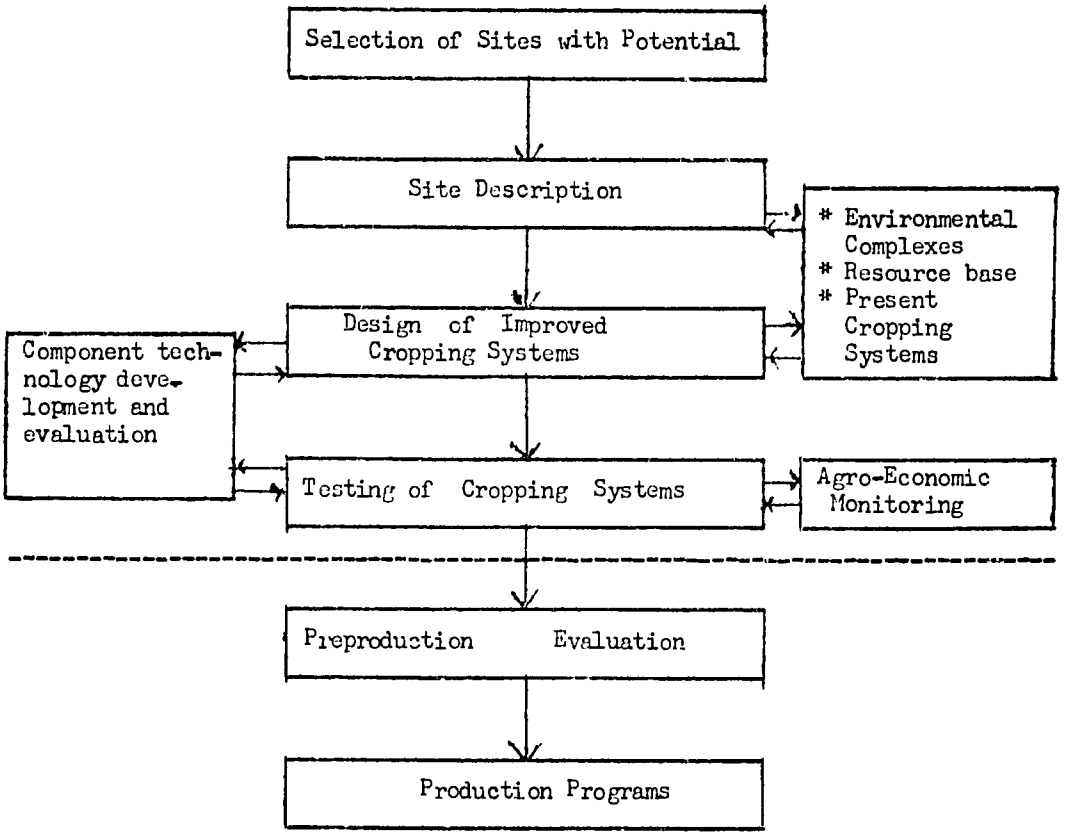
The really significant difference between the research-extension system and the traditional extension system which ends with production demonstrations is that the production programs, as envisaged by HMG in planning for intensive areas, pocket programs, or in general production, are the end product. The impact is a planned phase of the entire system - not one left to chance or without observation. Feedback in production campaign stages can be vital to determine those aspects of national policy which are critical to production and may thus be constraints to the achievement of national production goals.

D. Implementation of Research Outreach

1. A Comprehensive View

Since the research stations involved in AERP have different national and regional responsibilities their approach to on-farm trials could be quite different and experience shows they are different. To reduce these differences that may come from the major commodity stations a different approach to on-farm testing has to be implemented. Instead of the rice station concentrating on rice trials in farmers' fields and similarly the wheat station concentrating on wheat trials, a cropping

Figure 2. Components of the Research Outreach Methodology
(From Zandstra et al)



systems approach is required if farmers problems are to be approached on the basis of their relative importance to farmers in an area.

CIMMYT has given four steps in planning on-farm research. These are -

"Researchers must make a series of decisions in planning an on-farm experimental program. First, researchers must determine if farmers in the region are sufficiently alike to allow a common set of experiments and a common recommendation. If there are significant differences among farmers (and parcels), researchers must somehow divide farmers (parcels/patterns) into more homogeneous groups and design experiments for each group.

Second, they must then decide which problems are going to be investigated and which technological components will be included in experiments for each group of farmers (parcels). For each technological component chosen, the levels, timing, and type of input or practice must be decided.

Third, for each set of experiments, researcher must determine the level of non-experimental variables or those variables that are fixed for all treatments in the experiments.

Finally, the researchers must choose sites on which to locate the experiments. The circumstances of the farmers for whom the technology is intended will be a key factor in all of these decisions".

(parenthical insertions are this author's)

2. Information for Decision Making

Basic to sound on-farm research will be the methodological approach to this type of research. This has been addressed in the case of the cropping systems research program (Fig. 2) so that the research phase and the preproduction verification phase both start with acquisition of knowledge regarding the

farmer and his circumstances. This will compose the site survey.

This is a basic phase which should and must be adopted for all research outreach from a station. The procedures and questionnaires to use in this phase have been developed and are reproduced in the "Guidelines for Preproduction Verification Trials of Cropping Systems Recommendations. Appendix A" and in "Guidelines to Research Outreach".

Site description includes information which can be provided by survey or from existing data -

1. Identification of land types.
2. Identification of existing crops, crop varieties, cropping patterns and farming enterprises.
3. Description of cropping systems determinants eg. rainfall and rainfall patterns, temperature, occurrence of hail, drought, or flooding.
4. Description of farm types and the farm resource base.

This can be provided by secondary data from agroclimatic information on rainfall, temperature, soil characteristics, topography, population and related information which may be available from existing sources. A key informant survey of the Pradhan Panch of the panchayat and two knowledgeable farmers of each ward can provide additional basic information for the site description and from which on-farm research can be planned.

3. Establishment of Field Trials

The next step is to design all trials on a pattern basis. Predominant patterns have been determined on the basis of the surveys already conducted and decisions made regarding which patterns are to be verified.

In most cases, in view of research data already available from on-farm trials these pattern trials would be preproduction

verification trials. Trials would be established to verify existing technologies in the selected areas. If the survey indicates a predominance of other patterns than those presented in the "Guidelines for Preproduction Verification Trials of Cropping Systems Recommendations" then a pattern research program could be initiated in collaboration with the Cropping Systems Program.

Superimposed on these pattern trials will be adaptive trials of component technology. These are a common feature of cropping systems research. Superimposed trials could be variety trials, fertilizer trials, insect control experiments, etc. Data to be collected would then be -

1. Pattern data over a 12-month crop cycle on:
   - i) Improved practices
   - ii) Farmer practices
2. Component technology data within patterns
   - i) FFT of the principal crops in the patterns
   - ii) Cluster-of-trials involving the major crops
   - iii) Minikit trials which could include minor crops as well as major crops.

Such an approach to on-farm research simplifies the procedures and yet makes the data collected much more comprehensive than if these data were collected independently from larger numbers of farmers.

Shaner et al* (Table 1) compare the characteristics of farmer-managed trials which will be the predominant type of on-farm trial and the superimposed and researcher-managed trials. These are good guidelines to an understanding of these three types of on-farm trials.

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* - Shaner, W.W., P.F. Philipp, and W.R. Schmehl - Farming Systems Research and Development - Guidelines for Developing Countries, 1982, West View Press, Boulder, Colorado.

4. Pre-production Verification of Patterns

Cropping systems research and earlier FFT's have established some information at the farmer level so that judgements and decisions can be made regarding how to proceed with research outreach.

Much of the present technology, component and pattern, to be used in farmers' fields can be said to be at the preproduction evaluation (verification) stage.

At this research outreach stage some components of the original research process are to be repeated. The diagram (Fig.2) will be followed as outline in implementing research outreach by the station team working in collaboration with the extension SMS, JT, JTA and contact farmers.

Sites selected for preproduction evaluation must be reasonably certain to provide a demonstrable impact in production by an increase in productivity through increasing crops in the pattern or by increasing cropping intensity of the pattern.

The cropping pattern research already conducted at research sites has generally taken into consideration at least three levels of suitability. Zandstra et al have classified these as biologically feasible, technically feasible and economically viable. In the preproduction verification stage the patterns and levels of inputs used have been designed with these three levels of suitability under consideration. Verification is to relate the economically suitable levels with those the farmers are now using.

5. Use of Components in Superimposed Trials

The component technology trials to be superimposed on the patterns should, according to IRRI,

- "evaluate the return farmers derive with existing practices from purchase of material inputs used for fertilization, pest and disease control and weed control;

Table 1. Comparison of Researcher-Managed Trials, Superimposed Trials, and Farmer-Managed Tests for Cropping Systems Experiments (From Shaner et al)

Characteristics of Trials and Tests*	Researcher-Managed Trial	Superimposed Trial	Farmer-Managed Test
Plot size	Generally small - on the order of 75 square metres	Both large and small	Generally large - on the order of 1,000 square metres
Number of treatments	5.20	4.6	2 - 4
Number of replications per field	1.5+	1.2	1.2
Total replications across farms, per land type	4.5+	4.10	4.25
Field design	Completely randomized, randomized complete block, randomized incomplete block, split plot	Completely randomized, randomized complete block, randomized incomplete block	Completely randomized, mostly paired treatments
Sensitivity to treatment differences	Medium to high	Medium to high	Low to medium
Types of data collected	Physical and biological	Predominantly physical and biological, but some socio-economic	Physical, biological, socio-economic

* - These characteristics will vary with experimental objectives, type of treatment, farm size, and cooperating farmers

+ - Usually all replications will be placed on one farm field to give the complete experiment. However, if the field is small and only one or two replications on a field are possible, additional replicates will be placed on other fields of the same land type to give a total of four or five replications for the treatment.

- evaluate the return the cropping pattern component technology obtains from these inputs;
- determine if it is possible to modify the management components assigned to the cropping pattern for weed, insect, and disease control and fertilization that lead to increased yield; and
- determine if these yield increases are sufficient to pay for the additional costs of modified management practices.

To achieve these objectives, superimposed trials must include -

- a simulation of the farmers' management level;
- the farmers' management level without any purchased material inputs;
- the level of component technology assigned to the cropping pattern; and
- a level of component technology that is expected to produce higher yields than the cropping pattern at the same or higher levels".

The trials presently being put in farmers' fields do not meet all these criteria and these may not be always necessary. When designing trials for research in farmers' fields, these criteria can be useful in including treatments or varieties that will give comparable data in one 12-month cycle upon which the team could make determinations regarding plans for production, retesting etc.

6. Where More Specific Information is Needed from On-Farm Trials Without Risk to Farmers

Researcher-managed trials are those which could be considered when more detailed information is to be obtained in farmers' fields regarding a component technology. A good illustration of this is the fertilizer trial. Research stations often do not

have soils which are representative of farmer conditions so that fertilizer trials conducted on research stations are often misleading regardless of the quality of the trials being conducted. To put these in farmers' fields will require greater numbers of treatments, and more specific control of other variables. These trials are best managed by the research station staff itself. By contrast many aspects of the patterns trials and simple component trials can be handled by the farmers or the extension staff.

Researcher-managed trials are as the name implies, to be managed primarily by the research-extension team itself in contrast to the trials already mentioned which could be considered farmer-managed.

Shaner et al list several ways in which researcher-managed trials may be of value.

"1. Provide means of screening available technologies according to their suitability for different types of farmers and conditions.

2. Help the research-extension team define the characteristics of the research area more precisely.

3. May be used to partition the research area according to physical gradients that cannot be recognized visually, such as a change in moisture availability with distance from an irrigation source or across rainfall gradients.

4. Assist the team in recognizing the gap between current and potential yields.

5. Provide an opportunity for the team to work with and learn from farmers.

6. Give the team the opportunity to experiment with riskier treatments because the farmers' welfare is not at stake.

7. Allow the team to identify some of the difficult and less successful experiments before proceeding with farmer-managed trials".

E. Mechanism For Establishing Research Outreach Trials

Tho identification of sites for research outreach activities and the site survey lead to a stage of problem identification and planning. These phases can be done best within the existing framework of the AERP. The semiannual meeting provides opportunity for research and extension staffs of the command areas to meet for the purpose of reviewing existing information, establishing priorities for problem solution and designing on-farm trials to solve these problems.

Using trial information already available the patterns to test in the chosen site can be determined. These would be those predominant patterns as revealed in the site descriptions. The number of patterns to be tried would need to be restricted to no more than four, preferably less than this number, since each would be replicated among five different farmers. These would be the pattern trials to be conducted in the area. Information available from Cropping Systems would indicate if pattern information is already available.

The pattern information to use has been presented in the "Guidelines for Pre-production Verification Trials of Cropping Systems Recommendations" and would determine the technologies to use such as crop varieties, cultural practices, fertilizer rates etc.

In addition to the pattern trials the semiannual workshops would determine what component trials will be needed to gather supplemental data of a regional (command) area concerned. These component trials will be dictated by the problems of an area and the priority which the semiannual workshop placed on these problems. Farmer Field Trials of varieties are an ongoing function of commodity programs and would logically be superimposed upon the patterns selected. Simple fertilizer trials will also be superimposed upon patterns.

In the initial stages of the research outreach program, minikits, which have fewer varieties than the FFT, would also be superimposed on the selected patterns but only if they contain different varieties than the FFT or vice versa. Simple cultural-practice trials of the

nature of those used in the maize program in a cluster-of-trials could also be superimposed.

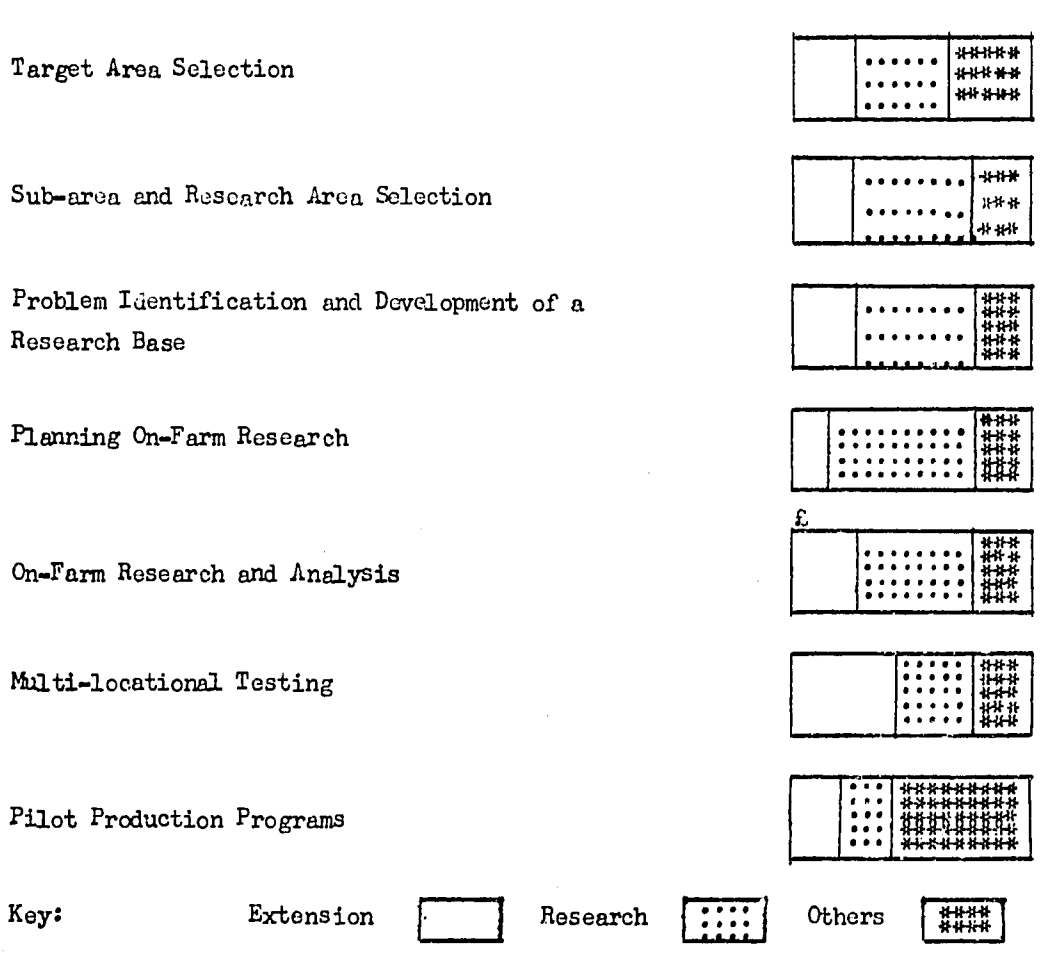
F. Respective Roles of Research, Extension, and Support Agencies in Research Outreach and Production Activities

Research outreach is a support service to extension but it cannot be conducted in isolation from extension. It must be conducted in conjunction with the extension service and with farmers. Shaner et al point out that farming systems is a new concept and the respective roles of research and extension have not been fully developed. They have provided a concept of the relative effort of extension, research and other agencies in the various activities of a research and development program (Figure 3).

Research outreach as a support service to extension would need collaboration from extension itself. Shaner et al have outlined the role of extension in the various activities of a research and development process. An adaptation of their table is presented in Table 2.

It has already been cited (Fig. 3) that research outreach is to be done in collaboration with extension, and for good reason. As farmer recommendations (the product of on-farm research) are developed they are to be put to use in production programs. The entire process is a dynamic one in which research personnel are involved from the research station to the on-farm research phase. Extension personnel and farmers are also involved in this phase as well as in the formulation of farmer recommendations. In the preproduction and production phases the extension personnel and farmers assume a dominant role and research personnel a monitoring role to assess the level of acceptance of different components of the technology.

Figure 3. The division of effort between extension, research, and "others" for each activity in the FSR & D process. These are theoretically useful divisions of effort; the actual divisions of effort depend on the specific conditions in each country. "Others" include those such as national decision makers, AIC, ADB, production program personnel, farmers.



(From Shaner et al)

Table 2. Extension's participation in research outreach and development activities (adapted from shaner et al)

Activity	Extension Participation
Target area selection	- Participate as team member to identify target area. - Cooperate in supply of secondary and primary data for site description.
Selection of Sub-area and farmer cooperators	- Team member in sub-area selection within panchayat - Identification of farmers for survey for site description and trials on their farms.
Problem Identification	- Participate in semiannual workshop to review and assist in formulating research plans to provide assessment of farmer problems and feedback to researchers regarding recommendations, on-farm trials etc.
Planning on-farm Research	- Help identify current farmer practices. - Help identify farmer cooperators. - Provide feedback from farmers to researchers.
On-Farm Research and Analysis	- Assist in supervision of farmer-managed trials. - Assist in farmer evaluation surveys. - Assist in data collection. - Review data presented in semiannual workshops. - Develop recommendations for further trials and for production.
Extension of results	- Organize field days to acquaint farmers with trials in farmers' fields which can be used as demonstrations.
Pilot Production Program	- Help determine feasibility of the new technology. - Assist in bringing about changes in support systems such as MIC and ADB. - Assist in defining and coordinating tasks of cooperating agencies. - Help in finalizing the package of new technology into extension literature for defined area campaigns.

Summary

This paper seeks a rational integration of the research outreach program of the research stations with the Training and Visit (T and V) systems of extension and the cropping systems methodology of on-farm research. All of these programs have a common focus on farmer problems, the development of farmer recommendations to increase his production potential, and acceleration of the transfer of technology into production programs that will have a significant impact on production.

There is no conflict but a complimentarity of activity and responsibility of research and extension in the on-farm research phase. This logically leads to the production phase in which other agencies such as the AIC, ADB and others will play a significant role if farmers are to respond to the technologies presently available and others which can be effectively developed by the methodologies and interactions outlined.

REPORT ON FINGERMILLET - 1982

- K.M. Singh,
- D.B. Tamang, and
- A.N. Bhattarai.*

In Nepal, fingermillet (Eleusine coracana) is cultivated in about 1,21,800 hectares out of which 80% lies in the hilly region. It is cultivated both as mono as well as relay crops with maize. Relay cropping of fingermillet with maize is prevalent in hilly area. The national average grain yield of fingermillet is 1.31 t/ha.

Two varieties of fingermillet, Dalle-1 and Okhale-1, have been recommended for general cultivation. Dalle-1 is for Inner Terai to mid hill regions (upto 1500 m.), and Okhale-1 for mid hill to high altitude regions (2400 m.). About 620 kg seed of recommended varieties Dalle-1 and Okhale-1 were sent to various districts for their distribution with a view to promote and evaluate their yield potential in the different agro-climatic conditions through the cooperation of respective District Agricultural Development Offices.

SUMMARY OF THE TRIALS CONDUCTED IN 1982:

1. Advanced Varietal Trial (AVT)

Seven entries were tested in this trial. The trial was conducted at Khumaltar, Kabhre, Jumla, Kakani and Pakhribas. This trial was conducted as a sole crop except at Pakhribas, where it was relayed in maize crop.

At Khumaltar, the grain yield of NE 1304-43, IE 143, Dalle-1 and NE 6401-26 were 5750, 5625, 5450 and 3375 kg/ha which were significantly higher than the local check. The yield of local check was only 175 kg/ha. Local check which took about 153 days was the most late maturing variety. IE 143, NE 1304-43 and NE 1305-55 matured in 104, 107 and 107 days

* - Assistant Agronomist, Agronomy Division, Khumaltar; Agronomist, National Maize Development Program (NMDP), Rampur, Chitwan and Chief Agronomist, Agronomy Division, Khumaltar respectively.

respectively. They were earlier in maturity among the entries. Local check and NE 1304-43 were highly susceptible to root-rot disease (Sclerotium spp.) while Dalle-1 was slightly susceptible to root-rot diseases.

At Kabhre also, the grain yield difference was highly significant. The grain yield of NE 1304-43, NE 1305-55, IE 143 and Dalle-1 was 3600, 3500, 3150 and 3150 kg/ha respectively, whereas, the local check yielded 2450 kg/ha. Here too, the local check was the longest duration variety and IE 143, NE 1304-43 and NE 1305-55 were early maturing entries as compared to the entries tested. The local check and NE 1304-43 were highly susceptible whereas the variety Dalle-1 was slightly susceptible and varieties IE 143, NE 1703-34, NE 1305-55 were moderately susceptible to blast.

At Jumla, the yield differences were not significant. Local check gave the highest grain yield (2265 kg/ha) and the entry NE 1305-55 gave the second highest grain yield (1824 kg/ha). Days to maturity of IE 143, NE 1703-34 and local check were 165, 167 and 175 days respectively.

At Kakani, transplanting was late and hence grain yield of all the entries were low. NE 1305-55, NE 1304-43 gave more grain yield than local check. NE 1305-55 was shortest duration variety among the lot.

At Pakhribas, fingermillet was relayed with maize. Grain yields were low because of high percentage of sterility. Local check was the most late maturing variety among the entries. Details have been given in table 1.

2. Preliminary Evaluation Trial (PET)

Fifteen entries were tested in this trial. Trial was conducted at Khumaltar and Kakani.

At Khumaltar, the grain yield of IE 143, Dalle-1, NE 1305-55, NE 1010-1, NE 1305-46, NE 1002-2, NE 1703-34, NE 6401-26 were 4300, 3675, 1725, 1650, 1450, 1175 and 1150 kg/ha respectively which were

significantly higher than the local check (125 kg/ha). Varieties IE 143, NE 1703-34, NE 1305-55 were early maturing among the lot. Local check, NE 1304-43, NE 010-2, NE 3201-2 and NE 1001-4 were highly susceptible to root-rot disease (Sclerotium spp.). Incidence of this disease was only traced in case of Dalle-1.

At Kakani, entries IE 143, Dalle-1, NE 1304-43 and NE 1102-12 gave more grain yield than the local check. IE 143 and Dalle-1 were shortest duration varieties in respect to maturity. In this trial the treatments were not significant. Details have been given in table 2.

3. Relay Cropping of Fingermillet in Maize in Different Dates of Transplanting

In this experiment there were four dates of transplanting viz., 29th July, 6th August, 29th August and 2nd September. This trial was conducted at Khumaltar. About 28 days old seedlings were transplanted. The fingermillet variety was Dalle-1 which was transplanted in the maize seed multiplication plot. The inter-cropped maize variety was Arun. Nitrogen at a rate of 15 kg/ha was top-dressed after removing the maize stunts. Maximum grain yield of 915 kg/ha was obtained from 6th August planting. The grain yield from 29th July and 29th August plantings were 674 and 702 kg/ha respectively. The lowest yield was obtained from the last planting, i.e. 2nd September. The difference between the treatments was significant. The yield of the treatments 1 and 3 were at par, but the second treatment was significantly different only from the last treatment. Details have been given in table 3.

4. Farmer's Field Trial

A set of farmers' field trial comprising of five varieties NE 1304-43, NE 1305-55, NE 6401-26, Dalle-1 and NE 143 were sent to Ilam, Parbat, Palpa, Jumla, Pakhribas and Lumle. The result from Pakhribas only was available. The varieties NE 6401-26, NE 1305-55, IE 143 and NE 1304-43 produced 694, 301, 209 and 97 kg grain hectare respectively whereas the local check produced only 75 kg/ha. Dalle-1 was not included in this trial. The local check was the most late maturing variety among the

entries. Details have been given in table 4.

5. Minikits

There were four varieties of fingermillet in minikit packets. They were Dalle-1, Okhale-1, NE 6401-26 and NE 1305-55. The minikits were sent to 12 different hilly districts. The shortest duration entry NE 1305-55 was sent to Jumla. These minikits were relayed into maize crop. Details have been given in table 5.

CONCLUSIONS:

The trials and the observations clearly indicate that some of the lines tested have higher yield potential as compared to local ones. Some lines such as IE 143. NE 1703-34 and NE 1305-55 were short duration varieties among the entries in all the locations indicating a possibility of replacing late maturing varieties with the early maturing ones.

ACKNOWLEDGEMENTS:

The authors are thankful of different Agriculture Stations and Farms for conducting the respective trials, and are grateful to respective Managers and District Agricultural Development Officers for helping to run the fingermillet program successfully.

Table 1:

Grain Yield (kg/ha) and Plant Height (cm), Days to Panicle Emergence and Maturity of Different Fingermillet Varieties, Fingermillet Advanced Varietal Trial, '82

Sl No.	Entries	Grain Yield					Plant Height		
		Khumaltar	Kabhre	Jumla	Kakani	Pakhribas	Khumaltar	Jumla	Pakhribas
1	NE 1304-43	1150	1325	1304	350	216	90	75	66
2	NE 1703-34	5750	3600	1486	300	170	74	76	56
3	NE 1305-55	2650	3400	1824	350	309	92	75	68
4	IE 143	5625	3150	1446	175	224	91	78	53
5	NE 6401-26	3375	1700	1356	300	723	96	84	74
6	Dalle-1	5450	3150	1588	150	592	122	98	67
7	Local Check	175	2450	2265	325	254	60	95	64
	F	**	**	**	NS				
	CV %	55	24	8	35				
	LSD (0.05)	2794	962	189	-				

Sl. No.	Days to Panicle Emergence					Days to Maturity				
	Khumaltar	Kabhre	Jumla	Pakhribas	Kakani	Khumaltar	Kabhre	Jumla	Pakhribas	Kakani
1	97	104	153	126	142	149	162	195	197	210
2	65	84	116	91	127	107	131	167	152	177
3	78	84	138	90	118	118	137	175	152	170
4	66	82	112	89	122	104	130	165	151	175
5	87	101	120	108	132	134	153	179	166	180
6	90	103	147	119	148	137	162	195	187	195
7	100	102	119	121	140	153	164	175	193	204

Table 2: Grain Yield (kg/ha) and Other Characteristics of Fingermillet Varieties, Preliminary Evaluation Trial - 1 9 8 2.

Sl. No.	Entries	Khumaltar				Kakani		
		Grain Yield	Days to Panicle Emerg.	Days to Maturity	Disease Reaction	Grain Yield	Days to Panicle Emergence	Days to Maturity
1	IE 14[illegible]	4300	66	104	T	950	118	199
2	NE 1102-12	575	102	149	H	725	142	208
3	NE 3801-2	650	104	150	VH	550	148	210
4	NE.....	1650	98	133	M	600	149	210
5	NE 1703-34	1175	66	106	M	600	130	193
6	NE 2101-21	650	98	147	H	700	145	205
7	NE 1305-55	1725	79	116	M	500	122	190
8	NE.....	100	100	143	VH	700	148	210
9	NE 1304-43	1025	98	143	H	776	148	208
10	IE 980	3675	90	140	T	875	145	202
11	NE 1305-46	1500	77	115	M	600	120	185
12	NE 1001-4	550	102	147	VH	650	146	208
13	NE 1001-2	1450	98	142	M	625	138	202
14	NE 6401-26	1150	90	140	M	550	134	198
15	Local	125	102	144	VH	575	146	205
	F	**				NS		
	CV %	50				40		
	LSD (0.05)	941				-		

****

Table 3: Relay Cropping of Fingermillet in Maize at Different Dates, Khumaltar, 1982

Plot Size : 7.5 m^2 (2 rows 18.75 cm apart 5m long plant spacing 10 cm)

Sowing Dates : Four - 1) S_1 = 29th July 1982 (Shrawan 14, 2039)
2) S_2 = 06th August 1982 (2039 Shrawan 22)
3) S_3 = 29th August 1982 (Bhadra 13, 2039)
4) S_4 = 02nd September 1982 (Bhadra 17, 2039)

Fertilizer : Maize - N P K
100 60 40 kg/ha
60 60 40 kg/ha basal
40 0 0 kg/ha top-dressing

: Fingermillet - 15 kg N/ha after removing the maize straw

Varieties : Maize - Arun
Fingermillet - IE 980

Sl. No.	Treatments	Grain Yield (kg/ha)	Maturity Days
1	S_1	674	170
2	S_2	915	
3	S_3	702	
4	S_4	254	
	F	**	
	CV %	51	
	LSD (0.05)	603	

Table 4: Farmers' Field Trial on Fingermillet - 1 9 8 2

Location : Pakhribas Agricultural Centre
Altitude : 1750 m.
Treatment : 5 (Five)
Plot Size : 26 m^2 (13 m X 2 m)
Spacing : Row to row - 20 cm
Plant to plant - 10 cm
Fertilizer : Manure @ 10 Mt/ha
Fertilizer @ 20 kg/ha (Top-dressing)

Sl. No.	Entries	Grain Yield kg/ha.	Days to Panicle Emergence	Days to Maturity
1	NE 1301-43	97	122	193
2	NE 1305-55	301	81	151
3	NE 6401-26	694	105	171
4	IE 143	209	88	151
5	Local Check	75	132	200

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Table 5: List of Fingermillet Minikit Distribution - 1 9 8 2

Sl. No.	Name of Districts	No. of Minikit	Variety
1	Okhaldhunga	10	Okhale-1
		2	NE 6401-26
2	Dhading	10	Dalle-1
		10	Okhale-1
		2	NE 6401-26
3	Dhankuta	20	Dalle-1
4	Nuwakot	10	Dalle-1
		10	Okhale-1
5	Dadeldhura	20	Okhale-1
		10	NE 6401-26
6 a	Sindhupalchowk	10	Dalle-1
6 b	IHDP, Dandapakhar	10	Okhale-1
		5	Dalle-1
		5	Okhale-1
		2	NE 6401-26
7	Kabhrepalanchowk	30	Dalle-1
8	Ilam	5	Okhale-1
9	Parbat	10	Dalle-1
		10	Okhale-1
10	Jumla	5	NE 1305-55
11	Lalitpur	10	Dalle-1
		10	Okhale-1
12	Bhaktapur	10	Dalle-1
		10	Okhale-1

FINGER MILLET INITIAL EVALUATION TRIAL - 1982

D.B. Tamang*

Introduction

Fingermillet (Eleusine coracana) is one of the most important cereal grain crop of Nepal, especially for the high hills, mid-hills and inner Terai. It has many valuable features which mark it off sharply different from the other food grain of the World. It is one of the hardiest crop suited for the dry farming that can be thought of. It can grow under conditions of very low rainfall, and can withstand severe drought, reviving again after a good shower of rain with remarkable vigour. Fingermillet is a grain of great nutritive value and considered more sustaining to people doing hard physical work than any other grain. The crop is remarkably free from stored grain pests and diseases which usually attack other grains. Its straw is a valuable fodder greatly esteemed particularly in the mid-hills both for working and milking animals. Inspite of the above mentioned importances, this crop is still neglected to this day. With an eye to promote and evaluate the response of improved management practices, fertilizers and manures an "Initial Evaluation Trial on Fingermillet" had been carried out at the Agriculture Station, Rampur, Chitwan since 1980.

Materials and Methods

An experiment was laid out in 1982 monsoon season, i.e., August planting at Agriculture Station, Rampur, Chitwan. A complete Randomized Block Design was adopted with four replications including fifteen promising entries of fingermillet. The levels of chemical fertilizers were 40:40:20 NPK kg/ha prior to transplanting in the form of complesal and muriate of poatsh. The entire amount of fertilizers were applied in a single dose as a basal dressing. A spacing of 20 cm row to row and 10 cm plant to plant was maintained in all the cases. The sowing of seed in the nursery bed was done on July 26, 1982. The transplanting of all the varieties was done on August 23, 1982. An intercultural operation was also done by manual labour. Besides this,

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different kinds of observations pertaining to yield of grain were recorded from time to time in the experimental plot.

Results and Discussions

The data with respect to grain yield, 50 percent panicle emergence, grain yield on per day basis and total crop days of each entries are shown in the table 1. The present finding is in consonance with the last years "Fingermillet Initial Evaluation Trial - 1981".

In the third year's trial also, it is found that the entry R. Local was the highest grain yielder by producing 4580 kg/ha. In the same fashion, NE (2101-21) and NE (1104-13) have occupied the second and the third position by yielding 3453 kg and 3400 kg/ha respectively. In this trial, Dalle-1 ranked fourth position having yielded 3120 kg/ha. Upto last year this had gained second position. On account of an abnormal drought during transplanting and growing period, about 5-10 percent plant population was totally dried and consequently could not revive. For this reason, slight reduction in the final grain yield was recorded as regards to Dalle-1. It has given an indication of slight susceptibility to drought as compared to other high yielding entries. There are some promising entries, e.g. NE (5401-21), NE (5401-26) and NE (5401-22). All these varieties have yielded within the range of 2258 to 2577 kg/ha. Analysis of variance on grain yield has shown highly significant difference among the entries tested.

Considering the duration of the crops in the field, these entries can be classified into three main groups. Of them, NE (2101-21), NE (1305-40), IE (143), NE (7303-34), NE (1101-12), NE (1305-55), NE (6401-22) and NE (6401-22) took 121-122 days to mature. Secondly, NE (6401-26, NE (6401-21), NE (1304-1), NE (1304-43), NE (1703-34), Dalle-1 and NE (1104-13) took 130-131 days and whereas R. Local took 155 days which was the most late maturing variety.

From the result it is found that the difference between treatments were highly significant. Unlike previous years, the variety R. Local was superior to all the entries in relation to grain yield. NE (2101-21) and NE (1104-13) were the second superior varieties in this experiment.

Conclusions

The selection strain R. Local, NE (2101-21) and NE (1104-13) have given an average grain yield of 4580 kg. 3453 kg and 3400 kg/ha respectively. On the other hand, the recommended variety Dalle-1 has yielded only 3120 kg/ha. In the last two years' experiment also the selection strain R. Local had produced the highest yield. In the same way, the selection strains NE (2101-21) and NE (1104-13) have given higher yield over Dalle-1. Considering their average performance over three years the selection strain R. Local proved to be the best having yielded 3757 kg/ha. The corresponding yields of selections NE (2101-21) and NE (1104-13) were 3453 kg and 3400 kg/ha respectively.

From the above result, we come to the conclusion that the promising selection strains, e.g. NE (2101-21), NE (1104-13), NE (6401-21), NE (6401-26), NE (6401-22) and NE (1101-12) need thorough investigations and research works in respect to other yield attributing, characters. On part of R. Local despite its high yielding potentiality, it still needs further selection works in order to strike balance between synchronous tillering habit and maturity period. The problem of rodents and birds is also unavoidable in the field.

Acknowledgements

The author would like to thank for Mr. R.P. Kantha for his valuable assistance during the field work at Rampur.

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Table 1: Fingermillet Initial Evaluation Trial, 1 9 8 2

Date of Sowing : 26/7/1982
Transplanting Date : 23/8/1982

Sl. No.	Variety	Days to 50% Pancile Emergence	Days to Maturity	Grain Yield in kg/ha	Grain Yield in kg/day
01	NE (1304-1)	92 DAS*	131 DAS	4000	30.53
02	NE (2101-21)	70 DAS	121 DAS	3453	28.54
03	NE (7303-34)	85 DAS	122 DAS	1760	14.43
04	NE (1101-12)	80 DAS	122 DAS	1880	15.41
05	NE (1305-40)	82 DAS	121 DAS	867	7.17
06	NE (1305-55)	70 DAS	122 DAS	1196	9.80
07	NE (Dalle-1)	80 DAS	131 DAS	3120	23.83
08	R. Local	95 DAS	155 DAS	4580	29.55
09	NE (1104-13)	80 DAS	131 DAS	3400	25.95
10	NE (6401-22)	65 DAS	122 DAS	2258	18.51
11	NE (6401-26)	78 DAS	130 DAS	2407	18.52
12	NE (6401-21)	70 DAS	131 DAS	2577	19.67
13	NE (1304-43)	74 DAS	131 DAS	1777	13.56
14	IE (143)	84 DAS	121 DAS	1665	13.76
15	NE (1703-34)	85 DAS	131 DAS	1073	8.19
	F			**	
	CV %			35	
	LSD (0.05)			1079	

* - DAS = Days after sowing.

FINGERMILLET ADVANCED VARIETAL TRIAL - 1982

- Dambar B. Tamang*

INTRODUCTION:

In Nepal, fingermillet occupies very significant place from the point of view of food commodities. It was grown in an area of 1,21,795 ha out of which about 80% was in the hills during 1979/1980. On account of an ignorance and misguided sentiment, it is often called as a poor man's food or "Kuanna".

This crop can be cultivated in places of varied agro-climatic conditions and soil types, both under irrigated and rainfed conditions from Terai plain, up to an altitude of about 2500 metre above mean sea level. On the other hand, even an unfertile piece of land can be brought into use for its farming without any risk. Unhasitatingly it can be advocated that it is one of the most important cereal foods for the majority of the hilly people who toil hard and moreover, it is also a favourite and beneficial to diabetic patients.

The national average yield of fingermillet is about 1.31 Mt/ha. Having thought of present situation, the first and foremost work is to increase the yield per unit area by introducing modern technology, improved varieties, use of fertilizers, adopting scientific management and cultural practices and timely plant protection measures, which could immediately help to solve the shortage of food to a considerable extent.

Since 1980, initial work has been undertaken by starting fingermillet varietal trials at the Agriculture Station Rampur, with a view to sort out genuine high yielding strains. Actually speaking, there is a shortage of high yielding, fertilizer responsive, disease and insect pest resistant varieties. This being the main reason "An Advanced Varietal Trial" comprising of seven varieties had been conducted in order to determine the suitability and adaptability of high yielding varieties and strains of fingermillet for the monsoon season plantings at the Agricultural Research Station, Rampur, Chitwan.

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* - Agronomist, National Maize Development Program, Rampur, Chitwan, Nepal.

This research paper presents the result of the trial for 1982.

MATERIALS AND METHODS:

Seven varieties were included in this experiemnt. Of them, one variety Rampur Local, locally called Chaure, was also included as a check. The design was laid out in a complete randomized block with four replicates providing a plot size 3 X 3 m. Six indigenous types of fingermillet along with one recommended variety, Dalle-1 were evaluated in a fertilized and transplanted field during the monsoon season of 1982.

In the beginning, a small piece of land was separately ploughed well so as to get good tilth with the help of a cultivator. In this piece of land seven individual nursery beds were prepared for seven entries by giving reasonable amount of compost and chemical fertilizers. Eight kilogram of seeds/ha were pre-treated with 10 g of Agrosan G.N., one day prior to sowing in the nursery beds. The seeds were sown broadcast on 20 August 1982. Thereafter, the beds were levelled, irrigated and covered by means of litter to avoid doves, sparrows, and other kinds of birds. Further irrigations were given according to the prevailing weather conditions.

The entire experimental plots were ploughed with the help of harrow and cultivator. Afterwards, the fertilizers were applied and incorporated well in the soil at the rate of 40:40:20 NPK kg/ha. These fertilizers were supplied from complesal only due to lack of superphosphate. Similarly, 20 kg of potash/ ha was given from muriate of potash prior to last preparation of the land.

As the seedlings became 25 days old they were removed from their respective nursery beds. These seedlings were transplanted one plant per hill by adopting a spacing of 20 cm row to row and 10 cm plant to plant for all the varieties. After one month of transplanting, usual intercultural operation of one weeding was given by manual labour. Various observations regarding yield attributing factors and disease and insect pest reactions, were taken from time to time right from their vegetative growth to harvesting.

Table No.1: VARIETAL CHARACTERISTICS AND GRAIN YIELD OF DIFFERENT VARIETIES - FINGERMILLET AVT, 1982, RAMPUR.

Sl. No.	Name of the Entries	50% Pancile Emergence Date	Date of Harvesting	Total Crop Days	Grain Yield (kg./ha.)	Grain Yield in kg. / day
1.	R. Local	20-11-1982	14-1-1983	147 DAS	2406 kg	16.39 kg
2.	Dalle-1	06-11-1982	27-12-1982	130 DAS	2098 kg	16.14 kg
3.	NE (6401-22)	21-10-1982	15-12-1982	117 DAS	1878 kg	16.05 kg
4.	NE (6401-26)	02-11-1982	28-12-1982	129 DAS	1312 kg	10.17 kg
5.	NE (1304-43)	30-10-1982	17-12-1982	130 DAS	1123 kg	8.64 kg
6.	NE (1305-55)	02-11-1982	18-12-1982	119 DAS	738 kg	6.20 kg
7.	NE (1304- 1)	17-11-1982	3-1-1983	136 DAS	564 kg	4.15 kg
	F				**	
	CV %				19	
	LSD (0.05)				402	

RESULTS AND DISCUSSIONS:

The above table gives an idea that the varieties NE (6401-22) and NE (1305-55) were the earliest maturing varieties among them, which took 117-119 days to mature. NE (6401-26), NE (1304-43), Dalle-1 and NE (1304-1) took from 129 to 136 days whereas, R. Local took 147 days to mature and it was the most late maturing variety among the lot.

The difference between the treatments was highly significant in this experiemnt. Inspite of highly asynchrony tillering habit and slightly shattering tendency, R. Local was the highest yielder among the varieties tested. R. Local has proved superior to others in connection with the yield by producing 2406 kg/ha but was at par with Dalle-1 which produced 2098 kg/ha.

Owing to an unfavourable weather condition and unusual drought, the transplanting was too late, resulting in poor plant population (reduced by about 5-10%). Reduction in grain yield was due to direct effect of the severe drought recorded in all the promising varieties this year. Besides this, the variety Dalle-1 was moderately susceptible to drought. Whereas, R. Local was observed moderately resistant to drought too. Inspite of an abnormal weather

condition, the variety R. Local has produced an increased yield over other lines.

There are some diseases which are major economic importance. Among them, leaf and neck blast (Pyricularia spp.), leaf blight (Helminthosporium spp.) and foot and stem rot (Sclerotium rolfrii) which were commonly observed in all the varieties except R. Local and Dalle-1. These diseases were not so severe as compared to the last year probably because of too late planting of the trial. On the other hand, rodents and birds were also the most harmful external agents for a field experiemnt. This may also be one of the causes of lower yield in the field.

Damage symptoms of stem borer, leaf eating caterpiller were also observed in the beginning of the plant growth. Side by side, an un-identified beetle was also noticed inside the spikes. But the total loss of the crop caused by these above mentioned insects was not significant.

With a view to collect more informations and data, under various agro-climatic conditions, two sets of trial were sent to Pakhribas and Lumle Agriculture Centres. Their results are given below:

Table No. 2: ADVANCED VARIETAL TRIAL ON FINGERMILLET, 1982
LOCATION : Lumle Agriculture Centre

Sl. No.	Name of the Entries	Yield (kg./ha.)				Mean Yield kg/ha.
		Rep I	Rep II	Rep III	Rep IV	
1.	NE (6401-26)	1700	1050	500	2750	1500
2.	NE (1305-55)	1775	1850	550	2200	1594
3.	NE (1304-43)	2550	2150	1450	3550	2425
4.	NE (1304- 1)	1600	1950	300	2250	1525
5.	NE (6401-22)	1500	1900	1000	3800	2050
6.	Dalle-1	3100	3100	1850	3950	3000
7.	Local (Kalo Bhundo)	950	2400	850	2450	1662
	F					**
	CV %					14
	LSD (0.05)					395

The difference between the treatment was highly significant. At this location too, the variety Dalle-1 proved superior to others by producing 3000 kg/ha, whereas, the local variety Kalo Bhunde had produced only 1662 kg/ha. On the other hand, the variety NE (1304-43) and NE (6401-22) were also better than the local one. They produced 2425 and 2050 kg/ha grain respectively and were at par. The rest of the strains NE (1305-55), NE (1304-1) and NE (6401-26) were slightly inferior to local, though statistically they were at par.

The problem of diseases and insect pests was not serious like at Rampur. This may be due to cold climatic effect.

Table No.3: ADVANCED VARIETAL TRIAL ON FINGERMILLET, 1 9 8 2

LOCATION: Pakhribas Agriculture Centre

Sl. No.	Name of the Entries	Yield (kg./ha.)				Mean Yield
		Rep I	Rep II	Rep III	Rep IV	
1.	NE (6401-26)	1963	2308	1546	1719	1884
2.	NE (1305-55)	1233	1356	1208	1121	1230
3.	NE (1304-43)	1844	2290	1650	1604	1847
4.	NE (1304- 1)	1813	1229	2688	1475	2101
5.	NE (6401-22)	829	1108	963	927	957
6.	Dalle-1	1844	2463	2146	1802	2064
7.	Local	1921	1833	2671	1473	1975
8.	Dalle Sano	1869	1969	1652	1260	1688
9.	Mudke Kodo	2438	3188	2038	1917	2395
	F					**
	CV %					17
	LSD (0.05)					447

Highly significant treatment difference was obtained in the trial at Pakhribas also. In this experiment three local checks were used. Variety Mudke Kodo was superior to the others which yielded 2395 kg/ha. Most of the varieties have shown overall good performances except Dalle Sano and NE (1305-55). Of them, the variety NE (1304-1) and Dalle-1 yielded 2101 and 2064 kg/ha respectively. These two varieties occupied second and third position among the

lot and were at par. The varieties NE (1304-43), NE (6401-26) and one of the local checks produced yield within the range of 1847 - 1975 kg/ha. The three varieties were at par. Dalle Sano yielded only 1688 kg/ha.

At this location too, the diseases and insect pests problem was negligible. Perhaps, this was because of unfavourable climatic conditions for the disease and insect development.

CONCLUSIONS:

The selection R. Local has given an average yield of 2406 kg/ha. In spite of asynchrony tillering habit and slightly lodging tendency in the latter period of the crop, it has good yield attributing characters like good tillering habit, highly resistant to diseases and insect pests etc. It is resistant to drought also.

From the result of the trial at Rampur, it may be concluded that the selection R. Local is best suited for the Inner Terai conditions. Hence, this strain may be recommended for large scale cultivation to step up the production of fingermillet.

Mudke Kodo, NE (1304-1), NE (6401-26) and NE (1304-43) have given very encouraging result at Pakhribas. The trial result of Lumle location has also shown that NE (1304-43) and NE (6401-22) are promising lines. Nevertheless, these strains need further evaluation before recommending them for their large scale cultivation.

ACKNOWLEDGEMENTS:

The author would like to thank Mr. R.T. Kantha for his sincere cooperation during the field work at Rampur.

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FINGER MILLET TRIALS

DISCUSSION:

S.K. Upadhyaya : Do you have any program for the production and distribution of improved variety seeds of finger millet ? How much improved variety of finger millet seeds are available this year ?

D.B. Tamang : We do have a finger millet seed production program in various farms and stations. Presently, we are multiplying Dalle-1 and Okhale-1 variety seeds which are mainly distributed to different districts as minikits. The targeted production of finger millet seeds is 2500 kg this year.

N. Sharma : The beetle you mentioned could be Popilio nasuta. Entomology Division, Khumaltar had reported similar insect from other locations which was later identified as P. nasuta.

PRELIMINARY REPORT ON THE STUDY OF MILLET DISEASES IN NEPAL

*Binay K. Batsa, and
Damber B. Tamang

INTRODUCTION:

Millets cultivation is extended from tropical to temperate belts of Nepal since so many years. From these different agroclimatic regions, evidences of severe disease problems are often at our knowledge. But no plant protection measures are being applied by the millets growers. This may be because of unavailability of appropriate technology in Nepal. Historical background of millets pathological work is very new in our country. But from 1980 some attention is paid for the preliminary work and now the development is at the stage of its infancy. On the basis of survey and surveillance of different districts, observations taken from different introduction lines at Rampur and elsewhere we could be able to identify some problematic diseases of millets in Nepal.

INCIDENCE OF DISEASE OUTBREAK IN NEPAL:

Blast (Pyricularia spp) of fingermillet has become an indemic disease in most of the millet belts. The pathogen invades the crop at any stage of growth. It can cause the death of the seedlings at nursery. After panicle emergence, infection at neck and fingers may kill the panicle resulting in considerable loss in grain production. Yield loss up to 95% in some of exotic genotypes and 100% in some local cultivars was assessed at Rampur in 1980. Another threat to fingermillet production is foot-rot (Sclerotium - rolfsii) in Chitwan. In 1980, the disease appeared at panicle emergence time and the infected plants suddenly wilted and died. Loss from negligible to over 50 percent was recorded, based on number of plants damaged or killed (Batsa 1980). Later on this disease was reported from Ilam, Makwanpur and Dhankuta districts in 1981.

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The most serious disease of sorghum (Sorghum vulgare) was noted to be Anthracnose (Colletotrichum spp) at Rampur in 1981 and 1982. It was very severe in most of the exotic cultivars. Downy mildew (Sclerospora sorghi) was first observed in sorghum in Tumlingtar, Sankhuwasabha district in 1980. But it has not been so much destructive to sorghum in our country. On the other hand, this is a big threat to monsoon maize in foot hills and Terai of Nepal. Another cropping hazard to sorghum was identified as the incidence of grain molds. Molds attacked the panicle prior to maturity. Infected grains become shrivelled, discolored and are detoriated. Ergot and smut which are supposed to be dangerous disease in India, are not yet observed here.

In the case of pearl millet the incidence of grain molds is very challenging. No incidences of green ear disease, ergot and smut out-break are observed.

Very little is known about fox-tail millet in Nepal. Even then some foliar diseases have been observed and identified at Rampur this year.

List of diseases with casual organism is presented below:

	Name of Crop		Name of Disease	Place & Year of Collection in Nepal
1.	Fingermillet (Eleusine coracana(L) Gaertn)	1.	Blast (Pyricularia spp)	
		2.	Foot-Rot/with (Sclerotium rolfsii (Sacc) curzi)	Rampur, 1980
		3.	Leaf blight (Helminthosporium-spp)	"
		4.	Banded leaf and sheath blight (Rhizoctonia spp)	"
2.	Sorghum (Sorghum vulgare pers.)	1.	Downy Mildew (Sclerospora - sorghi Western and Uppal)	Tumlingtar Sankhuwasabha, 1980.
		2.	Anthracnose (Colletotrichum - spp)	" & Rampur, '81

3.	Leaf blight (Helminthosporium-turcicum Pass)	Rampur and Siraha, 1982
4.	Target leaf spot (Helminthosporium spp)	Rampur, 1982
5.	Zonate leaf spot (Gloeocercospora sorghi Baird Edg.)	"
6.	Grey leaf spot (Cercospora sorghi Ellist Everhart)	Rampur, 1981
7.	Oval leaf spot (Ramulispora - spp)	Rampur, 1982
8.	Grain molds - Penicillium spp	Rampur, 1981
	- Aspergillus spp	"
	- Fusarium spp	"

3. Pearl Millet

Pennisetum typhoides (Burm, f.) staps and C.E. Hubb)

1.	Leaf blight (Helminthosporium turcicum Pass)	Rampur, 1982
2.	Banded leaf and sheath blight (Rhizoctonia spp)	"
3.	Zonate leaf spot (Gloeocercospora spp)	"
4.	Grain Molds - Aspergillus spp	"
	- Fusarium spp	"
	- Penicillium spp	"

4. Fox-tail Millet (Setaria italica (L) Beauv.)

1.	Blast (Pyricularia setariae Nigikado)	"
2.	Leaf blight (Helminthosporium -spp)	"

RESULTS AND DISCUSSIONS:

From the field observations it is obvious that, blast is the most destructive disease of fingermillet in hills and Terai of Nepal. Severe infection of early stage and even at heading time (till maturity) can lead up to 100% loss in yield. Most of the cultivars screened for better agronomical traits were found susceptible to the blast at Rampur condition.

Variety Rampur Local was found not only resistant to blast but it was found tolerant to foot-rot and other foliar diseases also. Variety Dalle-1 was found slightly tolerant to blast but it was susceptible to foot-rot. None of the sorghum and pearl millet varieties tested, were found resistant to grain molds at field conditions. Myagdi 1, 2, 3 and 4 (Local genotypes of sorghum) were found moderately resistant to Anthracnose leaf disease. No incidence of ergot, smut and green ear disease of peral millet and sorghum is noted up till now.

CONCLUSION:

Blast and foot-rot were found very destructive to fingermillet in Nepal. Yield reduction up to 100 and 50 percent was recorded at Rampur. Variety Rampur Local was found highly resistant to these disease but variety Dalle-1 was observed slightly tolerant to blast only. The variety Rampur Local needs to have a thorough selection works to make it synchronous in tillering habit and reduction of maturity period. None of the sorghum and pearl millet genotypes were found resistant to grain molds. Myagdi 1, 2, 3 and 4 (Local introductions of sorghum) were found comparatively superior from foliar disease point of view. There was no incidence of ergot, smut and green ear disease of sorghum and pearl millet at Rampur.

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REGIONAL REPORT ON SUMMER CROPS

EASTERN DEVELOPMENT REGION, BIRATNAGAR

- M.P. Upadhyaya*

Introduction

1.1 General Description:

This region lies between 26° 20' to 23° 8' Northern longitude and 86° 8' to 88° 15' Eastern latitude. The height ranges from 70 to 8848 m above the sea level. Its east-west length is 161 to 198 km. It has 16 districts, 5 are in Terai, 8 in Mid-hill and 3 in mountain. The total population is 2,797,500 and the area is 28,202 km^2. The total land is 2,820,200 ha. The cultivated land is roughly 21% of the whole regional area. The distribution of land under the three categories of geographical classification are:

Mountains	—— 35.2%
Hills	—— 39.2%
Terai	—— 25.6%

1.2 Climate:

This region has got wide variations in climate. The Southern plain (Terai) is the hotest part of the region. Maximum temperature ranges from 35 to 40 °C and the minimum temperature drops down far below the freezing point (-8 to -10 °C) in Namche Bazaar of Solukhumbu district. The average rainfall in Terai and mid hill ranges from 1500 to 2800 mm, highest in Jhapa district. This rain is not evenly distributed throughout the year. Its is minimum in winter and the maximum in summer (June to September). More than 70 to 75% rain is received from June to September.

1.3 Special Crops

Jute, tea and cardamom are special crops of this region. On

* - ADO, Illam District, Eastern Development Region.

commercial scale, tea is cultivated only in Jhapa and Illam mainly due to suitability of climatic conditions. Cardamom has mainly been cultivated in Illam. Since the Agricultural Year (2032 to 2033) this crop has spread on substantial area in Panchthar, Taplejung, Terahthum, Dhankuta, Bhojpur and Sankhuwa Sabha and in other hills. Jute is mainly grown in Jhapa, Morang and Sunsari for commercial purpose. It is alo cultivated in the plains of Udaypur district. Since last year the production of cardamom and jute have decreased due to lack of market and low price of the fibre respectively. Wider fluctuation and drastic drops in the price of these crops regulate their areas and production.

1.4 Irrigation Projects:

There are four important irrigation Projects viz, Kankai, Sunsari-Morang, Chandra Canal and Kamala. These Projects will irrigate approximately one hundred thousand (1 Lakh) hectares after the completion of their construction and innovation as well as renovation works. Sunsari-Morang Irrigation Project will provide irrigation to 66,000 ha of land in Sunsari and Morang district after its completion, out of which about 43,000 ha areas is being irrigated since last paddy season. Kankai Irrigation Project is providing water in all the seasons but not in large area in Jhapa. It irrigates above 5000 ha in rainy season and about 500 ha in winter season.

Chandra Canal is providing water mainly in rainy season but negligible amount in winter. Kamala (Eastern Canal) is irrigating the North-Western area of Siraha district since last paddy season.

1.5 Development Project:

As new approaches and dimensions of development, some projects have been launched in this region. The name of each projects and its area of coverage are given below:

S.No.	Name	Districts Covered
1	Sagarmatha Integrated Rural Development Project (ADB/M)	Siraha, Saptary and Udaypur
2	T and V System (World Bank)	Morang, Sunsari and Jhapa
3	Koshi Hill Area Development Project (British Aid)	Dhankuta, Terahthum, Bhojpur and Sankhuwa Sabha
4	Fishery Production Program	Sirha, Saptary, Sunsari, Morang, Jhapa and Phatehpur and Tarahara Fishery Centres
5	Pakhribas Agriculture Centre (British Aid)	Dhankuta

Constraints:

The constraints spelt out below are mainly faced in maize and rice.

1. Timely unavailability of demanded variety of maize seeds
2. Higher requirement of soil fertility for improved varieties
3. Management of post harvest losses
4. Unavailability of sufficient and timely irrigation facilities
5. A new pest in rice (Annilidae type) has been noticed in Sunsari and Morang districts which have created a problem in last paddy season especially in lowland patches. It is still unidentified and no significant control measure has been found to control this pest.

Summary

Inspite of several problems which this region is facing in successfully launching the mass production programs, we are confidently moving in positive direction. "Chaite Dhan", winter maize as well as spring corn cultivation and multiple cropping are getting popular.

In Jhapa district the farmers are replacing the area of wheat by planting winter maize due to many asthetic and economic factors. We need solutions to solve the new pest problem in rice to

avoid the future hazards in its cultivation. We see our bright and hopeful future in the fast changing situation in ever growing need of the farmers.

Note: The total area of this region under rice is 148,521 ha and under maize is 119,920 hectares.

Table 1: Area Under Improved Cultivation Practices - Maize

Sl. No.	District	2037/2038 (1980/1981) Target (in ha)	2037/2038 (1980/1981) Achievement (in ha)	2038/2039 (1981/1982) Target (in ha)	2038/2039 (1981/1982) Achievement (in ha)
01	Jhapa	110	1526	1480	1480
02	Illam	1700	1755	988	1000
03	Panchthar	1500	1000	1493	1513
04	Taplejung	200	100	200	496
	Mechi Zone Total:	4500	4081	4161	4489
01	Morang	4000	4745	4000	4000
02	Sunsari	3000	3065	2400	2925
03	Dhankuta	2000	2289	1994	1994
04	Terahthum	1750	1950	1747	1747
05	Sankhuwa Sabha	300	550	275	275
06	Bhojpur	400	700	497	497
	Koshi Zone Total:	11450	13299	10913	11438
01	Saptary	400	518.2	400	400
02	Siraha	1000	732	1100	1100
03	Udaypur	800	747	220	220
04	Khotang	400	460	400	555
05	Okhaldhunga	1450	1498	1597	1599.5
06	Solukhumbu	30	25	50	50
	Sagarmatha Zone Total :	4080	3980.2	3767	3924.5

Table 2: Eastern Region Target For 1982/1983 (2039/2040)

Area Under Improved Cultivation Practices

CROP: MAIZE

Sl. No.	Districts	Target (in ha)	Extension Methods		
			Result Demonstration	Minikit Demonstration	Production Demonstration
01	Jhapa	2000	36	-	4
02	Illam	1000	10	-	3
03	Panchthar	1645	8	15	3
04	Taplejung	400	10	15	4
Mechi Zone Total:		5045	64	30	14
01	Morang	4285	30	-	2
02	Sunsari	613	25	-	5
03	Dhankuta	2205	56	-	4
04	Terahthum	1750	10	20	-
05	Sankhuwa Sabha	290	10	-	1
06	Bhojpur	700	10	20	1
Koshi Zone Total:		9843	141	40	13
01	Saptary	400	20	-	5
02	Siraha	1154	20	-	5
03	Udaypur	1000	9	-	2
04	Khotang	500	10	10	2
05	Okhaldhunga	1650	10	15	2
06	Solukhumbu	90	5	-	-
Sagarmatha Zone Total:		4794	74	25	16
GRAND TOTAL :		19682	279	95	43

REGIONAL REPORT ON SUMMER CROPS

WESTERN DEVELOPMENT REGION, POKHARA

- M. L. Pradhan*

The major summer crops, rice and maize are grown in this development region. Apart from these crops, millet, black gram, green-gram, ground-nut and sugarcane also are successfully grown. Rice is the predominant staple food in potential rice growing areas, especially in Terai, whereas maize takes the place of main food grain in hilly districts.

Report on Rice:

Rice is the leading food grain grown in all the districts of the region except Manang and Mustang. More than 75% of the rice growing areas of the region are concentrated in three districts of Terai namely: Rupandehi, Kapilvastu and Nawalparasi, whereas other 11 districts of the hill are unable to fulfil their requirements.

Total area under improved rice cultivation in the fiscal year 1980/81 and 1981/82 were 65,345 and 69,621 hectares respectively. We expect 185,405 metric ton of produce from 75,271 ha area coverage in the current fiscal year 1982/83 and we have proposed to achieve 207,108 metric ton of rice from 85,225 ha in the F.Y. 1983/1984 in this region. Thus it looks that the area under improved rice cultivation and the production are increasing year after year.

Among the popular improved varieties Masuli, IR-20, CH 45, T-176, Laxmi, Sabitri, Janaki, Chandina are the main, whereas Masuli is almost saturated in all rice growing areas. Popular local varieties like Pokhreli Masino, Mansara, Basmati, Kalanimak, Jhinuwa, Biramful, Pahele, Gudura etc. also are grown in large scale in Terai as well as in Hills.

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Report on Maize:

Maize is the second main food grain grown in all the 16 districts of the region. It is the main staple food of the hill people.

In the F.Y. 1980/1981 and 1981/1982, total area under improved maize was 32,524 and 31,338 ha respectively. In this current F.Y. 1982/1983 the total target of the region is 60,892 metric ton of production from 31,897 ha of improved maize cultivation and the proposed target for the F.Y. 1983/1984 is 64,228 metric ton from 37,629 ha. It shows that the area and production of maize also is increasing.

So far as the varietal choice of the farmers is concerned, Kakani Pahenlo, Khumal Pahenlo and Rampur Pahenlo, Hetauda Composite and Rampur Composite are widely adopted in different suitable localities of the region. Arun is an impressive and is in initial stage. Among the local varieties, Sathiya is popular one, being a short duration crop. In Hills, Palpa, Syangja, Kaski, Tanahu, Lumjung, Gorkha, Baglung and Parbat are the potential maize growing areas whereas in Terai, Nawalparasi is the main one.

Other Summer Crops:

Fingermillet is the third major summer crops grown in Hill districts and consumed as main food locally. This cereal is cultivated singly as well as mixed crop with maize, soybean etc. As the improved varieties like Dalle and Okhle are in short supply, the farmers of this region are cultivating the local varieties. Among other summer crops sugarcane and different types of pulses are also equally grown and consumed locally.

Extension Activities:

There are 16 districts in this region and each district has an agriculture development office which looks after all the agriculture extension activities. The main objective of these offices is to disseminate the technical know-how to the farmers through different methods of agriculture extension such as result, method and production demonstrations. Similarly, minikit distribution has become another effective tool to innovate the farmers. In the F.Y. 1981/82, 1,728 packets of rice and 1,131 packets of

maize minikits were distributed to the farmers of different districts. To diffuse the promising technology, ADO Offices are organizing different types of trainings at different levels. Farmer's field visit, farmers-day, discussion, distribution of posters and pamphlets are the other regular activities carried out by the ADO Offices. Most of the activities are undertaken by the extension workers, especially JT/JTAs, who are the main stimulating agents at field level.

In Gorkha and Palpa districts, a special seed storage program has been introduced. In Gorkha, Agriculture Development Office has provided the seed growing farmers, with metal bins in different pockets to store the improved seeds. Each bin has the capacity of 400 kg and a total of 37 bins have been distributed in different pockets of the districts to store the improved maize seeds till now. The seed growing farmers in this district are convinced to grow and sell the seeds on their own risk. As it is difficult to transport the improved seeds from one place to another in hilly areas the bin has great importance to store the improved seeds locally in different locations. Farmers of Gorkha district are very much interested and encouraged with this program.

In Palpa district also almost similar type of program has been launched. A group of farmers are provided with seed bins. The bin is kept with a selected farmer in a village and called as Seed Bank. Other farmers bring the seed they have produced and put in the Seed Bank safely. Thus, different farmers of a particular locality can put their product safely to use in the next season. Now, the program has been started to some types of vegetable seeds produced in different locations of Palpa district.

Seed Multiplication Program:

So far the seed multiplication program is concerned, it has been conducted only in maize and vegetables in small scale. During the F.Y. 1980/1981 this program was conducted in 3.96 ha in districts of this region whereas in the F.Y. 1981/1982 this program was carried out in 22 and 5 ha in maize and other summer crops respectively. Similarly, the program is continued

in the current F.Y. 1982/1983 also.

Observations and Suggestions:

1. Due to heavy drought in the last monsoon season, great loss in rice, maize and fingermillet production was observed.

2. At the time of harvest, rice and fingermillet were destroyed by hail stone to some extent, in some areas.

3. The seed storage program introduced in Gorkha and Palpa is found very much encouraging and helpful to preserve improved seeds locally in hilly areas.

4. Availability of inputs - seeds and fertilizer in time is still a problem in the hilly districts.

5. Mostly summer crops are grown under rainfed conditions, therefore, irrigation is vital to further development in agriculture in Nepal.

   a. Improvement of existing local canals
   b. Distribution of water pump sets in feasible areas.
   c. Long term plan in channelizing the big river water into irrigation.

6. Establishment of organized market may bring a break-through in boosting up the productivity of agricultural products.

Area Under Improved Rice And Maize During Last Four Years In Western Development Region

(Area in Hectares)

District	Area Under Improved Rice				Area Under Improved Maize			
	1978/1979	1979/1980	1980/1981	1981/1982	1978/1979	1979/1980	1980/1981	1981/1982
01. Nawalparasi	15110	19200	19375	19300	9000	9576	9600	5608
02. Rupandehi	14347	24866	22778	31476	538	1545	1424	2103
03. Kapilvastu	10664	18004	19020	6460	410	350	358	448
04. Palpa	330	355	448	1483	3500	4585	4734	5619
05. Arghakhanchi	125	150	175	236	350	406	493	450
06. Gulmi	210	155	304	252	625	1040	947	1328
07. Baglung	114	100	113	401	1006	1620	1610	1894
08. Parbat	80	82	501	500	1002	1505	1533	1450
09. Myagdi	20	20	20	155	511	1023	1100	1155
10. Mustang	-	-	-	-	-	-	-	-
11. Syangja	599	522	1101	2846	1576	2504	2727	32..
12. Kaski	410	510	834	3819	1043	1502	1826	1903
13. Tanahu	349	439	476	2293	1017	1921	2006	2507
14. Lamjung	26	50	88	200	752	1500	1500	1782
15. Gorkha	82	100	112	200	1007	1200	2646	1855
16. Manang	-	-	-	-	10	5	20	16
Regional Total:	42466	64553	65345	69621	22337	30282	32524	31338

Source: Regional Progress Report 1978-1979 to 1981-1982, Western Development Region, Pokhara.

Extension Activities on Rice And Maize During 1981-82 In Western Development Region

(Figure in number)

Sl. No.	District	Extension Activities on Rice				Extension Activities on Maize			
		Result Demonstration	Method Demonstration	Production Demonstration	Minikit Demonstration	Result Demonstration	Method Demonstration	Production Demonstration	Minikit Demonstration
01	Nawalparasi	50	75	5	333	—	4	—	131
02	Rupandehi	70	59	—	152	41	50	—	25
03	Kapilvastu	85	75	5	350	60	25	—	43
04	Palpa	25	13	—	—	72	43	2	52
05	Argha-khanchi	20	24	1	28	—	—	—	75
06	Gulmi	26	16	1	90	33	25	1	84
07	Baglung	30	60	—	—	15	30	1	—
08	Parbat	20	36	1	50	16	41	1	—
09	Myagdi	20	20	1	—	10	10	1	—
10	Mustang	—	—	—	—	—	—	—	—
11	Syangja	30	107	1	150	21	43	1	60
12	Kaski	13	25	2	191	18	13	2	130
13	Tanahu	60	80	3	209	22	60	1	181
14	Lamjung	15	85	1	—	15	50	—	100
15	Gorkha	17	90	1	175	27	40	1	250
16	Manang	—	—	—	—	10	14	1	—
Regional Total:		481	765	22	1728	360	448	12	1131

Source: Regional Progress Report, 1981-1982; Western Development Region, Pokhara.

Area Under Improved Rice And Maize During 1981-1982 In Western Development Region

(Area in Hectare)

Sl. No.	District	Area Under Improved Rice			Area Under Improved Maize		
		Intensive Program	Pocket Program	Regular Program	Intensive Program	Pocket Program	Regular Program
01	Nawalparasi	200	5000	14100	1037	--	4571
02	Rupandehi	1246	5012	25218	78	310	1715
03	Kapilvastu	1448	3207	1805	41.8	334	72
04	Palpa	--	1040	443	6	--	5613
05	Gulmi	--	--	252	52	--	1276
06	Argha-khanchi	--	15	220.5	--	--	450
07	Baglung	--	330	71	--	1775	119
08	Parbat	--	--	500	--	--	1450
09	Myagdi	--	--	155	--	--	1155
10	Mustang	--	--	--	--	--	--
11	Syangja	--	2016	830.5	129.5	--	3091
12	Kaski	900	2341	578	21.8	--	1881
13	Tanahu	350	995	948	--	--	2507
14	Lamjung	--	--	200	15	--	1767
15	Gorkha	100	--	100	10	--	1845
16	Manang	--	--	--	--	--	16
Regional Total:		4244	19956	45421	1391.1	2419	27528.5

Source: Regional Progress Report 1981-1982, Western Development Region, Pokhara.

Proposed Program of Maize For 1983/84
In Western Development Region

(Production in Ton)

Sl. No.	District	Intensive Program		Pocket Program		General Program	
		Area	Produce	Area	Produce	Area	Produce
01	Nawalparasi	1470	4410	258	-	4731	9006
02	Rupandehi	102	921	370	750	2425	5830
03	Kapilvastu	100	300	277	692	73	131
04	Palpa	-	-	200	500	6000	10368
05	Arghakhanchi	-	-	7	12	543	864
06	Gulmi	76	228	22	58	1451	2380
07	Baglung	-	-	5	-	2100	3746
08	Parbat	-	-	50	38	1950	3013
09	Myagdi	-	-	--	-	1296	2132
10	Mustang	-	-	-	-	--	-
11	Syangja	50	150	30	20	3120	5220
12	Kaski	150	195	10	7	2540	3334
13	Tanahu	41	123	31	78	2574	4590
14	Lamjung	23	69	35	62	2203	3168
15	Gorkha	36	110	174	-	3057	3168
16	Manang	-	-	4	-	20	70
Regional Total:		2048	6506	1484	2217	34077	55503

Including Project Program:

Source: According to discussion on Regional Program Planning and Budget Seminar Held in Khairenitar on January.

SUMMER CROPS REPORT, 1982
PAKHRIBAS AGRICULTURAL CENTRE, DHANKUTA

- H.B. Thapa,
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ABSTRACT

This report summarizes the major points asiring from work at PAC during the summer season of 1982.

Recent changes in the organization of PAC are also outlined.

1. INTRODUCTION

Pakhribas Agricultural Centre (PAC) has, for several years, been working on a sectional basic i.e. each component of agriculture being looked after by a separate section. This has now been changed as PAC moves towards a more multidisciplinary approach to agricultural extension. The original seven sections (Agronomy, Crops, Horticulture, Livestock, Forestry/Pasture, Seed and Training) have been re-organized and their responsibilities changed. Agronomy remains as the crop research section and the Training Section is still responsible for on-farm training. Pasture work has now been given to the Livestock Section to come in line with the HMG/N system. There are no longer any Crops and Horticulture Sections and their work in extension has been divided into two regions; the section being designated as Agricultural Extension - Local Target Area, and Agricultural Extension - Northern Target Area. The production work previously done on the farm by Crops and Horticulture is now being done by the Seed Technology and Agricultural Production Section (STAP). STAP is responsible for all farm production (except forest tree seedlings) and also quality control (field inspection and testing) of all seed produced both on the farm and in the Panchayat.

PAC has, in the past, been completely separate from any HMG/N agricultural work in the Eastern hill area. This year has seen a

change as PAC is now working with HMG/N/KHARDEP in the 2 Agricultural Service Posts areas at Tankhuwa and Mohrang. One more ASP in Dhankuta District (Ankhisalla) and 2 ASPs (Ghoretar and Chainpur) in Bhojpur and Sankhuwasabha are being assisted by PAC from 1983. Pakhribas is supplying technical expertise, training and inputs to the areas as for the HMG/N staff at the Posts.

2. SUMMARY OF EXTENSION WORK

2.1.1 All the Agronomy and Production work is to provide a back up to the Extension Section, and the aim of these together is to assist farmers to bring about gradual improvement in their farming systems in order to improve their economy and prosperity through individual and cooperative efforts.

2.1.2 The extension section works in 15 Panchayats in the Dhankuta, Terahthum and Taplejung districts and is also involved with HMG/N/KHARDEP in two of their Agricultural Service Posts (ASPs) based at Tangkhuwa and Mohrang (a total of 8 Panchayats) some more ASPs are also being assisted by PAC in the near future in the Bhojpur, Chainpur and Dhankuta districts. PAC is providing help in the form of technical guidance, training to the JT/JTAs and Farmers, and inputs.

2.1.3 The working system of extension section, the concept of Field Assistants, Supervisors and different types and levels of trainings have already been reported in our previous reports and were presented in the previous conferences also.

The main achievements of the extension sections have been summarized below:

2.2 TRAINING

2.2.1 A specific training for the JT and JTA in FFT planting, layout recording etc was organized in Tangkhuwa and Mohrang ASPs in which 2 personnel from each ASP participated.

2.

2.2 During this period, training on various subjects like grain storage, cultivation of summer crops, seed selections, soil treatments, insect and rodent control etc were given to a total of 1724 farmers in the centre in the target Panchayats and ASPs as Panchayat level training, Ward level training, Leader Farmer training and Special trainings.

2.3 SEED MULTIPLICATION

The following crops seed were multiplied in the farmers field:

Table 1:

Sl. No.	Crops	Area Under Seed Multiplication (Ropani)	Varieties
1.	Maize	1370	Hetauda Composite and Amarillo.
2.	Rice	5	Pokhareli Masino
3.	Soybean	15	Lumle-1

3. SUMMARY OF SEED TECHNOLOGY WORK

This work essentially consists of Seed Production/Variety maintenance in Centre, Field inspection of all seed crops grown with farmers on contract, seed testing to ensure the minimum quality standards fixed by the Department of Agriculture, storage of seed and packing for distribution.

3.1 Seed Production

3.1.1 Maize: Over 62 Ropanis of land was planted with maize. This consisted of 20.80 Ropanis (1.04 ha) of the variety Amarillo Del Bajio in the Northern area of the Farm and 41.5 Ropanis (2.08 ha) of Hetauda Composite in the South area. Although the planting began from the first week of March most of the fields were planted in April. Harvesting started in late August and continued through to the end of September. A few plots in the Northern area of the farm were harvested in October. Seeds of different plots have been given different lot numbers for identification and are processed and recorded separately. This method of

keeping separate records started from this year and will help us monitor the distribution and performance of the lot.

Due to the untimely rain and especially during harvest yield has not been very good this year. Although the incidence of stalk rot and borer was less than the last year, a large number of cobs had to be discarded because of fungus growth in the lack of proper drying facilities. This amounted to over 1600 kg of grains which were supplied to Livestock Section for animal feed purposes.

Only 2.657 MT of Hetauda Composite and 1.216 MT of Amarillo Del Bajio could be secured as grain. Further cleaning is still being done for seed purposes. The average yield of Amarillo Del Bajio grown in the North farm (alt.: C.5,500 ft) stood at 1.365 MT/ha and that of Hetauda Composite in the South farm (alt.: C. 4,500 ft) was 1.288 MT/ha.

To help supply the highly demanded white varieties, population of three different samples are also being multiplied this winter in cooperation with Tarahara Agri. Station, the Seed Production Farm at Jhumka (Sunsari) and the Resettlement Farm of the British-Gurkhas, Nepal. One of the samples was received on request through the I.C.P. A detailed report will be written after the crops are harvested and seeds cleaned.

A total of 1.593 MT of maize seeds were made available from the Centre for further multiplication and general cropping.

3.1.2 Soybean: Only 4.1 Ropanis could be planted with Soybean Lumle-1 either as sole crop or intercropped with maize. The total production of grain was 203 kg of which 172.5 kg were good for seed. The average yield of grains came to be 1.228 MT/ha. Mild infestation of frog eye spot was observed. From the previous years production 65 kg of seeds were made available for further multiplication/investigation and general cropping purposes.

3.1.3 Finger Millet: The variety Okhale-1 was grown for multiplication purposes in one Ropani. No serious diseases were seen but the flowering and maturity within the plot was variable. Crops harvested were grouped arbiterily in two batches as early and late harvests. There was mild lodging due to wind and rain. The yield was 76 kg which turns to be 1.520 MT per hectare.

3.2.1 FIELD INSPECTION OF SEED CROPS (MAIZE)

Fifty-one Seed Crops grown with farmers on contract were inspected to check the field standard. Although most crops were acceptable a few had to be rejected. In lack of a proper botanical description of the varieties it was not always possible to clearly distinguish the off types/rogues from the variety mentioned. Isolation distance also created some difficulties in that natural barriers and geo-climatic factors such as wind direction, temperature and orientation of the hills had to be considered. It has been planned to conduct a trial on how close a variety under multiplication can be to other crop of maize in conditions prevailing in the hills.

3.2.2 SEED TESTS

A summary of tests done (April 1982 - January 1983) on summer crops is presented in Table below:

Table 2:

Crop	Test Type					
	Germination		Purity		Moisture Content	
	No. of Tests	Average Result %	No. of Tests	Average Result %	No. of Tests	Average Result %
Maize	39	94.99	35	99.02	298	30.78
Soybean	8	95.34	8	99.92	35	16.34
F. Millet	-	-	-	-	2	19.62
Rice	4	91.06			10	24.82

4. SUMMARY OF AGRONOMY AND EXTENSION SECTION TRIALS AND DEMONSTRATION WORK ON-FARM TRIALS (PAC) (For further detail, see Table 3)

NMDP MAIZE VARIETAL TRIAL (NORTH)

4.1 This varietal trial was carried out in cooperation with NMDP. Altogether 9 varieties were tested at an altitude of 1750 m.a.s.l. Of all tested varieties Suwan 8075 (2465 kg/ha) yielded the highest and was significantly better to all other varieties except Rampur-2 (2345 kg/ha) and Janaki Seto (2138 kg/ha). Other top yielding varieties were Rampur-1 and Manakamana-2 both yielding 1840 kg/ha. Local yielded the lowest (1197 kg/ha).

Plant height was observed highest in Local (232 cms) and Rampur (175 cms), and shortest being Manakamana-2 (128 cms) and Rampur-2 (134 cms).

Arun-4 was the earliest maturing (129 days) variety followed by Manakamana-2 (161 days) and Ganesh-2 (165 days).

Suwan 8075, Rampur-2, Manakamana-2 and Arun-4 varieties seem to be promising from yield potentiality and maturity point of view and are to be tested further in farmers field. Instances of rust was observed in all the varieties.

4.2 NMDP MAIZE VARIETAL TRIAL (SOUTH)

Some set of varieties as above were tested at an altitude of 1350 m.a.s.l. in PAC. The top yielding 4 varieties were Rampur-2 (3505 kg/ha), Janaki (3167 kg/ha), Suwan 8075 (3175 kg/ha), and Rampur-1 (3038 kg/ha). These varieties were not significantly different to each other. Again in the low altitude also Local variety ranked the last by yielding 1300 kg/ha.

Maturity was the earliest in Arun-4 (133 days) followed by Manakamana-2 (142 days) and Rampur-2 (146 days).

In low altitude also Local was the tallest variety (237 cms) followed by Janaki (208 cms) and Suwan 8075 (184 cms), shortest being

Arun-4 (143 cms), Rampur-2 (166 cms) and Manakamana-2 (167 cms).

Janaki which is being extended to the Panchayats has proved to be one of the outstanding varieties in both high and low altitudes. Besides this new varieties Rampur-2, Suwan 8075 and Arun-4 showed an encouraging result.

4.3 PAC MAIZE VARIETAL TRIAL

Altogether 9 varieties were tested, of which Local was the highest yielding (4442 kg/ha) though not significantly higher than Ganesh-2 (4400 kg/ha). Janaki Seto (3987 kg/ha), Hetauda Composite (3813 kg/ha) and Rampur-1 (3507 kg/ha).

Rampur-2 ranked the last yielding (2807 kg/ha)

The earliest maturing varieties were Arun-2 (134 days), Manakamana-2 (145 days), Ganesh-2 (150 days), Hetauda Composite (150 days) and Rampur Composite (150 days) last being Local (287 days), Hetauda - Composite (221 days) and Janaki Seto (216 days).

Variety Ganesh-2 shows promising result from this trial. Janaki and Hetauda Composite varieties currently being extended by PAC also prove their superiority over other varieties though they are slightly late maturing, but higher yielding than the comparatively early and low yielding varieties like Arun-2 and Rampur-2.

Although Local variety yielded the highest, its other agronomical characters such as the excess plant height and late maturing donot allow it to proceed forward.

It can be concluded from the maize varietal trials conducted in PAC that emphasis would be given to the need multiplication of Janaki, Arun-2 (for early maize). Suwan 8075, Ganesh-2, Rampur-2, Manakamana-2, Arun-4 would be tested further in the farmers field.

4.4 HALF - SITE SELECTION ON RAMPUR-1 / MANAKAMANA-1

This breeding program is being conducted in cooperation with NMDP. The objective of this trial is to develop superior white seeded maize

variety for the eastern hills.

Selection from the promising lines were made and the material was sent to NMDP for winter planting. This program will be continued until the aim is achieved.

4.5 NMDP ADVANCED VARIETAL TRIALS ON FINGER MILLET (SOUTH)

Nine varieties of millet were tested in cooperation with NMDP at an altitude of 1350 m.a.s.l. The highest yielding varieties were Mudko Kodo (2396 kg/ha), NE 1304-1 (2102 kg/ha), Dalle-1 (2064 kg/ha). No significant difference was observed between Local (1975 kg/ha) and other top yielding varieties except Mudko Kodo. NE 6401-22 yielded the lowest (956 kg/ha) that was significantly lower to all other varieties except NE 1305-55.

The lowest yielding variety NE 6401-22 was the shortest (57 cm) variety of all, NE 1304-43 being the tallest one (82 cms).

There was a difference of 39 days between the earliest maturing variety. Among the earliest maturing were NE 13 (137 days), NE 1304-43 (139 days) and NE 6401-22 (147 days). Dalle-1 (176 days), Mudko Kodo (176 days) were the last maturing ones.

Like previous trials, the Local variety showed better result than the improved ones.

4.6 KHUMALTAR ADVANCED VARIETAL TRIAL ON MILLET

This trial was conducted in cooperation with Agronomy Section, Khumaltar at an altitude of 1750 m.a.s.l. Among the 9 varieties, NE 6401-26 yielded the highest (564 kg/ha) and was significantly better to all other varieties except IE 980 (521 kg/ha). Other top yielding varieties were Local (251 kg/ha) and Okhale-1 (177 kg/ha). Mudko was the lowest yielding variety (81 kg/ha) of all.

From the maturity point of view, IE-143 ranked the first with 151 days closely followed by NE-1305-53 and NE 1703-34 both maturing in 152 days.

A difference of only 21 cms between the tallest and shortest variety suggests that all the tested varieties were almost of similar growing habit. Intercropped yield of maize and NE 1305-55 was the highest - 3789 kg/ha followed by maize and Okhale-1 (3633 kg/ha.).

NE 6401-26 a medium statured, early maturing and highest yielding variety proved to be the best and is worth further testing.

4.7 FINGER MILLET FPT (KHUMALTAR)

Five millet varieties were planted under maize to see their performance as well as to see their effect to maize yield. But unfortunately maize yield could not be recorded, and the yield obtained from the millet varieties was very poor.

In this unreplicated observation trial NE 6401-26 yielded the most (618 kg/ha) and NE 1305-55 ranked second with an yield of 250 kg/ha. The Local variety (75 kg/ha) yielded the lowest.

No firm conclusion can be drawn from this observation trial, since no maize yield could be recorded and the millet yield was very low.

4.8 LOCAL MILLET VARIETAL TRIAL

Promising varieties from local collection were tested in the trial. Although a non-significant result was obtained, between the yield of tested varieties, Hyeks (4322 kg/ha) was the highest yielding of all Okhale (4307 kg/ha), Latte (3911 kg/ha) and PAC Local (3892 kg/ha) were the other top-yielding varieties. Dange variety gave the lowest yield (2293 kg/ha) of all.

The earliest maturing varieties were Dalle Sano (171 days), PAC-Local (172 days) and Toplines (175 days). Dange the lowest yielding variety took maximum days (200 days) to mature.

A severe lodging was observed in all the varieties, due to the excess plant growth, lodging was recorded the maximum 5 (1-5 scale) in Okhale-1 variety and it was between 3-4 (1-5 scale) in other varieties.

None of the improved varieties have proved to be better to local ones in our past trials, here in this trial also Local varieties show an encouraging result. In future, testing of the best local varieties together with the improved one will continue.

4.9 RICE COORDINATED VARIETAL TRIAL

Of all 16 varieties, Kaushing 27 yielded the highest (3307 kg/ha) and was significantly better to all other varieties except Jc 24 (3088 kg/ha). Other higher yielding varieties were NR-10045 (2766 kg/ha) and Darmali (Local) (7723 kg/ha). The yield obtained from Himali (IR - 2298) - 420 kg/ha was significantly lower to all other varieties except IR 9209-36-3-2 (769 kg/ha).

In terms of straw yield, Pokhareli Masino ranked first with 9850 kg/ha, other varieties producing higher straw yield were Darmali (7723 kg/ha) and Kausing 27 (7120 kg/ha).

K 39-96-1-1-1-2, P 33-C-19, and NR 10041-66-3-1 were the earliest maturing varieties matured in 154 days, 161 days and 163 days respectively. Kausing 27 (192 days), JC 24 (192 days), Pokhareli Masino (192 days) and Darmali (192 days) were among the late maturing ones.

Plant height was recorded the highest in Darmali (123 cms) followed by Pokhareli Masino (133 cms).

Attack of blast disease was not so severe this year as before. It was recorded the highest 4 (0-5 scale) in Himali and the top yielding varieties suffered the least (1-2) from this disease.

Pokhareli Masino currently being extended by PAC ranked 12th from yield point of view still it is preferred by the farmers for its straw yield and fine grains.

Kausing 27 - a promising variety in term of both grain and straw yield can not be extended, due to high susceptibility to blast disease in the previous years, though suffered less in this trial.

4.10 FERTILIZER RESPONSE TRIAL ON POKHARELI MASINO AND DARMALI

This was an unreplicated observation trial planted to see the response of Pokhareli Masino and Darmali varieties to a low level application of fertilizer. Both varieties were planted with and without fertilizer. Fertilizer was applied in fertilized plots @ 60:30:0 NPK kg/ha in both the varieties.

The result showed an increase in grain yield in Pokhareli Masino from the fertilizer application (2021 kg/ha). The average grain yield obtained from non-fertilized plot only 1800 kg/ha. In contrast Pokhareli Masino and Darmali responsed negatively to the fertilizer application. The average yield obtained from fertilized plot was 1303 kg/ha whereas the unfertilized plot yielded higher than that (1561 kg/ha).

In a separate trial conducted to see the response of Darmali to the application of fertilizer (30 kg N/ha - basal application), same result as above was observed. Both the grain yield as well as straw yield was lower in the plots where fertilizer was applied. Average grain and straw yield was 2175 kg/ha and 7392 kg/ha respectively without fertilizer and 1191 kg/ha and 6467 kg/ha with fertilizer.

However, the reason for the negative response of Darmali to fertilizer could not be explained clearly, the heavy attack of blast in the fertilized plots may be one of the reasons for the lower grain and straw yield.

It is worth testing Pokhareli Masino with different level of nitrogenous and phosphatic fertilizers.

4.11 UPLAND RICE FPT

This trial was conducted in cooperation with NRIP. In this unreplicated trial, B 9 C - MD yielded the most (893 kg/ha) followed by MW 10 (788 kg/ha) and Bindeshwari (881 kg/ha), Malika (110 kg/ha), IR- (166 kg/ha) and Local (276 kg/ha) were among the lowest yielding ones.

All the tested varieties suffered from moderate to high degree of sterility and heavy infestation of blast disease occurred to them all.

The promising varieties B9C-MD and MW 10 will be tested further in farmers field.

4.12 SOYBEAN COORDINATED VARIETAL TRIAL (BARI)

Altogether 15 varieties of soybean were tested in this trial in cooperation with GLIP at 1350 m.a.s.l. The average yield obtained from the soybean varieties was very low. The soybean plants were very lean and thin and were suppressed by the excessive maize growth.

From whatever the yield obtained the top yielding varieties were - Lumle-1 (376 kg/ha), PK - 7394 (237 kg/ha) and 11 - 4 (149 kg/ha). Lumle-1 yielded significantly better to all the varieties. Maize yield was also recorded the highest (3345 kg/ha) with Lumle-1, whereas maize yielded the lowest with Gassy-17 (2853 kg/ha). Celest was the lowest yielding of all (19 kg/ha) followed by Desoto (21 kg/ha).

Almost all the varieties matured at the same time (157 days) except Desoto which matured in 125 days.

Lumle-1 - The PAC recommended variety proved to be the best variety. Other varieties like PK 7394 and 11-4, will be tested further.

4.13 SOYBEAN COORDINATED VARIETAL TRIAL (WITH MAIZE)

This trial was planted at an altitude of 1750 m.a.s.l. intercropped with maize. The trial material was obtained by GLIP.

The highest yielding varieties were KS 4197, KS 525 (181 kg/ha), UPSLY-2 (171 kg/ha) and 11-4 (165 kg/ha), and were not significantly different to each other. Lumle-1 ranked the 7th (111 kg/ha). Gassy-17 (41 kg/ha) and Dill (46 kg/ha) were the lowest yielding ones. Maize yield was the highest (3817 kg/ha) with soybean variety CES-16-103 and was the lowest (2389 kg/ha) with Ransom.

None of the varieties took more than 156 days (Lumle-1) to mature. The earliest maturing variety was Desoto (123 days).

Lumle-1 was the tallest (98 cms) and Desoto (46 cms) was the shortest variety of all.

4.14 SOYBEAN VARIETAL OBSERVATION ON PADDY LIPS

Same set of 15 varieties as above were planted in the paddy lips to test their suitability for growing on the paddy lips. Soybean varieties were planted in 10 meter strips. As in other soybean trials, the yield from this trial was very low.

Variety 11-4 yielded the highest (3 kg/1000 M.) followed by UPSLY (2.8 kg/1000 M.) and Local PAC (2.6 kg/1000 M.). These varieties will be tested further.

4.15 LOW MID ALTITUDE GRAIN LEGUME TRIAL

This trial was planted on Bari land at an altitude of 1350 m.a.s.l. with maize and in total 8 varieties of different beans were tested. This was also badly affected by the drought.

Cow Pea (Muga Local) produced the highest yield (249 kg/ha) and was significantly better to all other beans. Other top yielding varieties were V - 7816 (48 kg/ha) and Jare Simi (44 kg/ha), Winged - bean (13 kg/ha) and V - 7833 (8 kg/ha) yielded the lowest.

The intercropped yield of maize and cow pea was the highest (2805 kg/ha).

Trials on bean will continue in future to find out the best varieties.

4.16 LUPIN VARIETAL OBSERVATION

Lupin an oil seed legume was planted in PAC to see its performance in this area. Altogether 3 varieties were tested in which Albus Kejvski ACCN 14 = 2214 yielded the highest (922 kg/ha) variety Albus CV Butte RCVP and Angus trifolios amarri yielded 656 kg/ha and 533 kg/ha respectively. All the varieties were obtained from UK.

Work on Lupin will continue in future.

4.17 POTATO VARIETAL OBSERVATION

A collection of local potato varieties was made by the extension section. From that a total of 25 varieties were planted for

observation. Each variety was planted in one 3 metres long row.

Grausa 27 'S', Halo Alu - 1 and Halo - II yielded 2 kg/3 metre, 1.6 kg/3 metre and 1.6 kg/3 metre respectively and looked promising than other varieties. Instances of late blight attack was observed in all the varieties but was recorded lower in the above mentioned varieties.

Selection work on potatoes will continue, since we do have the problem of brown rot disease in the improved Kufri Jyoti and CFJ varieties.

4.18 CROPPING SYSTEMS TRIALS

From 1982 summer different maize based and rice based cropping systems trials have been started. Observation and grain yield assessment are being made. These trials will be continued in the future.

4.19 SEED MULTIPLICATION

Seed multiplication of different crops - rice, beans, soybeans and maize was done on small scale, and the total seed produced will be used for future trials.

5. FARMERS FIELD TRIAL (FFT) AND DEMONSTRATION

5.1 MAIZE VARIETAL FFT

Maize Varietal FFT was conducted in different Panchayats of the Dhankuta, Terahthum and Taplejung Districts, of which significant result was obtained from 4 sites.

In high altitude of Hattikharka Panchayat Amarillo Del Bajio (3781 kg/ha) yielded significantly better to all other varieties except Hetauda Composite (2656 kg/ha). In Pakhribas Panchayat (high altitude) again Amarillo Del Bajio (6552 kg/ha) was the highest yielding variety of all and there were no significant difference between Amarillo Del Bajio, Hetauda Composite (6531 kg/ha), Rampur Seto (4714 kg/ha) and Suwon-1 (4331 kg/ha).

Whereas in low altitude of Muga Panchayat, Janaki yielded the highest (6164 kg/ha), and there was no significant difference between

Janaki, Hetauda Composite (5165 kg/ha). In Nigaradin (low altitude) Hetauda Composite (3715 kg/ha) yielded the highest, and was significantly better to other varieties except Janaki (3389 kg/ha).

In high altitude the overall mean of the varieties shows that Amarillo Del Bajio yielded the highest (3652 kg/ha) followed by Hetauda Composite (3309 kg/ha) and Suwan-1 (2733 kg/ha). Local was the lowest yielding one (1962 kg/ha).

In mid altitude - overall mean yield of Hetauda Composite (4151 kg/ha) ranked the first. Other higher yielding varieties were - Janaki Seto (4055 kg/ha), and Local (3593 kg/ha).

Average yield of Janaki Seto from low altitude sites was the highest (3701 kg/ha) followed by Hetauda Composite (3516 kg/ha) and Rampur-1 (3128 kg/ha).

In high altitude Suwan-1 matured the earliest (154 days) Local being the last (174 days). Again Suwan-1 (153 days) was the earliest maturing variety in mid altitude also - Hetauda Composite and Local both matured in 156 days, ranking the last. Whereas in low altitude Janaki and Rampur-1 Seto matured in 139 days, and were the earliest maturing ones, though not much difference was observed between the earliest and last maturing varieties.

Heavy attack of rust disease was observed in all the varieties, and the disease severity was more this year than the previous years.

Amarillo Del Bajio, Hetauda Composite and Janaki proved their superiority over other varieties in high, mid and low altitudes respectively. Seed multiplication and distribution of first two varieties is already being done. From this year Janaki also will be extended to the farmers. Varietal FFT with promising varieties will continue in future.

5.2 MAIZE VARIETAL DEMONSTRATION

Varietal demonstrations on maize were planted with 2 improved

varieties and 1 Local variety in the ASP's and in the new Panchayats of Taplejung District, to know the reaction of farmers towards the improved (recommended) maize varieties, and to popularize them at the same time.

Hetauda Composite, Janaki and Local were planted, in low altitude and Amarillo Del Bajio, Hetauda Composite and Local in high altitude. The overall mean from low altitude shows that Janaki yielded the highest (4511 kg/ha) followed by Hetauda Composite (3479 kg/ha). Local (3042 kg/ha) ranked the last.

In high altitude, Hetauda Composite yielded the most (3334 kg/ha) followed by Local (3204 kg/ha). Amarillo Del Bajio yielded the lowest (2064 kg/ha). The farmers preferred Janaki for its higher yield and its white grain.

5.3 MAIZE MINIKIT DEMONSTRATION

Maize varieties : Amarillo Del Bajio, Hetauda Composite and Janaki were demonstrated in the high, mid and low altitudes respectively at the Panchayats of the Dhankuta, Taplejung and Terahthum Districts. This demonstration was planted in one ropani (500 m^2), half of which was fertilized (60:30:0, N:P:K kg/ha) and half was without fertilizer.

Average yield obtained from Amarillo Del Bajio with and without fertilizer was 4397 kg/ha and 3675 kg/ha respectively. Hetauda - Composite with fertilizer yielded 3691 kg/ha and without fertilizer 3097 kg/ha. Janaki produced the highest yield of all (5315 kg/ha) with fertilizer, and 3740 kg/ha without fertilizer.

5.4 RICE CVT FFT

This was an unreplicated, observation trial in which 4 varieties from NRIP and 2 varieties from PAC were included.

The highest yielding varieties were JC-24 (2070 kg/ha), Pokhareli - Masino (1962 kg/ha) and Local (1921 kg/ha).

Variety K-39 (120 days) matured the earliest followed by NR-10041 (148 days), Pokhareli Masino (156 days) was the last maturing one. Blast disease occurred in all varieties. Local was the most affected one.

Farmers preference was to Pokhareli Masino for its yield potential, (both grain and straw) and fine grain type. JC-24 though yielded the highest, was not preferred by the farmers, due to its shorter plant height. K-39, earliest maturing variety, performed very good in the field but it was severely damaged by rats.

5.5 RICE VARIETAL FFT

Altogether 6 varieties from NRIP and from our local collection were tested in this trial. Non-significant result was obtained from all sites. However, the overall mean of the varietal yield showed that Local (1337 kg/ha) was the highest yielding of all. The other top yielding varieties were Pokhareli Masino (1197 kg/ha) and Hukpa (989 kg/ha). Kuntage (618 kg/ha) yielded the lowest.

K-39 and Local at the same period (134 days and were the earliest maturing ones. Pokhareli Masino and Malika matured in 170 days and ranked the last from maturity point of view.

5.6 RICE MINIKIT DEMONSTRATION

Pokhareli Masino was planted in 250 m^2. The average yield obtained was 2153 kg/ha. The farmers preferred this variety to their local. Despite of the drought hazards its performance was better than the local variety in all Panchayats.

5.7 UPLAND RICE VARIETAL FFT

In this trial, two varieties VL 206 and Bermi were replicated in each site and 3 extra varieties were kept unreplicated for observation in each of the site.

Significant results was obtained from two sites. Wherever the result was significant, VL 206 yielded significantly better than Bermi.

The overall mean yield of VL 206 (1309 kg/ha) was the highest followed by Basmati Saskata (1126 kg/ha). Other top yielding varieties were Chobo (860 kg/ha) and Bermi (748 kg/ha). Bindeshwari being the lowest (385 kg/ha).

The earliest maturing varieties were Tauli Seto (116 days), Bermi (117 days) and VL 206 (128 days).

VL 206 (98 cms) and Chobo (96 cms) were the tallest of all varieties.

The farmers were very much impressed with the upland rice, especially with VL 206. Previously, upland rice was cultivated nowhere in these areas. Seeing the performance of the varieties the farmers have shown keen eagerness to grow it in their land in future.

Variety VL 206 will be demonstrated in minikit demonstration.

5.8 MILLET VARIETAL FFT

Six finger millet varieties were tested in this trial in 3 sites. A significant result was obtained from 2 sites.

In Phalate, Okhale-1 (2233 kg/ha) yield the highest and was significantly better to other varieties except Mudke Kodo (2138 kg/ha). Other higher yielding varieties were Local (2008 kg/ha) and Latte Kodo (1762 kg/ha). Dalle-1 (1242 kg/ha) was the lowest yielding of all, which was significantly lower to all other varieties. In Phakumba also Mudke Kodo (2045 kg/ha) yielded the highest and was significantly better to other varieties except Okhale-1 (1950 kg/ha) and Local (1202 kg/ha).

The overall mean yield of the varieties showed that Okhale-1 (2144 kg/ha) ranked the first followed by Mudke Kodo (1992 kg/ha), Local Okhale-1 (1863 kg/ha) and Dalle-1 (1067 kg/ha) ranked the last.

The highest yielding Okhale-1 matured earliest of all (161 days). Local variety took maximum 170 days to get matured.

The promising varieties will be kept in the demonstration in farmers field.

5.9 GROUNDNUT VARIETAL FFT

Three varieties from NODP and one Local variety were tested in low altitude groundnut growing areas (2 sites). A significant result was calculated from one site.

AC 343 (593 kg/ha) in Muga yielded the highest and was significantly better to all other varieties. Local (425 kg/ha) was the highest yielding variety. NC 6 (317 kg/ha) was the lowest yielding of all.

The overall mean of kernel yield from AC 343 (421 kg/ha) was the highest. Local yielded 309 kg/ha and ranked second. NC 6 (264 kg/ha) was the lowest yielding of all.

None of the tested varieties were resistant to tikka disease. The Local variety was worst affected of all.

The best variety AC 343 will be demonstrated in the farmers field.

5.10 SOYBEAN MINIKIT DEMONSTRATION

Lumle-1 was planted both in Bari and in Khet bunds, the area grown was 250 m^2 and 100 m long strip respectively.

The yield obtained from Bari land was 1432 kg/ha and that from Khet bund was 33/100 metre strip.

This variety has already gained popularity in the Panchayats and seed multiplication program has been started.

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PAKHRIBAS AGRICULTURAL CENTRE
DHANKUTA
SUMMARY OF ON FARM TRIALS RESULTS AND DETAILS (OFT)
(Summer Crop 1982)

Table - 3

S.NO.	Trial Name	Land Type	Fertilizer/Manure		Net plot N	Altitude Masl.	Significance	LSD P=0.05	Top yielding treatments	Yield kg/ha
			Basal	Top dressing						
1.	NMDP Maize Varietal Trial	Bari	30kg N/ha Compost+FYM	30 kg N/ha 15t/ha	5 m^2	1350	**	773	(a)Rampur-2 (b)Janaki Seto (c)Suwan -8075	3505 3167 3102
2.	NMDP Maize Varietal Trial	Bari	30kg N/ha Compost+FYM	30kg N/ha 15t/ha	5 m^2	1750	**	475	(a)Suwan -8075 (b) Rampur-2 (c)Janaki Seto	2465 2345 2138
3.	FPT Maize 1982	Bari	30kg N/ha	30kg/ N/ha	4.5 m^2	1750	**	971	(a)Farmer's Local (b)Ganesh-2 (c)Janaki Seto	4442 4100 3987
4.	Soyabean Co-ordinated Varietal Observation on Paddy strips	Khet bund			Harveted from 10m long strips	1350	-	-	(a)11-4 (b)Upsly (c)PAC Local	301gm/10 288gm/10 254gm/10
5.	Soybean Co-ordinated Varietal Trial (Intercropped with maize)	Bari	30kg N/ha Compost+FYM	30kgN/ha 10t/ha	5 m^2	1750	*	88	Soybean only (a)KS419/KS525 (b)Upsly -2 Soybean+Maize Total (a)CEB-16-103+ (b)Upsly -2	181 171 3919 3296
6.	Low/Mid Altitude Grain Legume Trial (Intercropped with Maize)	Bari	FYM + Compost 10t/ha		6 m^2	1350	**	62	Bean only (a)Cow pea (b)Common bean (V-7816) Bean+Maize (a)Cow pea + (b)Common bean (V-7842)	249 48 2805 2621

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Table-3(Contd.)

SUMMARY OF ON FARM TRIALS RESULTS AND DETAILS (OFT)Summer Crops 1982) Continued

S.N.	Trial Name	Land type	Fertilizer/Manure Basal	Fertilizer/Manure Top dressing	Net plot size	Altitude m.a.s.l.	Significance	LSD P=0.05	Top yielding treatments	Yield kg/ha
7.	Soybean Co-ordinated Varietal Trial (Intercropped with maize)	Bari	30kgN/ha Compost+FYM=10t/ha	30kg N/ha	$6M^2$	1350	**	73	Soybean only (a) Lumle -1 (b) PK - 7394 Soybean +Maize (a) Lumle-1 (b) Celest	376 237 3721 3454
8.	Rice Co-ordinated Varietal Trial (Mill)	Khet	kg/ha N P K 30:30:0: Compost +FYM = 10t/ha	Kg/ha 30 N	$4M^2$	1350	**	413	(a) Kaushing -27 (b) JC-24 (c) NR-10045-20-3-2	3307 3038 2766
9.	Up-land Rice Varietal Trial (Observation unreplicated)	Bari	-	30 kg N/ha	$27M^2$	1350	-	-	(a) B9C HD (b) M7 - 10	893 46
10.	Rice Fertilizer Trial on Darmali (Observation unroplicated)	Khet	30kg N/ha		$5M^2$	1350	-	-	Without fertilizer (a) Darmali With fertilizer (b) Darmali	2175 1191
11.	Fertilizer Response Trial on Pokhareli Masino and Darmali	Khet	kg/ha N P K 30:30:0	30kg N/ha	$5M^2$	1350	-	-	Pokhareli Masino (a) With fertilizer (b) Without " Darmali (a) With fertilizer (b) Without "	2021 1800 1303 1561
12.	Local Millet Varital Trial	Bari	Compost +FYM=10t/ha		$6M^2$	1350	NS	1112	(a) Mudke Kodo (b) Kokhale (c) Latte	4322 4307 3911
13.	Finger Millet Varietal Trial (Observation unreplicated)	Bari	- (Compost + FYM = 10t/ha	20kgN/ha	$6M^2$	1750	-	-	(a) ME-6401-26 (b) ME-1305-55 (c) IE-143	618 250 115

Table-3(Contd)

SUMMARY OF ON FARM TRIALS RESULTS AND DETAILS (OFT)
(Summer Crops 1982) Continued.

S.N	Trial Name	Land type	Fertilizer/Manur Basal	Fertilizer/Manur Top dressing	Net plot size	Alti-tude a.s.l.	Signi-fican-ce	LSD P=0.05	Top yielding treatments	Yield kg/ha
14	NMDP Advanced Varietal Trial on Millet (Intercropped with Maize)	Bari	30 kgN/ha	30 kg N/ha Compost + FYM=10t/ha	4.8M^2	1350	**	392	Millet only (a) Mudke Kodo (b) NE- 1304-1 Millet + Maize (a) NE-1304-1 (b) Mudke Kodo	2396 2102 Total 5486 5474
	Finger Millet Varietal Trial (Intercropped with Maize)	Bari	30 kg N/ha	30kg N/ha Compost + FYM = 10t/ha	4.8M^2	1750	**	142	Millet only (a) NE - 6401-26 (b) TE - 980 Millet + Maize (a) ND -1305-55 (b) Nokhale -1	564 521 3789 3633
	Local Potato Varietal Observation	Bari	-	60kg N/ha Compost +FYM =20t/ha	3M long	1750	-	-	(a) Grausa 27'S' (b) Hale Alu-I (c) Hale Alu-II	Yield kg per 3M. 2.20 1.60 1.584
17.	Lupin Varietal Observation	Bari	-	- Compost + FYM = 10t/ha	0.90M^2	1750	-	-	(a) Albus Koivskii mutant ACCN 14-2214 (b) Albus CV, butter cup (c) Augusttelius amarri	922 656 533

** = Significant at 1% level
* = Significant at 5% level
NS = Not significant among treatments.

PAKHRIBAS AGRICULTURALL CENTRE
DHANKUTA
SUMMARY OF FFT RESULTS AND DETAILS

Table -4

S.N.	Trial Name	Site	Land Type	Fertilizer	Harvested area	CV %	Top yielding Varieties	Yield kg/ha
1.	Maize Varietal FFT	5	High Altitude Bari	As per farmer's practice	3.75M^2	19-32	1.Amarillo del Bajio	3652
							2.Hetauda Composite	3309
							3.Suwan - 1 Seto	2733
		4	Mid Altitude Bari	"	3.75M^2	20-37	1.Hetauda Composite	4151
							2.Janaki Seto	4055
							3.Local	3593
		4	Low Altitude Bari	"	3.75M^2	11-46	1.Janaki Seto	3701
							2.Hetauda Composite	3516
							3.Rampur-1 Seto	3128
2.	Rice Co-ordinated var.FFT	6	Khet	"	-	-	1.JC 24	2070
							2.Pokhareli Masino	1926
							3.Local	1921
3.	Rice Varietal FFT	2	Khet	"	-	-	1.Local	1338
							2.Pokhareli Masino	1197
							3.Mukpa	989
4.	Upland Rice var.FFT	6	Bari	"	7.5	14-50	1.VL 206	1390
							2.Jasmati saskata	1126
							3.Chebo	860
5.	Millet Varietal FFT	3	Bari	"	6M^2	15-30	1.Pokhle -1	2044
							2.Mudke Kalo Kodo	1992
							3.Local	1863
6.	Groundnut var. FFT	2	Bari	"	6M^2	13-35	1.JC 343	421
							2.Local	309
							3.KG 15729	266

Annexure 1

ON-FARM TRIAL PROGRAMMES 1983

01. Maize: The selection work for higher yielding white varieties will continue until a superior variety is developed from the white maize breeding program which is being conducted at PAC in cooperation with NMDP.

A reliable fertilizer recommendation for maize will be made from the previous maize fertilizer trials conducted in PAC and in farmer's field.

The high, mid and low altitude trials organized by NMDP will be continued.

02. Rice: A promising variety of main crop rice, Pokhareli Masino has already been identified and the seed multiplication program started. K-39 an early maturing variety has become highly successful to impress the farmers in low altitude. This variety as an early rice, will be demonstrated widely in the target Panchayats and seed multiplication program will be started.

Varietal work on rice will be continued to find out an improved and superior variety which will supersede Pokhareli Masino.

Twice Azolla was brought from Soil Section, Khumaltar and twice it died. At the beginning, it multiplied and covered the pond rapidly, but unfortunately it died at the later stage. Again Azolla will be brought, probably another species that will survive in this climate.

The intial evaluation trials and advanced varietal trials on rice organized by NRIP will be continued.

03. Finger Millet: This year finger millet variety Okhale-1, collected by NMDP from Okhaldhunga, has shown promising result in the farmers field, than the local varieties. This variety will be demonstrated in the farmers field. Search for still higher yielding variety will continue. For this finger millet varieties from NMDP and local varieties will be tested further.

04. Upland Rice: Upland rice varietal FFT, carried out in 1982 summer in the farmers field has given an encouraging result. VL 206 upland rice variety has already been identified and this variety will be demonstrated in the farmers field and seed multiplication program be started at the same time.

Varietal trial on upland rice organized by NRIP will be continued to find out a superior variety.

Fertilizer work on upland rice will be carried out.

05. Sorghum: The sorghum varieties obtained from NMDP last year had very low germination percentage, hence no varietal trial on the same could be conducted. This year varietal trial on sorghum will be conducted in the low altitude sorghum growing areas of PAC target Panchayats. It has been hoped that some improved varieties will be obtained from NMDP.

06. Common Bean: Variety A-21 and few other have been identified as an useful intercrop of maize at higher altitude. These varieties will be tested further in the farmers field this year.

07. Soybean: Seed multiplication program of Lumle-1 variety has already been started. Seed will be distributed to grow it on an intercrop of maize and for growing on paddy bunds.

Coordinated varietal trial on soybean organized by GLIP will be conducted in the future also.

08. Groundnut: Varietal trial on groundnut was conducted last year in the farmers field, from which AC 343 (from NODP) has shown promising results. This variety will be put into demonstrations.

Varietal selection work on groundnut with varieties from NODP will be continued this year also.

09. Pigeon Pea: Pigeon pea is grown in some of the low altitude Panchayats, last year 3 varieties from GLIP were obtained and planted. The

result from this trial was not encouraging, so this trial will be planted this year also with early maturing promising varieties from GLIP.

10. Cropping Systems Trials: Cropping Systems Trials on the following will be conducted this year:

1. High altitude potato based
2. High altitude maize based
3. Mid altitude maize based
4. Mid altitude rice based
5. Low altitude rice+maize based
6. Low altitude rice - rice based.

Annexure 2

PAKHRIBAS AGRICULTURAL CENTRE
DHANKUTA
SUMMER CROPS FARMERS FIELD TRIAL AND DEMONSTRATION PROGRAMME 1983
DISTRIBUTION CHART

S.N.	PANCHAYAT		RICE		MAIZE	U.RICE		G.NUT		BEANS	MILLET		SOYA	PIGEON PEA		SORGHUM		POTATO		TOTAL		FFT + Demonstration
			Minikit Demonstration Early - Main	Varietal FET Early - Main	Minikit Demonstration Early/Late	Varietal FET	Minikit Demonstration	Varietal FET	Minikit Demonstration	Varietal FFT	Varietal FFT	Minikit Demonstration	Varietal FFT	Minikit Demonstration	Minikit Demonstration	Varietal FFT	Cropping System FFT	Varietal FFT	Minikit Demonstration	Varietal FFT	FFT	Demonstration	
1	Pakhribas		–	1M	2L	1H	1	–	–	–	–	1	–	–	–	1	1HMB	–	–	–	–	3+1	9
2	Chorlikharka		1E	1E	1E	1M	1	–	–	–	–	–	1	–	1	–	1LRRB	1	–	–	5	4	9
3	Sanne		1E	1E	1E	1L	–	1	–	–	–	1	–	–	1	–	1MMB	–	–	–	6	3	9
4	Muga	LTA	–	1M	–	1L	–	1	1	1	–	1	1	–	1	1	1LRPB	–	–	–	6	2+1	9
5	Hattikharka		1E	IE	1E	IM	1	–	–	–	1	–	–	–	–	1	1HPB	–	–	–	6	3	9
6	Phalate		–	1M	1E	1H	–	1	1	1	–	1	–	–	–	–	1LRB						
7	Murtidhunga		–	1M	1E	1H	1	–	–	–	1	1	–	–	–	–	1MRB	1	–	–	6	2+1	9
8	Dhungesangu		1E	1M	1E	1L	–	–	–	–	–	–	1	–	–	1	–	–	–	1	5	2	7
9	Sangu		1M	–	–	1L	–	–	–	–	–	1	–	–	–	–	–	–	1	1	2	3	5
10	Phakumba		–	1M	–	1H	1	–	–	–	1	1	–	–	–	1	1HPB	–	–	–	5	2	7
11	Change	NTA	–	1M	1E	1H	–	–	–	–	–	1	–	–	1	–	1LRB	–	–	–	4	3	7
12	Khamlalung		1M	–	–	1M	1	–	–	–	1	1	1	–	–	–	1MRB	–	–	–	4	3	7
13	Hangpang		1E	1E	–	1L	–	1	–	–	–	1	–	–	1	–	1MMB	–	–	1	5	3	8
14	Niguradin		1E	1M	–	1H	–	–	–	–	–	1	–	–	1	–	–	–	–	1	3	3	6
15	Phulbari		1M	1M	–	1M	–	–	–	–	–	–	–	–	–	1	–	–	1	–	3	2	5
16	Morahang		1M	1M	2M	1M	–	–	–	–	1	1	–	1	–	–	–	–	1	–	3	6	9
17	Tankhuwa	ASP	1M	1M	2M	1L	–	–	-1	–	1	1	–	1	1	1	–	–	–	–	4	7	11
18	Chungbang		1E-1M	1M	2M	1M	–	–	1	–	–	–	–	2	1	–	–	–	1	–	2	8	10
	TOTAL	LTA	3	7	7	7	4	3	2	2	3	4	3	–	4	3	9	2	–	4	67		
		NTA	6	6	1	8	2	1	–	–	2	6	2	–	3	3	5	–	2	–	47		
		ASP	4	3	6	3	–	–	2	–	2	2	–	4	2	1	–	–	2	–	31		
		All Total	13	16	14	18	6	4	4	2	7	12	5	4	9	7	14	2	4	4			145

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Annexture 3

METEOROLOGICAL DATA RECORDED AT
PAKHRIBAS AGRICULTURAL CENTRE
APRIL 1982 - SEPTEMBER 1982
MONTHLY SUMMARY

MONTH AND YEAR	AVERAGE MAX. TEMP. °C	AVERAGE MIN. TEMP. °C	MEAN TEMP. °C	AVERAGE SOIL TEMP.				PRECIPITATION			AVERAGE RELATIVE HUMIDITY		DAILY EVAPORATION (MM)	AVERAGE DEW POINT	WIND SPEEDS MT/S	SUNSHINE HRS		GRASS MIN.TEMP.	
				5 CM	10CM	30CM	50CM	TOTAL RAINFALL (MM)	NO.OF RAINY DAY MONTH	HIGHEST RAINFALL IN 24 HRS WITH DATES	MORNING AT 8.40 AM	DAY TIME AT 1 PM				TOTAL	AVERAGE DAILY	AVERAGE	LOWEST
APR 1982	23.0	12.1	17.6	18.7	18.0	20.4	20.8	74.8	15	37.7MM 25.4.82	86	70	4.46	14.7	0.86	194.4	6.4	9.5	7.5
MAY 1982	26.0	15.3	20.7	22.9	22.0	24.1	24.3	44.0	10	14.4MM 15.5.82	67	55	5.75	15.0	0.98	295.4	9.8	12.6	10.0
JUN 1982	23.0	16.6	19.8	22.3	21.5	22.9	23.5	231.5	24	48.3MM 30.6.82	88	80	5.60	17.7	1.11	60.6	2.0	15.8	14.3
JUI 1982	23.7	17.5	20.6	22.2	21.6	22.6	22.8	252.0	25	45.5MM 21.7.82	93	81	2.75	18.9	0.80	43.0	1.4	16.8	15.4
AUG 1982	23.7	17.4	20.6	22.4	21.5	22.6	22.9	280.1	28	43.5MM 8.8.82	90	93	2.19	19.2	1.11	72.6	2.3	16.2	15.0
SEP 1982	22.6	16.1	19.4	21.0	20.5	21.9	22.2	255.8	22	58.5MM 17.9.82	88	89	1.88	17.2	0.79	77.8	2.6	14.6	10.5

LUMLE REPORT ON MAIZE, FINGER-MILLET AND SOYBEAN, 1983

1. Abstract

Varietal screening field experiments were conducted at the Lumle Agricultural Centre (LAC) and in its target villages on Maize, Finger-millet and Soybean during 1982 season. Amarillo del Bajio and Kakani Yellow maize varieties were found high yielding varieties of maize in FFT. Kakani Yellow and Rampur-1 were indicated superior genotypes of maize in NMDP varietal trial. Likewise, Arun-2 and Kakani Yellow were the favourite maize varieties of the farmers.

Dalle-1 and NE 1304-43 were shown superior cultivars of finger-millet in A.V.T., whereas Farmer Field Trials (FFT) indicated NE 1304-43 and NE 6401-26 superior germplasm of finger-millet.

PK-7394 and Celest varieties of soybean with maize (Kakani Yellow) produced highest yields. PK-7394 and Desoto with maize produced highest gross returns. Varietal trial showed UPSLY-2 and Ransom highest yielders of soybean. Fungicidal trial conducted on soybean indicated that spraying of Dithane M-45 at 20 days interval effectively controls the fungal diseases (F.E.). Weeding trial carried out on soybean showed that weed removed after 30 days of sowing produces best results. Lumle-1 and Columbus varieties of soybean were found giving best results when sown at 5cm depth. Spacing trial conducted on the same varieties indicated that 40cm apart planted crops produce highest yields. Columbus and Lumle-1 were found giving highest yields when planted on 10th of May and 25th of April respectively. FFT indicated Lumle-1 as the highest yielding variety of soybean.

2. Introduction

The Lumle Agricultural Centre is situated at an altitude of 1675m with a total area of approximately 58 hectares of land. The annual

precipitation it receives is 5143mm (203") (an average of 12 years).

The very endeavour of LAC's Agronomy Section has been to provide new knowledge and skills on improved agricultural techniques to farmers so that they become better off in their staple crops such as maize, wheat, potato and legumes thereby improving their livelihood. To achieve the above mentioned goal we conduct simple investigational exercises (based on the farmers problems) to back up extension work and carry out the later as the main program with an equal importance to training activities.

Extension Activities

Till now, LAC has been covering the following main extension services in its target villages, though, efforts are being made to channel these services to the appropriate agencies. A start has already been made in this regard.

Services

A. Input supply,
B. Village based seed multiplication program,
C. Seed dressing program,
D. Grain storage program,
E. Village based training program, and
F. Investigational exercises on farmers' plot.

Supply of Inputs

Supply of inputs is a major problem in the hills because of difficult terrene, lack of communication and villages situated beyond the easy reach.

In the pursuit of overcoming this problem all possible efforts are being made to multiply improved seeds in the villages in close supervision of village based field staff and LAC based staff. The results have been excellent on this aspect.

The amount of seed shown in the table given below was produced in the villages by the farmers themselves:-

Seed Distribution

Year	Maize (kg.)	Soybean (kg.)
1974	28	0
1975	443	109
1976	380	300
1977	700	251
1978	3,920	300
1979	5,526	340
1980	11,517	681
1981	15,685	736
1982	4,800 (to date) (2,395 K. Yellow + 2405 Arun-2)	Not available

The farmers have also been provided seed dressing and grain storage services. These exercises have enabled the farmers to safe guard seeds and food grains against insect/diseases.

The farmers have been able to overcome the problems such as how to apply chemicals and how much, how to control insects and with what etc through the training program conducted in the villages. The farmers have also been given training on simple seed selection techniques, such as mass selection, to improving the quality of seed.

3. Investigational Exercises

We have been conducting simple trials and investigational exercises at the centre and also in the target villages to find out appropriate technology and high yielding, disease/insect resistant varieties of major and other crops. In this endeavour, we are working in close collaboration with the National Crop Development Programs.

Materials / Methods / Result and Discussions

Trials / Investigational Exercises in the Villages

3.1 Farmers' Field Trial on Maize:

The performance of Kakani Yellow has been satisfactory over the years which has given on an average 65% higher yield over local types (average of more than six years). However, this maize does not fit in rice based cropping pattern nor is it easily

adjusted in high altitudes. In the pursuit of finding an answer to this problem we have been conducting FFT in the villages and other varietal selection at LAC. On the whole, the exercises have been a rewarding one.

Farmers' Field Trials were conducted at 17 locations of which 10 are reported below and the remaining seven were destroyed by hailstone.

Sl. No.	Variety / Location Location	Rampur Comp.	Amarillo del Bajio	Manakamana 1	Kakani Yellow	Arun 2	Khumal Yellow	Local variety
1.	Dhikurpokhari	4267	5977	2909	3714	4129	4464	2362
2.	Salyan	3665	5214	2094	4244	2943	3071	3603
3.	Bhadaure	1434	1675	1388	2017	1634	3662	2270
4.	Langadi	2770	4027	2978	5189	2089	2790	2718
5.	Ghandruk	2012	2812	3251	2389	2462	2623	3955
6.	Sikha	4667	5293	4386	4273	4404	4783	1025
7.	Dhampus	3002	3861	1467	2640	2172	3408	2021
8.	Ramche	4289	3733	1537	3913	3867	3022	2309
9.	Histan-Mandali	3010	4587	4826	2930	2002	2589	3477
10.	Lekhphat	2105	2276	1369	3789	2456	4044	1969
Ave. Yield (T/ha.)		3.122	3.946	2.621	3.510	2.816	3.446	2.571
Ranking		4	1	6	2	5	3	7

On an average Amarillo del Bajio has produced the highest yield (3.946 t/ha) followed by Kakani Yellow (3.510 t/ha) and Khumal Yellow (3.446 t/ha). One of the favourite varieties of maize namely Arun-2 has stood fifth in the ranking with an average yield of 2.816 t/ha.

Across the locations, Amarillo del Bajio has outyielded all other varieties at Dhikurpokhari, Salyan, Sikha and Dhampus. Similarly, Khumal Yellow was observed superior at Bhadaure and Lekhphant. Likewise, Kakani Yellow, Local, Rampur Composite and Manakamana-1 were found as the best yielding varieties at Langadi, Ghandruk, Ramche and Histan-Mandali respectively.

The farmers have indicated Arun-2 as the variety of their choice which is reflected in their seed demand which is an increase of 92.75% (2405 kg as compared to last year (1248 kgs.).

Farmers' Field Trial (LAC) (1982)

S. N.		Dhipur-Pokhari (1)	Sallyan (2)	Bhadaure (3)	Langdi (4)	Ghandruk (5)	Sikha (6)	Dhampus (7)	Ramche (8)	Histan-Mandali (9)	Lekhphant (10)	Mean Yield (t/ha) at 12% moisture
1.	Rampur Composite	4.207(3)	3.665(3)	1.434(6)	2.770(5)	2.012(7)	4.667(3)	2.002(3)	4.289(1)	3.010(4)	2.105(5)	3.116(4)
2.	Amarillo del Bajio	5.977(1)	5.214(1)	1.675(4)	4.027(2)	2.812(3)	5.293(1)	3.861(1)	3.733(4)	4.587(2)	2.276(4)	3.946(1)
3.	Manakamana-1	2.909(6)	2.094(7)	1.388(7)	2.978(3)	3.251(2)	4.386(5)	1.467(7)	1.537(7)	4.826(1)	1.369(7)	2.621(6)
4.	Kakani Yellow	3.714(5)	4.244(2)	2.013(3)	5.189(1)	2.389)6)	4.273(6)	2.640(4)	3.913(2)	2.930(5)	3.789(2)	3.509(2)
5.	Arun-2	4.129(4)	3.943(6)	1.634(5)	2.089(7)	2.462(5)	4.404(4)	2.172(5)	3.867(3)	2.002(7)	2.456(3)	2.816(5)
6.	Khumal Yellow	4.463(2)	5.071(5)	3.662(1)	2.790(4)	2.623(4)	4.783(2)	3.408(2)	3.022(6)	2.589)6)	4.044(1)	3.446(3)
7.	Local variety	2.362(7)	3.603(4)	2.270(2)	2.718(6)	3.955)1)	1.025(7)	2.021(6)	2.309(5)	3.477(3)	1.969(6)	2.571(7)
'F' test(0.05)		**	NS	**	NS.	**	NS	**	NS	NS	**	**
CV %		17.806	21.032	18.159	14.385	3.245	27.805	18.281	23.101	32.795	15.124	
L.S.D.at 5%		1.727 t/ha	-	0.893t/ha	-	0.903t/ha	-	1.187t/ha	-	-	0.952t/ha	

Analysis of pooled data
Treatments x Locations
CV%
L.S.D.at 5%

28.761
0.818 t/ha

* Figures in parenthesis ᵽ represent the ranking. Each site had two replications.

3.2 Minikit Demonstration

The object of the exercise was to popularize improved varieties of maize among the farmers and also to bring more areas under improved maize.

A total of 18 minikit demonstration was put at 18 different locations but the results were reported only from 13 locations with satisfactory performance. In the remaining 5 locations hailstone caused the damage.

Performance of Arun-2 (4.685 t/ha) Dharapani (Dhakurpokhari Panchayat) and Kakani Yellow (4.172 t/ha) at Garpar (Dana Panchayat) were excellent.

3.3 Farmers' Field Trial at the Centre (LAC/AGRO/T/Mz/2/82)

The objective of the exercise was to find out high yielding, early maturing, disease resistant varieties of maize as compare to recommended variety (Kakani Yellow) and local genotypes. The trial also aimed to study the yield variation in FFT conducted in target area with that of experimental plot at the centre.

The trial was designed in RBD with two replications and the plot size used was 6 m^2. Eight varieties were tested against local and Kakani Yellow.

Results:

(Mean of 2 Replications)

Treatment No.	Variety	Plant stand/Plot	Days to 50% Silking	Maturity Days	Plant Height in Cm.	Lodging %		Ear Height in Cm.	Husk Cover with BT*	No. of Ears/Plot (Net)	Disease (0.5)						Yield t/ha. at 12% Moisture
						Root	Stalk				CR	Cob Rot %	Stalk Rot %	HB	(Phyto) BS	Cul.	
01	Ganesh-2	28	90	144	176	8	4	89	6	11	3	3	19	2	0	2	1.786
02	Manakamana2	23	94	146	182	12	0	95	6	12	2	2	20	3	0	2	1.642
03	Rampur-2	28	90	147	163	11	0	81	2	11	3	2	23	3	1	2	1.444
04	Rampur-1	24	101	157	188	0	0	101	3	9	2	2	14	1	0	2	1.407
05	Arun-2	30	85	135	169	5	0	71	3	12	3	2	18	3	0	2	1.588
06	Rampur C.	19	98	157	176	42	0	97	4	9	3	1	0	2	1	2	1.545
07	Lumle Local	30	87	132	246	21	0	138	0	4	4	0	8	4	1	3	1.257
08	Kakani Y.	28	90	147	224	14	0	122	2	12	2	0	13	2	1	2	1.838
09	Amarillo del Bajio	25	94	144	196	15	0	97	3	12	2	0	13	2	1	3	2.073
10	Khumal Y.	23	91	146	180	19	0	94	5	11	2	4	15	2	0	2	1.785
'F' - test (P=0.05)																	NS
CV %																	39.24

* - BT. = Bare Tips.

Amarillo del Bajio has topped all other varieties by producing the highest yield (2.073 t/ha) leaving Kakani Yellow (1.838 t/ha), Ganesh-2 (1.786 t/ha and Khumal Yellow (1.785 t/ha) in second, third and fourth positions respectively. Arun-2 was placed in the sixth position after Manakamana-2.

Arun-2 has taken 85 days to 50% silking and matured (135 days) more or less with the local (132 days).

3.4 NMDP Varietal Trial (HMGN) LAC/AGRC/T/Mz/1/82

The objective of the experiment was to develop superior genotypes for temperate region of Nepal. The trial was designed in RBD with 4 replications. Planting was done on 26 April 1982. Fertilizer was applied @120-60-40 kgs NPK/ha plus F.Y.M. @10t/ha.

The result is summarized below:

Treatment No.	Variety	Yield (T/ha) at 12 % Moisture
01	Ganesh-2	4.361
02	Manakamana-2	4.769
03	Rampur-2	4.608
04	Arun-4	4.472
05	Arun-2	3.565
06	Rampur-1	5.180
07	Rampur Composite	3.365
08	Khumal Yellow	4.698
09	Sarlahi Seto	-
10	Kakani Yellow	5.682
	'F' test (P=0.05)	SIG
	CV %	12.874
	L.S.D. at 5%	0.998 t/ha

Kakani Yellow has produced the highest yield (5.602 t/ha) followed by Rampur-1 (5.180 t/ha) and Manakamana-2 (4.769 t/ha).

Arun-2 and Arun-4 have taken 79 days to 50% silking and matured in 129 and 130 days respectively. Rampur 1 was observed as the latest maturing variety which took 153 days.

Rampur-1 (239 cm), Khumal Yellow (237 cm) and Ganesh-2 (227 cm) were observed as tallest varieties, whereas Arun-2 (208cm), Manakamana-2 (210 cm) and Rampur-2 (212 cm) were found as shortest varieties.

The highest number of root lodging was found in Ganesh-2 (27%), followed by Khumal Yellow (26%) and Arun-4 (20%). Fifteen percent root lodging was observed in Arun-2.

The highest number of open husk cover was observed in Manakamana-2 (44%) followed by Rampur-1 (25%).

The occurrence of cob rot disease was noticed highest in Khumal Yellow (39%) followed by Manakamana-2 (36%), Rampur-2 (33%), Rampur Composite (29%), Ganesh-2 (24%) and Rampur-1 (23%). Arun-4 and Arun-2 have scored below 16% cob rot infection. Rampur-2 was found the most susceptible to common rust followed by Manakamana and Khumal Yellow. Stalk rot, Helminthosporium, Physoderma and Curvularia were noticed in almost all the varieties.

Insect damage was observed highest in Manakamana-2, Rampur Composite and Khumal Yellow.

3.5 Breeding Work on Maize (HMGN)

This is the second year since we entered in a breeding program on high land materials of maize in close collaboration with the National Maize Development Program, Rampur. The objective of the exercise was to develop superior genotypes of maize for higher hills.

Selected Materials were as Follows:

Ganesh-2 Half-Sib		Selected Lines	Selected Cobs
Female rows	-	184	314
Male	-	-	150

The selected materials were sent to NMDP for further evaluation.

4. Finger Millet

Finger millet as a crop plays an important role in the hill farming. It does fairly well even under low rainfall and low fertility and requires no special attention in its storage. This crop is rotated with maize.

At LAC, no work was done on this crop till now. However, from this year we have entered in finger millet improvement work in close collaboration with NMDP, Rampur.

4.1 Finger Millet Advanced Varietal Trial (1982) (HMGN) LAC/AGRO/T/-Mt/2/82

The objective of the trial was to screen the suitable variety/ varieties of finger millet under the agro-climatic condition of LAC.

The trial was designed in RBD with 4 replications. Plot size used was 2m X 2m. Manuring of nursery was done with FYM @ 12.9 t/ha and the trial plots were manured with compost @18.5 t/ha. Seeds were sown in the nursery on 24 April 1982 which subsequently transplanted on 23 June 1982. There were seven treatments.

Trt. No.	Variety	Heading Days	Maturity Days	Grain Yield (T/h)
1.	NE-6401-26	48	96	1.500 (7)
2.	NE-1305-55	33	73	1.593 (5)
3.	NE-1304-43	59	137	2.425 (2)
4.	NE-1304-1	27	73	1.525 (6)
5.	NE-6401-22	92	150	2.013 (3)
6.	Dalle-1	84	137	2.975 (1)
7.	Local(Kale Bhunde)	59	116	1.663 (4)
	'F' - test (P = 0.05)			HS
	CV %			20.559

The highest grain yield was produced by Dalle-1 (2.975 t/ha) followed by NE-1304-43 (2.425 t/ha) and NE 6401-22 (2.013 t/ha).

NE-1305-55 and NE 1304-1 took only 73 days to mature whereas NE-6401-22 took 150 days and was the latest variety.

4.2 Farmers' Field Trial on Finger Millet (HMGN) LAC/AGRO/T/Mt/3/82

The objective of the exercise was to find out the best variety of millet suitable for farmers' own environment.

L.S.D. at 5% 0.599 t/ha
L.S.D. at 1% 0.82 t/ha

The trial was designed in RBD with 3 replications. Plot size used was 2m X 2m. Nursery was manured with FYM @ 12.9 t/ha and the trial plots were manured with compost @ 18.5 ton per hectare. Seeds were sown in the nursery on 10 May 1982 which subsequently transplanted on 23 June 1982. There were five varieties including a local one. The result is presented below:

Trt. No.	Variety	Heading Days	(Mean of 3 Replications) Maturity Days	Grain Yield (T/ha.)
1	NE-1304-43	85	138	4.100 (1)
2	NE-1305-55	51	97	2.650 (4)
3.	NE-6401-26	58	110	3.200 (2)
4.	IE-143	34	84	2.125 (5)
5.	Local	90	146	3.000 (3)
	'F' - test (P = 0.05)			SIG.
	CV %			16.281
	L.S.D. at 5%			0.927 t/ha.

NE 1304-43 has yielded the highest grain yield (4.100 t/ha) followed by NE-6401-26 (3.200 t/ha) and Local (3.000 t/ha).

IE-143 was the earliest variety which took 84 days to mature whereas the Local took 146 days and was the latest variety among the tested ones.

4.3 Evaluation of Local Finger Millet Germplasm

During the season, a total of 51 varieties of finger millet was studied under the evaluation of varieties of Local Finger - Millet germplasm of which 25 types were received from the Pakhribas Agricultural Centre and the remaining 26 local varieties were from LAC target area. These varieties were observed in a two replicated observation block.

The varieties were:

From PAC : PAC series 1 to 25

LAC Local Types : Khuinjeri local, Pokhara local, Garpar - local, Salija local (A to E), Sikha local, Bhuka local, Durlung local A & B, Ulleri local A and B, Sabet local, Gharamdi local, Puranogaun local, Ramche local, Lekhphant local A and B, Lespar local, Khalanga local A and B, Ramche local 'B' and Durlung 'C'.

PAC-13 and PAC 18 complete failed to set grains. On an average grain yield basis Bhuka local topped the list (1.1775 t/ha) followed by Salija local 'A' (1.470 t/ha), Khuinjeri local (1.450 t/ha), Kalo Bhunde (1.410 t/ha), Puranogaun local (1.330 t/ha), Durlung local 'C' (1.320 t/ha), Lekhphant local 'A' (1.310 t/ha), PAC-17 (1.285 t/ha), Salija local 'C' (1.250 t/ha) and Salija 'B' (1.230 t/ha). These germplasms will be evaluated further with necessary modifications.

5. Soybean

A moderate crop of soybean was harvested at the centre. Variety-wise availability of seed is given below:

	Variety	Seed (kg)
1.	Lumle-1	462
2.	Tainung-3	171
3.	Columbus	135
4.	Daro	69
	Total:	837 kg

This crop is slowly catching up the momentum as a summer legume. Farmers are now multiplying these varieties themselves as a result of which more seeds are available in villages itself. A collection of demand for the seed is underway.

5.1 Trials/Investigation LAC/AGRO/T/Sb/7/82

Coordinated Varietal Trial on Soybean Under Maize (1982), (HMGN)

The objective of the trial was to find out high yielding disease resistant cultivar suitable for intercropping environment in hills.

The trial was designed in RBD with 3 replications. Plot size used was 9.6 sq.m. (4.8 sq.m. net). Fertilizer was applied @ 60-60-30 kgs N:P:K/ha (for maize). The half dose (30 kgs N/ha) N was applied when the maize crop was at knee high stage. Soybean seeds were treated with Rhizobium culture prior to planting. Crops were planted on 8 May 1982.

The Result is Presented Below:

Ent. No.	Soybean Varieties	Yield (t/h) at 12% Moisture	Ranking	Maize Variety Used	Yield (t/h) at 12% Moisture	Ranking	Maize + Soybean Yield (t/h)	Ranking
01	Ransom	0.750	3	K. Yellow	2.805	11	3.555	9
02	Sathiya	0.638	4	"	3.596	6	4.234	5
03	11.4	0.565	6	"	2.827	10	3.392	10
04	KS419XKS525	0.834	1	"	3.389	7	4.223	6
05	Celest	0.548	8	"	4.002	3	4.550	2
06	(300229)-1-8 Shih-shih X SRF 400	0.361	10	"	3.764	4	4.125	7
07	Clark-63	0.351	11	"	2.899	9	3.250	12
08	Gasoy-17	0.575	5	"	2.794	12	3.369	11
09	CES-16-103	0.554	7	"	3.135	8	3.689	8
10	Desoto	0.781	2	"	3.716	5	4.497	3
11	PK-7394	0.511	9	"	4.789	1	5.300	1
12	Hile	0.337	12	"	4.078	2	4.415	4
	'F' - test (P=0.05)						SIG.	
	CV %						17.527	
	L.S.D. at 5%						1.209 t/ha	

The treatment No. 11 (Soybean-PK-7394 (0.511 t/ha) and Kakani Yellow (4.789 t/ha) has produced the highest grain yield (5.300 t/ha) followed by Treatment No. 5 (4.550 t/ha). (Soybean var. - Celest (0.548 t/ha), Kakani Yellow (4.002 t/ha) and Treatment No. 10 (4.497 t/ha) (Soybean var. - Desoto (0.781 t/ha), Kakani Yellow (3.716 t/ha).

When the soybean crop was considered alone, Treatment No. 4, KS419XKS525, has produced the highest grain yield (0.834 t/ha) followed by Desoto (0.781 t/ha) and Ransom (0.[illegible] t/ha). The result suggests that Desoto (second ranking when soybean is considered alone) could be a suitable cultivar under maize which in combination with maize has produced the 3rd highest grain yield. Desoto being an early variety could fit into crop rotation easily.

On Economic Terms

With present market price (Soybean - Rs. 5.63/kg, Maize - Rs. 2.86/kg) the Treatment No. 11 (PK-7394 + Maize) has produced the highest economic gross returns (Rs. 16,573.4/ha) followed by Treatment No. 10 (Desoto + Maize) Rs. 15,024.7/ha) and Treatment No. 5 (Celest + Maize) (Rs. 14,530.9 per hectare).

Desoto was observed as the earliest maturing variety which took 63 days to flower and 125 days to mature. Hill took 134 days to mature while Sathiya and Celest took 141 days.

The highest number of pods/plant was found highest in PK-7394 (39 pods/plant) followed by Gasoy-7 (29 pods/plant). Desoto, (300229)-1-8-Shih-shih X SRF 400 and 11.4 each recorded 28 pods/plant.

5.2 Soybean Varietal Trial (Monoculture) (LAC) LAC/AGRO/T/Sb/6/82

The objective of this experiment was to find out superior genotypes of soybean as a monocrop under the agro-climatic condition of LAC. The trial was designed in (3 X 3) Balanced Lattice with 9 replications. Planting was done on 13 May 1982.

A total of 9 genotypes was evaluated and the result is presented below:

(Mean of 4 Replications)

Trt. No.	Variety	Days to Maturity	Grain Yield (T/ha) at 12% M.C.
1	Lumle-1	178	2.245 (8)
2	KS419 X KS525	150	3.280 (4)
3	UPSLY-2	138	3.661 (1)
4	(30029-1-8) Shih-shih-SRF 400	146	3.105 (6)
5	Ransom	145	3.489 (2)
6	Tainung-3	150	3.243 (5)
7	Local	150	2.680 (7)
8	Sathiya	130	3.376 (3)
9	Gurans	150	1.706 (9)
	'F' - test (P=0.05)		SIG
	CV %		24.261
	L.S.D. at 5%		1.052 t/ha

UPSLY-2, an early maturing variety, has produced the highest mean grain yield (3.661 t/ha) followed by Ransom (3.489 t/ha) and Sathiya (3.376 t/ha).

5.3 Fungicidal Trial on Soybean (LAC) LAC/AGRO/T/Sb/4/82

The objective of the experiment was to find out the effectiveness of Dithane M-45 spraying in controlling soybean fungal diseases (FE, PR) and its response on yield.

The trial was designed in RBD with 4 replications. The crop was sown on 29 April 1982. The variety used was Tung Chang Large. Manuring was done with only compost @ 7 t/ha.

Dithane M-45 was sprayed @ 3 gms/lit. in 10, 20 and 30 days interval. The first spray was given after 60 days of the crop sowing. The result is presented below:

(Mean of 4 Replications)

Ent. No.	Treatment	Plant Stand at Harvest	Pods/ Plant	Grain Yield T/ha at 12% MC.	Rank
1	Control	53	52	2.341	4
2	Dithane M-45 10 Days	50	65	2.689	1
3	" M-45 20 "	54	59	2.657	2
4	" M-45 30 "	52	53	2.418	3
	'F' - test (P=0.05)			NS	
	CV %			12.233	

The highest grain yield was produced by Treatment No. 2 (Dithane M-45 10 days interval) (2.689 t/ha) followed by Treatment No. 3 (20 days interval) and Treatment No. 4 (30 days interval). The lowest yield was recorded from the Control (2.341 t/ha).

Cercospora Leaf Spot (Cercospora sojina Hara) a fungal disease, was observed in all the treatments. Slight occurrence of this disease was noticed in the plot having Dithane M-45 sprayed at 10 days interval and intensity of the disease increased as the interval of Dithane M-45 spraying widened causing heaviest occurrence on Control plots. The result suggests that Dithane M-45 sprayed at 20 days interval can check the disease effectively as the grain yield in this treatment is nearly equal with that of the highest yielding treatment and the number of sprays cuts by half.

5.4 Weed Control Experiment on Soybean (LAC) LAC/AGRO/T/Sb/5/82

The objective of the exercise was to find out the critical period of manual weeding in soybean husbandry under the agro-climatic condition of LAC.

The trial was designed in RBD with 4 replications. The crop was sown on 7 May 1982. Fertilizer was applied @ 0-60-30 kg/NPK/ha plus compost @7 t/ha. The soybean variety used was

Lumle-1. There were seven treatments. The result is presented below:

(Mean of 4 Replications)

Ent. No.	Treatment	Plant Stand At Harvest	Pods/ Plant	Grain Yield (T/ha) at 12% M.C.	Rank
1	Weed removed 15 days	42	93	1.071	3
2	" " 30 "	57	77	1.455	2
3	" " 45 "	32	74	0.884	4
4	" " 60 "	35	97	0.785	5
5	" " 75 "	34	60	0.399	7
6	Weed removed throughout the crop period	59	131	1.589	1
7	Control	28	54	0.448	6
	'F' - test (P=0.05)			SIG	
	CV %			42.661	
	L.S.D. at 5%			0.599 t/ha.	

The Treatment No. 6 (Weed removed throughout the crop period) was the best yielder (1.589 t/ha) followed by Treatment No. 2 (weed removed after 30 days of sowing) and Treatment No. 1 (weed removed after 15 days of sowing). At this stage, the result suggests that the removing of weed after 30 days of sowing is as good as weeded throughout the crop period as there is no significant difference in yields between these two treatments.

5.5 Effect of Depth of Planting Cum Variety on Soybean Germination LAC/AGRO/T/Sb/3/82

The objective of the exercise was to find out the best planting depth in relation to soybean germination. Soybean varieties used were Lumle-1 and Columbus. The trial was designed in RBD with 4 replications. Manuring was done with compost and FYM @14 t/ha respectively. The crop was sown on 16 May 1982. There were six treatments. The result is presented below:

(Mean of 4 Replications)

Ent. No.	Variety	Days to Emergence	Grain Yield T/h at 12% MC.	Rank
1	Lumle-1 (5 cm)	7	3.874	1
2	Lumle-1 (8 cm)	10	3.342	5
3	Lumle-1(10 cm)	15	2.827	6
4	Columbus (5 cm)	7	3.611	2
5	Columbus (8 cm)	10	3.393	4
6	Columbus(10 cm)	15	3.588	3
	'F' - test ($P=0.05$)		NS	
	CV %		25.399	

Soybean seed planted at 5 cm depth took only 7 days to germinate, 8 cm depth sowing took 10 days and 10 cm depth sowing took 15 days to emerge.

Lumle-1 planted at 5cm depth has produced the highest grain yield followed by Columbus planted at 5 cm depth and Columbus planted at 10 cm depth. The result suggests that soybean seed planted at 5cm depth produces best results.

5.6 Soybean Spacing Cum Variety Trial (LAC) LAC/AGRO/T/Sb/2/82

The objective of the exercise was to find out the best planting arrangement for indeterminate and determinate varieties of soybean under monoculture condition.

The trial was designed in RBD with 3 replications. Manuring was done with compost only (farmers' practice). Soybean seeds were treated with rhizobium culture by slurry technique (prior to sowing). Sowing was done on 4 May 1982. There were six treatments. The result is presented below:

(Mean of 3 Replications)

Ent. No.	Variety	Seeds/ Pod	Pods/ Plant	Grain Yield T/h at 12% MC	Rank
1	Lumle-1 (60 cm)	2	123	2.286	6
2	Columbus(60 cm)	2	69	2.822	3
3	Lumle-1 (40 cm)	2	79	2.626	4
4	Columbus(40 cm)	2	69	3.196	1
5	Lumle-1 (30 cm)	2	87	2.609	5
6	Columbus(30 cm)	2	65	3.024	2
	'F' - test (P=0.05)			SIG	
	CV %			6.775	
	L.S.D. at 5%			0.341 t/ha.	

The entry number 4 (Columbus planted at 40 cm apart has produced the highest grain yield (3.196 t/ha) followed by entry number 6 (3.024 t/ha) (Columbus planted at 30 cm apart) and entry number 2 (2.822 t/ha) (Columbus planted at 60 cm apart). When Lumle-1 alone is considered, the entry number 3 (Lumle-1 planted at 40 cm apart) has given the best yield. The result of the experiment suggests that Columbus and Lumle-1 planted at 40 cm apart produce highest yields.

5.7 Date of Sowing Trial on Soybean (LAC) LAC/AGRO/T/Sb/1/82

The objective of the trial was to find out the optimum planting dates for promising cultivars of soybean under the agro-climatic condition of Lumle.

The trial was designed in split plot design with 3 replications. Manuring was done with compost only @ 23.8 t/ha. Soybean varieties used were Lumle-1 and Columbus. The result is presented below:

(Mean of 3 Replications)

Trt. No.	Sowing Date	Variety	Plant Stand At Harvest	Pods/ Plant	Seeds/ Pod	Grain Yield T/ha at 12% MC
1	25-4-1982	Lumle-1	36	57	2	5.267 (3)
		Columbus	34	68	2	5.162 (4)
2	10-5-1982	Lumle-1	40	64	2	5.121 (5)
		Columbus	58	42	2	7.740 (1)
3	25-5-1982	Lumle-1	37	42	2	4.259 (6)
		Columbus	63	44	2	6.128 (2)
4	10-6-1982	Lumle-1	57	36	2	3.430 (8)
		Columbus	62	33	2	3.268(10)
5	25-6-1982	Lumle-1	45	37	2	3.749 (7)
		Columbus	64	36	2	3.347 (9)
6	11-7-1982	Lumle-1	14	10	2	0.152(12)
		Columbus	23	24	2	0.392(11)
		'F' - test (P=0.05)				STG
		CV%				26.184
		L.S.D. at 5%				1.789 t/ha.

Columbus sown on May 10, 1982 has produced the highest grain yield (7.740 t/ha) followed by Columbus sown on May 25, 1982 (6.128 t/ha) and Lumle-1 sown on April 25, 1982 (5.527 t/ha).

5.8 Farmers' Field Trial on Soybean (In Village) LAC/AGRO/T/Sb/9/82

The objective of the exercise was to find out the yielding capabilities of improved varieties of soybean in the farmers' plot and also to popularize improved cultivars of soybean among the farmers.

The trial was designed in RBD with two replications. Plot size used was 2m X 1m. Manuring was done as per the farmers' practice. Sowing of the crop was done on May 12, 1982.

The result is summarized below:

(Mean of 2 Replications)

Ent. No.	Variety	Days to Maturity	Grain Yield (T/ha) at 12% M.C.
1	Lumle-1	180	3.175 (1)
2	Columbus	112	2.597 (3)
3	Tainung-3	156	2.568 (4)
4	Local	160	3.044 (2)
	'F' - test (P10.05)		NS
	CV %		22.909

The highest yield was produced by Lumle-1 (3.175 t/ha) followed by Local (3.044 t/ha) and Columbus (2.597 t/ha). Columbus took 112 days to mature, 20 days after the Local and took 180 days.

5.9 Initial Evaluation of Bean (LAC) LAC/AGRO/T/Sb/8/82

The objective of the exercise was to study the performance of promising beans under the agro-climatic condition of LAC.

The trial was designed in RBD with two replications. Plot size used was 2m X 2m and sowing was done on May 25, 1982. The result is presented below:

(Mean of 2 Replications)

Ent. No.	Variety	Days to Maturity	Plant Stand at Harvest	Pods Plant	Grain Yield T/h at 12% MC
1	Winged Bean	-	-	-	-
2	Gurans	111	25	12	0.275 (4)
3	Lumle-1	180	38	33	1.063 (1)
4	A-21	98	35	12	1.038 (2)
5	Local (Salija)	85	41	13	0.425 (3)
	'F' - test (P=0.05)				SIG
	CV %				27.679
	L.S.D. at 5%				0.43 t/ha.

Among the tested beans, Lumle-1 was the best yielder (1.063 t/ha) followed by A-21 (1.038 t/ha) and Local (Salija) (0.425 t/ha). Winged bean did not germinate.

Summary of the Report

With the help from the National Maize Development Program we have been able to screen Arun-2 maize variety for our target farmers. This maize being an early type, easily fits into the crop rotation in the higher hills (6,500' MSL). This maize has also been grown successfully on the paddy field as an early crop before the rice.

Minikit demonstration on improved cultivars of maize has been a significant one as it has achieved its objective. In one hand, this exercise was able to bring larger acreage under improved maize and on the other hand, it has provided the farmers to select the variety of maize according to their choice.

This is the second year since we participated in the breeding program in close collaboration with NMDP. It is too early to say anything on this but we hope the exercise will be a worthwhile one.

In general, Kakani Yellow continues to be the winner maize in our target area.

For the first time we conducted a few varietal trials (3) on finger millet at LAC. Therefore, our experience with this crop is just of one year and it would be wrong to sum up anything on this crop. However, one year's result indicates Dalle-1, NE1404-43, NE6401-22, NE6401-26, PAC-17 and some local types as promising cultivars of finger millet.

Trial works on soybean revealed that Lumle-1 and Columbus are best variety of soybean. These varieties have been doing well in the past also. Some of the new varieties such as PK-7394, Desoto, Ransom and UPSLY-2 are proving themselves as promising cultivars. Lumle-1 and Columbus planted at 5cm depth with 40 cm spacing have

produced best results. Spraying of Dithane M-45 at 20 days interval to control fungal disease on soybean has been as effective as that of 20 days interval. One weeding given after 30 days of sowing of the crop has been effective of control weeds in soybean crop.

Acknowledgement

We feel ourselves privileged for having given this opportunity by the National Maize Development Program to present this paper at this 10th Summer Crops Workshop. We would also like to gratefully acknowledge the help of NMDP, GIIP and Soil Division, Khumaltar for supplying us with materials required for trials. We look forward for such considerate help and cooperation in future as well.

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SUMMER CROPS REPORT, 1982
INTEGRATED HILL DEVELOPMENT PROJECT

- M.D. Bhatta and
J.S. Gaudin

This report summarisss IHDP activities in maize and fingermillet during 1982.

1. Maize

Seed Production

A total of 1.6 ton seed was collected from 10 farmers in 5 areas situated within a day's walk of Charikot, the headquarter of Dolakha district, Janakpur Zone.

In Sindhupalchowk district 500 kg seed from six farmers were collected near the market town of Barhbise on the Kodari Highway.

The varieties multiplied were: Khumal Yellow and Rampur Composite.

The price paid was Rs.10 per Pathi plus transportation cost which averaged Rs.1.82 per Pathi.

Overall the season was good. It was a little dry at planting time but sowing was not delayed. The farmers in our program area generally cultivated their fields better than last year. Cob formation was normal. Harvest was delayed by about a week due to wet conditions. Because of these wet conditions some of the grain became mouldy due to lack of care in hanging and drying the cobs.

The drop-out rate of farmers in this program has traditionally been high and this year was no exception. Of the 78 farmers who asked to be included in the program, 56 bought seed and only 16 sold back some or most of their harvest.

The high drop-out rate is the result of a number of reasons including; other market opportunities, lack of follow-up by our staff, poor wheat harvest or poor paddy crop in the field, lack of porters for transporting seed to our centres, good seed source from the local HMG Agricultural Farm.

However, the SPIS Project within the AIC gave a seed production training at Charikot during August 1982 and many of the farmers invited to participate were very impressed. This has given a boost to our program.

The SPIS will take over the supervision of our seed production program in the future and will work in collaboration with the ADO whose staff already participate in the field work.

Trials

From the National Maize Development Program, two trials were conducted and in addition, variety screening was continued from last year.

National Program FFT

Objective : To find out the superior maize genotypes for different agro-climatic regions of the country.

Location : Bonch Panchayat Dolakha district
2100 m altitude
South facing

Replications : 2 (Two)

Fertilization: 120:60:40 kg NPK/ha

Plot Size : 4 rows 3 m long

Spacing : 75 X 25 cm2

Planting Date: March 24, 1982

Harvest Date : October 8, 1982

Results :

Variety	Days to Silk (Days)	Plant Height (cm)	Ear Height (cm)	Plant Stand (No.)	No. of Ears (No.)	Yield (kg/ha)
Rampur-1	116	149	66	16	17	3889
Rampur-2	123	124	49	16	16	3777
Manakamana-2	119	166	70	11	12	3444
Ganesh II	111	149	80	12	13	3333
Arun-2	107	117	40	13	13	3000
Rampur Composite	122	143	60	6	8	2556
Local Variety	110	167	90	12	13	1778

NMDP Varietal Trial

Objective and Trial design were as for the FFT

Location : Sindhupalchowk district
2100 m altitude
South facing

Results :

Variety	Days to 50% Silk (Days)	Plant Height (cm)	Ear Height (cm)	Plant Stand (no.)	No. of Ears (no.)	Yield (kg/ha)
Rampur-1	120	149	69	18	21	4889
Manakamana-2	123	130	58	18	20	4822
Arun-2	103	124	43	18	19	4667
Ganesh-2	112	140	57	15	16	4600
Arun-4	105	125	41	14	16	4067
Rampur-2	122	150	61	7	8	3889
Khumal Yellow	126	145	72	16	17	3778
Rampur Composite	127	154	54	11	13	3333
Local	113	193	87	9	11	2444

Maize Varietal Trial - IHDP

Objective : To evaluate the popular varieties of the region

Location : Bonch, 2100 m, South facing

Method : As the two national trials described in earlier

Planting Date : March 25, 1982

Hatvesting Date : Second week of October, 1982

Results :

Variety	Plant Height (cm)	Ear Height (cm)	Plant Stand (no.)	No. of Ears (no.)	Yield (k/ha)
Ganesh-2	150	71	11	12	3622
Hetauda Composite	144	64	16	17	3406
Rampur Composite	124	76	10	10	2472
Local	180	79	12	13	2301
Arun-2	107	36	8	8	2083
Khumal Yellow	128	84	14	14	1812

Conclusion of Trial Results

As the trials were all basically the same, general conclusions can be drawn using the whole of the data.

1. The Arun varieties were consistently one month earlier than the others

2. Khumal Yellow, the most popular variety with the farmers of the region did not do well but this could be that the altitude of the trials was too high

3. Rampur Composite, the second most popular variety was also not highly rated within the varieties tested

4. Ganesh-2 performed well. This variety was popular in the region until recently and it is still grown in seed pockets

Manakamana-2. like in last year's trials, did well and could, together with Arun-2 for its short duration, be introduced with the aid of minikits next year.

Rampur-1 was the best of the new varieties that were tested

Extension

Our extension service informs us that there is no one variety that is universally popular. However, Khumal Yellow and Rampur Composite are asked for by many farmers and Ganesh-2 is still popular in some areas.

A total of 4.5 ton maize seed was distributed to the farmers last season but the demand could not be satisfied.

In the areas where our seed multiplication program is located, there is a considerable spreading of new varieties from our growers to neighbouring farmers. For example in Tokapur, Sindhupalchowk where our program has been running for 2 years, we havn't got back much seed but the varieties are well established in the area and are exchanged between farmers.

2. Millet

The Project, together with the ADO, continues to try and find an improved variety that yields better than the local ones.

This year minikits of two varieties were received from Agronomy Division. They were planted at Bonch 2100 m; South facing at Kirantichap 1200 m; East facing.

BNC Trial

Planting Date : Seedbed May 7, 1982
Transplanting July 4, 1982

Harvest Date : November 2, 1982 to December 12, 1982

Plot Size : 25 m^2

Results :

Varieties	Harvest Date	Days to Maturity	Yield (kg/ha)
IE 980 (Dalle)	Nov. 02, 1982	179	1600
NE 1304-43 (Okhale)	Nov. 19, 1982	196	1200
Local	Dec. 12, 1982	219	280

Kirantichap Trial

Planting Date : Seed - June 20, 1982
Transplanting - July 27, 1982

Harvest Date : November 09, 1982

Results :

Variety	Yield (kg/ha)
Local	1600
NE 1304-43 (Okhale)	1120
IE 980 (Dalle)	1000

Conclusions

As in past years the results lead to no firm conclusions. Dalle was better in the higher altitude, being of shorter duration and yielding higher than the local variety. It did poorly in the lower altitude where the local out-yielded both the improved varieties.

REPORT OF AGRICULTURE STATION SURKHET, 1982

- T.P. Giri*

Introduction:

Surkhet Agricultural Station is situated 26 km east of the district headquarter Birendra Nagar at an altitude of 500' above sea level. The annual rainfall is 1500 mm. About 95% of the rainfall is received during the monsoon (June-August). The annual temperature ranges from 4 °C minimum to 38 °C maximum. Frost during the winter and hot winds during the summer are usual.

Different activities were started in the station since 1977. Uneven, terraced land, low fertility, shallow soil depth, inadequate irrigation facilities, dense forest stubbles are the major problems. The soil type is sandy loam and pH ranges from 5.5 - 6.5.

1. Summary of Seed Production and Distribution Work at SAS

The seed multiplication program in rice and maize was carried during the last summer season.

Seed produced by the farm was distributed to the farmers directly from the station and to AIC. The amount of rice and maize seed distributed to the farmers and AIC are given in Table 1. Most seed was distributed to the farmers of the target area of the station.

2. General Performance of the Last Summer Crops

Generally, the performance of the last summer crop especially the rice was very poor due to very low rainfall during the growing season. Most of the people of this district failed to grow their rice crop. The damage of the rice crop was noted up to the extent of about 40%. However, the performance of the maize crop was quite normal.

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3. Result of Summer Crop Trials at SAS

i) General Report

During the last summer season, different trials conducted in the station include the NMDP varietal trials, International Pearl Millet Observation Nursery and ICRISAT Sorghum Varietal Trial. Farmers of the target area need the high yielding maize varieties replacing the local. This performance is reflected in the NMDP Varietal Trial and the varieties being extended in the target area. The rainfed area of the target Panchayat seek for the crops which can be grown successfully in the dry regions. International Pearl Millet Observation Nursery and ICRISAT Sorghum Trials conducted in the station has proved to be a boon to the area.

ii) NMDP Varietal Trial

This trial was planted at SAS during the last summer season. The main objectives were reflected towards the selection of superior maize varieties to replace the local varieties. After the compilation of the trial, varieties Arun-4 and Rampur-2 were found better in the area which yielded 2644 and 2244 kg/ha. Grain yield data are presented in Table 2.

iii) ICRISAT Sorghum Trial

Certain target area of the SAS has no irrigation facilities. It is worth while to investigate the crop which can be grown under a drought condition. To solve this problem, ICRISAT Sorghum Trial was planted in the station. The yield data and other interaction were noted.

Results and Discussions

Analysis of grain yield data showed that there was highly significant difference among the varieties tested. Variety SPV 386 produced the highest yield, i.e. 3033 kg/ha followed by SPV 351 which produced the 2991 kg/ha. The other two varieties produced very low yield (Table 3).

International Pearl Millet Observation Nursery

The principal objectives of this trial was to provide an opportunity to grow and assess the usefulness of early maturity pearl millet grain varieties. The trial materials were obtained from ICRISAT. This trial was planted at SAS to fulfill the requirements of the people of the areas where drought prevails. This trial included six entries, five test entries and a local check.

Results and Discussions

Analysis of grain yield data showed that there was no any significant difference among the varieties tested. However, the highest grain yield was obtained from ICMS 7703 which yielded 2320 kg/ha whereas Local Check yielded 2093 kg/ha (Table 4).

Technical Services Rendered to the Farmers

Besides research activities, technical assistances have been provided to the farmers including plant protection, equipment supply, supply of improved seed of cereals, vegetables and other technical know-how to the farmers.

Program for the Coming Season

Different research and extension support activities planned for the coming season (1982/1983) includes:

1. Minikit distribution, supervision and evaluation in the maize crop,
2. Farmers field trials,
3. Multi-lication testing in the cropping systems,
4. Varietal trial on maize,
5. Low and mid altitude trial on maize,
6. Production demonstration on maize and pearl millet, and
7. International Pearl Millet Adoption Trial.

Table 1: Production and Distribution of Rice and Maize Seed ('82/'83)

Name of the Crop	Total Seed Production/MT	Seed Handed to A. I C/MT	Seed Distributed to Farmers/MT	Remarks
Rice	5.171	0.5	4.5	
Maize	4.771			

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Table 2: Grain Yield kg/ha Obtained From NMDP Varietal Trial ('82/'83)

Sl. No.	Name of the Treatment	Grain Yield(kg/ha)	Remarks
01	Ganesh-2	2133	
02	Manakamana-2	2154	
03	Rampur-2	2244	
04	Arun-4	2644	
05	Arun-2	1944	
06	Rampur Composite	1110	
07	Khumal Yellow	1754	
08	Sarlahi Seto	1144	
09	Farmers' Variety	1400	Collected from Local Area

Table 3: Grain Yield kg/ha Obtained From ICRISAT Sorghum Varietal Trial, 1982 / 1983

Sl.No.	Name of the Entries	Grain Yield (kg/ha)
01	S. P. V. 351	2919
02	S. P. V. 386	3033
03	S. P. V. 422	1422
04	S. P. V. 424	1003

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Table 4: Grain Yield kg/ha Results of I.P.C.N. in 1982/1983

Sl. No.	Name of the Entries	Grain Yield (kg/ha)
01	GAM 73-K77	2125
02	W. C. 75	2145
03	SC_1-W-78	2041
04	Local Check	2093
05	I. C. M. S. 7703	2320
06	I. C. M. S. 7829	2218

IPIL IPIL (LEUCAENA) EXPERIENCES IN THE BASBARI PANCHAYAT, SINDHUPALCHOWK

Huta Ram Baidya*

This paper is an attempt to present you some of the performance of the villagers particularly of Bahunipati area (Basbari Panchayat of the District of Sindhupalchowk) with Ipil Ipil. This paper does not have the usual standard method of presenting a paper in a seminar like this. However, it is hoped this paper will help the Ministry of Agriculture and its departments like the Department of Agriculture to take up more scientific work on Ipil Ipil so that it will help its extension program both at the governmental level and at other semi governmental or at private organizational levels as ours.

Before proceeding further let me locate the area for you and also introduce the organization involved with the extension of Ipil Ipil in this area.

Bahunipati is a small Newar village on the bank of Indrawati River. Its Panchauat at present is Basbari. This village is approachable from the Arniko Rajmarga upto Lamidada, next village after Panchayat. A dirt road to Helambu starts about one kilometer below Lamidada and is now motorable upto Huguwapati, a distance of one hour walk or 15 minutes drive. Bahunipati is about 2 and a half hour walk along the bank of the Indrawati River. The road once constructed needs more work for motorized transport but it is an easy walk. Immediately above Bahunipati on the west mountain side is the Majhi village of a low income group people and still above this is the Nepal Thoak village, a Brahmin village.

The altitude of Bahunipati is about 2500 ft and the maximum height, where Ipil Ipil activity is goin on is about 4500 ft. These are estimates and not actual measurements. Over all the area where Ipil Ipil is being grown by the

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farmers is with subtropical climate.

The organization involved in the propagation of Ipil Ipil in this area is the Baudha Bahunipati (Integrated) Family Welfare Project of the Nepal Femily Planning Association. The Project has divided Sindhupalchowk into 4 blocks for administrative purpose and Bahunipati is one of the block head-. quarters. There is a Family Welfare Clinic at Bahunipati, run by qualified nurse staff. Besides Ipil Ipil, the Project also introduced NB 21 grass, Jamunapari goat, buffalo, coffee and junar in the area. Native fodder trees were also distributed but at present the Project is concentrating on Ipil Ipil only for maximum cost effectiveness results. World Neighbors is one of the donor agencies of the Project.

With this much introduction on the Project, let me move on to Ipil Ipil itself. Ipil Ipil (Leucaena leucocephala) a legume is a native of Central America. The trade relation established between the Philippines and Mexico by the Spanish after the conquest of Mexico helped Ipil Ipil to be introduced into the Philippines, between 1565 and 1815. It went on spreading to other countries during the 19th century particularly to Hawaii, Fiji, Northern Australia, India, East and West Africa and the Caribbean Islands.

It was brought to Nepal by Kiran Mani Dixit from the Philippines in 1957 and he still has one matured plant in his yard. Seeds collected from this plant were given to the Livestock Division for more work on this fodder tree.

I also brought some Ipil Ipil seeds from the Philippines at the request of Mr. L.P. Sharma of the Livestock Division around 1874/1975 because not much seed was available in Nepal then.

The involvement of the World Neighbours with the BB Family Welfare Project greatly helped to expand Ipil Ipil activities in the Project area. Not only the Livestock Fodder Section was tapped as a resource point for Ipil Ipil seeds and its cultural information other centres outside the country particularly India and the Philippines were tapped since 1976. A nursery was established at Bahunipati Family Welfare Clinic area and plants raised from this nursery were distributed to farmers free of cost. A few contract

nurseries were encouraged to help the extension of this fodder tree in areas which were far off from Bahunipati. Attempt was made last year (1982) to find the survival rate of the plants so far distributed in the Sindhupalchowk District by the Project. Unfortunately, no records are available on the distribution prior to 1979. Between 1979 to 1981 a total of 50,954 Ipil Ipil seedlings were distributed. During 1981 alone 17,895 plants reached the farmers. The survey indicated a mortality rate of 46.5 percent. Forty sven thousand two hundred and twenty plants were distributed during 1982. We do not know the mortality rate at this time. Hopefully it will be lower than 46.5 percent.

Ipil Ipil can be divided into three main types*:

1) Hawaiian type : Short, bushy varieties to 5m (15 ft) in height that flower when very young (4-6 months old). This type flowers year round rather than seasonally. Compared with the two types mentioned below, its yield of wood and foliage is low, its continuous flowering produces many seeds and it becomes an aggressive weed. This is a common type native to coastal Mexico that is now widely spread throughout the tropics. Its value lies in its ability to revegetate tropical hill slopes to provide firewood and charcoal and to shade plantation crops,

2) Salvador type : Tall, tree like plants to 20m (65 ft) in height having large leaves, pods and seeds and thick branchless trunks. They are also known as Guatemala types. They often produce more than twice the biomass of the Hawaiian type. Some extremely high yielding Salvador type cultivars also known as "Hawaiian Giants" are designated as K8, K28, K67 etc., and

3) Peru type : Tall plants to 15m (45 ft) like the Salvador type. But with extensive branching even lower down the trunk. They produce little trunk but extremely high quality foliage from the branches. Although these are highly productive forage varieties, they have only recently

* - Abstract from "Leucaena - Promising Forage and Tree Crop for the Tropics" National Academy of Science, Washington DC, 1977.

been discovered and their use outside Australia, Hawaii and Mexico still awaits testing.

Although all precautions were taken at the administrative level to identify the types and varieties and sources of the Ipil Ipil seeds received by the Project, and then distributed to the farmers it was confusing for the field staff. Some times seeds got mixed up, plants given to farmers were not recorded. More than one variety was given to one farmer. All these field problems generated a situation where we cannot exactly say or identify a plant. Attempt is now being made to identify plants with the farmers as far as possible and also to establish a small mother plant garden to help quality seed production. Inspite of these draw backs, the Project has gathered some information on the performance of Ipil Ipil from the farmers which is presented here. Terminologies are in farmers language.

Livestock plant ratio:

	Age of Plant	Dokoful From Trees	Animal Feed Per Day	Total Roughage
A.	18 months	3	2 bullocks 1 goat	3 angalo rice straw 1 Doko Koiralo
B.	36 months	2	1 buffalo 2 buffaloes	1 Doko rice straw and other roughage
C.	60 months	2	Buffalo with calf	1 Doko Ipil Ipil other 1 Doko ½ Bhari rice straw.
D.	18 months	2	1 buffalo	½ Doko Ipil Ipil ½ Doko rice straw

Note: Four Angalo equal one Bhari of rice straw.

This information seems to be very confusing and it is confusing because it certainly lacks the precisences which you are all used to. However, within our limited resources we have not been able to develop the manpower needed to get such precise information. However, we have derived some thumb

-rule guideline for our extension purpose.

1) Depending on the age of the tree, 2 to 3 trees harvested once every month will produce a Doko of Ipil Ipil fodder,

2) One Doko of Ipil Ipil is adequate for two large animals,

3) One Doko of Ipil Ipil should be mixed with one Doko of other grass and ½ Bhari of rice straw. Based on the above thumb rule it will be safe to assume that one tree per a large animal per day harvested once every month will provide enough Ipil Ipil for the animal.

In order to make the village farmer spell out this relation with his/her own experience, the B.B. Project has worked for almost 6 years. Extension activity was there from the very beginning but more happened since 1981. A group of farmers with some Ipil Ipil experience were invited to be the trainers for those without. The staff just acted as organizors of the training. Some initial motivation was needed to help the "Knowers" to expose themselves. As the session moved on it became more and more interesting because the "Knowers" and "Learners" completely opened up and started discussing topics directly related and relevant to their interest and situation, in their own language "without english".

One idea we introduced in this 1981 training was how to train the Ipil Ipil so that the tree does not grow excessively tall and at the same time dwarf enough so that animals would not brouse on them. This was a subject for discussion with demonstration by the farmer/s who had some idea. The best solution came up as a tree 6-9 feet high trained to one or two stems with the foilage canopy above 5 feet or so. Most of the innovators have now designed their plants to meet this specification.

We tried the same procedure in 1982 with similar success. One important aspect we included in 1982 was (a) involvement of the ladies of the family in Ipil Ipil transplanting, care and cutting. The effect is apparent now with some farmers. Very soon most heights of the Ipil Ipil will be related with the height of the female members of the family concerned.

We believe in teaching one idea or skill to hundred people rather than hundred ideas to one person. I think we have accomplished some thing in the Sindhupalchok district particularly in the Basbari Panchayat in Ipil Ipil Extension by adhering to this principle. However, we faced a transport problem in distributing Ipil Ipil seedlings from the nurseries. Because a Doko full of Ipil Ipil in Plastic tubes is really a man's full load and such a load can carry only about 60 to 70 plants, therefore, extension of Ipil Ipil to a distant area especially when he/she needs more than one Doko met with resistance. We are planning to teach farmers how to grow his/her own seedlings at his/her own place this February. It is just one skill that will go to the person upto the beginning of the rainy season. Then it will be followed by another training how to transplant just before monsoon sets in.

During 1982 we tried direct sowing of Ipil Ipil as a manure crop for maize. Drought of 1982 discouraged us. But we were lucky to receive the results from a lady farmer. She has tried this on a small scale. Her maize yield became two Doko when her usual yield was one. She planted Kodo after maize and applied the Ipil Ipil leaves as manure. Her Kodo yield also doubled. This season she has selected her worst plot and planted wheat and covered it with Ipil Ipil leaves. She did not use any chemical fertilizer on this plot. The present look of the crop is very satisfactory. According to her, this plot was never so green before. She would like to continue her experiments with Ipil Ipil leaf manure in maize, Kodo and wheat again and again and with many more.

One farmer submitted this recipe for the buffalo:

Four Pathi Kodo
One Pathi Ipil Ipil seed.

Grind them in a mill to produce floor. Prepare Kholey feed at the rate of 2 Mana per buffalo per day. His buffalo has put up weight. Other data is not available at this stage.

Ipil Ipil has been termed as a tree with great future in underdeveloped countries. It has been termed a wonder tree. Literatures are available on

this subject from the Philippines Council for Agriculture and Resources Research. There are other agencies also whose names and addresses are not difficult to find out which WN would be glad to provide if needed. However, since these literatures do not represent our situations it will be misguiding farmers if we base our extension activities on the findings of other countries alone and raise the expectation of the farmers on the benefit they could receive if they plant the trees. It is my feeling that the Ministry of Agriculture be involved to undertake some work on Ipil Ipil in more scientific line rather than be satisfied by some rough observation data reported by some one like me. I earnestly hope that this workshop seminar will discuss ways and means to draw up a plan to include some research on Ipil Ipil (1) as a fertilizer substitute to our crops, (2) as a feed substitute to livestock and poultry. I have included on abstract of some scientific information from other countries on Ipil Ipil for your information in Annex-1.

No one has tried to feed the animal on dried leaf. Some farmers have 1500 - 2000 plants. From my own rough calculation based on farmers experience it seems that 30-40 mature Ipil Ipil per one large animal will be adequate. People have planted large number to produce fuel wood from their eroded land or otherwise unproductive land. It is expected that within a year or two farmers will be using more Ipil Ipil to fertilize their land particularly maize and Kodo after they have heard and seen the lady inspite of this is also expected that some leaf will be surplus during non-fertilizing periods and we are thinking how quickly we can teach farmers to dry the leaves and store it for leaner days or sell them as animal feed.

And finally, I thank the organizors of this Seminar for extending and invitation to me to speak on Ipil Ipil in this gathering.

Annex-1

Abstract from Leucaena Based Farming, AH and Ag. Journal, July 1980.

1. Leucaena can accumulate 400 - 800kg of nitrogen
   40 - 80kg of phosphorus
   150 - 300kg of potassium

2. Livestock weight gain/ha/yr. 500 kg

3. Goats can gain 5 kg in 12 weeks feeding period with ration of:

   30 % rice straw
   20 % rice bran
   50 % Ipil Ipil dry leaves

4. Comparative composition (dry wt basis) of Alfalfa and Malawi grown Leucaena Forage.

	Leucaena Leaf	Alfalfa
Crude protein	25.9	26.9
Acid detergent fibre	20.4	21.7
Calcium	2.36	3.15
Phosphorus	0.23	0.36
Beta carotene (mg/kg)	536.0	253.0
Gross energy (kg/g)	20.1	18.5

5. Low-land rice fertilized with 1.5 t/ha dry leaves incorporated during land preparation yielded as much as those fertilized with 60 kg N from ammonium sulphate (8 ton and 9 ton computed grain yield respectively).

6. Upland rice (IR 36) fertilized with 10 t/ha of fresh Ipil Ipil yielded 4.3 tons of grains which was comparable to those fertilized with 80-30-30 kg NPK (inorganic) with 4.4 tons of grains.

7. Maize yield of plots interplanted with Ipil Ipil hedge rows whereby 1/3 of the herbage was used as fertilizer to maize and 2/3 harvested for dry leaves (for feed) were comparable to those applied with 60 kg N of ammonium sulphate.

8. An Ipil Ipil planted at a distance of 1 m X 1 m would result in 10,000 tree/ha. A tree when mature can yield 2 kg of dry herbage per year. This equal 20 tons/ha.

9. Ipil Ipil should be at least eight months old to one year before the herbage is cut for the first time. Subsequent cutting could be done every 2-3 months retaining at least one foot stubble height.

B. Abstract from Leucaena - promising forage and tree crop for the tropics National Academy of Science, U.S.A.

10. Leucaena - Rhizobium partnership is capable of annually fixing more than 500 kg N/ha. (Equivalent to 2500 kg Ammonium Sulphate per ha per annum.)

11. Each pod may contain 15 - 30 seeds.

12. It grows poorly in acidic soils.

13. Nutritive value of the leaflets is 27 - 34% protein.

IADS/ICP: ds
1983