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o COWPEA CULTIVATION : SOME UNANSWERED QUESTIONS

o VARIETY ADOPTION : A FUNCTION OF AGRONOMIC AND SOCIO-ECONOMIC VARIABLES

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COWPEA CULTIVATION : SOME UNANSWERED QUESTIONS[1/]

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I. INTRODUCTION

It is clear that legumes are one of the major sources for providing valuable protein in the daily diet of humans. Besides that they are characterized by the unique capacity of being nitrogen fixers and of obtaining most of their nitrogen requirement from the atmosphere. A strongly growing green manure legume may contribute to the soil as much as 45 - 65 kg N/ha and the effective use of legumes should contribute better soil and water conservation practices, as well as a fresh supply of organic matter to improve soil tilth.

In spite to their important contribution to human diet, livestock and soil, grain legumes receive less attention and investment than the other field crops. Farmers traditionally treat them as marginal crops, cultivation and management are minimal and they receive attention only after other crops have been tended.

Cowpea (Vigna unguiculata L.), being a legume crop, has all the above mentioned merits. It contains about 22.3% protein and is as good as other green manure legumes in terms of N contribution, after incorporation into soil, to the succeeding crops. Its bio-mass is an excellent fodder for livestock and green pods are the most liked vegetable for human consumption.

But in spite of the above mentioned facts, the cultivated area under cowpea is minimal and it remains a kitchen garden crop in Nepal. In some cases (Inner Terai and Hills) its limited cultivation is in association with maize with a very nominal plant number per unit area.

1/ - Paper Presented at the 13th Summer Crops Workshop held at JADP, Janakpur from March 10 - 13, 1986.

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Even in such a cropping practices the basic objective of including this crop is to get a few green pods for use as a vegetable.

What are the reasons for the limited acreage under this crop which is known to us for decades ? Why does it remain only as a kitchen garden crop ? Let us examine the following factors in brief. They might give some explanations to the questions raised above.

(A) Growth Habit:

Most of the cultivated varieties, at present, are of the trailing type. They need some kind of support to perform better. When it comes to larger areas the availability of supporting material and the labor to erect the supporting structures become the major limiting factors.

(B) Productivity:

The production potential of the existing varieties are not very encouraging. After going through all the difficulties mentioned in (A) they can hardly produce over 250-300 kg grain/ha in 100-120 days. The present level of productivity and the number of days required to mature a crop also become important factors in limiting cowpea cultivation on a large scale.

(C) Cropping Patterns:

i) As a sole crop it cannot compete in production against Spring and Summer maize crops widely grown in the hills and Inner Terai, ii) as a mixed crop it interferes with the cultivation of the succeeding crop and the crop it is mixed with, and iii) as a 90-110 days variety it does not fit during the fallow period between two major crops.

(D) Dual and Multipurpose Use:

Until now the utilization of cowpea is restricted to the green pods as vegetables and in some cases dried grain for pulse. Its green manure and fodder value is not very much known to the farmers.

If we look at all these factors mentioned above it appears that varieties with 60-70 days of maturity, determinant type with dual and multipurpose use (grain, green pods, fodder and green manure) may have scope for

testing in the different existing cropping patterns. New IITA (International Institute for Tropical Agriculture, Ibadan, Nigeria) cowpea lines tested at Parwanipur, Khumaltar and IAAS during the last two years showed encouraging results and offer potential for extending these new lines to on-farm testing. This paper presents the findings of such trials conducted at various Farming Systems Sites throughout the country in 1985 and draws some conclusions from similar trials conducted during 1984.

II. RESEARCH METHODOLOGY

Cowpea Variety Trials were conducted in the Spring and Summer seasons 1985 as a part of the Component Technology Evaluation Trials - the first step among several steps for promoting a variety to a Full Scale Production Program. A 10 m^2 plot was assigned to each variety. The rate of fertilizer application was 20:20:0 ($N:P_2O_5:K_2O$) kg/ha all basal, and a seed rate of 40 kg/ha. The planting method, wherever possible, of 60X25 cm was followed. Each location was considered as a replication. The estimation of pod yield was obtained by harvesting the whole plot (initial plan was to harvest grain). Bio-Mass yield was recorded after the pod harvest. The trials were planted in various land types and cropping patterns. A wide range of seeding dates was tested.

III. RESULTS AND DISCUSSIONS

Figures 1 A-C present the schematic representation of cowpea introduction into the exisiting cropping patterns at various Farming Systems Sites. At Ratna Nagar, Chitwan, Cowpea was introduced in the irrigated lowlands where farmers traditionally grow only two crops of cereals rice followed by wheat. A fallow period of 80 - 90 days after wheat and before rice was observed. At the same site in the Rainfed Uplands a fallow period of 70-80 days exists between the maize and mustard crops. Similarly, in the case of Pumdi Bhumdi, Kaski, in the Rainfed Lowlands cropping patterns - Rice-Wheat-Fallow and Rice-Mustard-Fallow have fallow periods of 100-110 days.

At Khandbari in the Rainfed Uplands (Tumlingtar) two maize crops are being grown. The cowpea was introduced as an alternative to the second maize (winter) crop. It was also tested in the Rice-Wheat-Fallow pattern in the Partially Irrigated Lowlands.

Tables 1 through 3 present the results of Cowpea Variety Trials at Ratna Nagar. Six varieties were included in each set and tested at five locations (Table 1). The mean green pod yields indicate that IT82E-18 was the highest yielder (4.38 t/ha) followed by IT82D-812. The standard deviations (Sd) for the means yields indicate considerable variation from location to location for the same variety. Most of these variations were due to stray animal damage and stealing of green pods by passersby.

In the Irrigated Lowland in the Rice-Wheat-Mungbean pattern six varieties were included in each set and tested at three locations. Results are presented in Table 2. Results from location 1 are not included in the analysis of variance, because the crop was almost completely grazed by stray cattle. The average of two locations indicates that IT82D-889 was the highest yielder (5.38 t/ha) followed by IT 82E-18. The variety TVX-289-4G did not produce any pods until about the time that the other varieties were being harvested.

Table 3 presents the results of the early maturity cowpea variety trial conducted in the Rainfed Uplands in the Maize-Fallow-Mustard pattern. This set had four varieties and was replicated on two farms. None of these varieties produced higher than 3.35 t/ha of green pods. IT 82D-889 performance looks more stable over locations.

On the basis of the green pod and bio-mass production, farmer reactions and site staff observations, the following varieties have been identified for further testing and evaluation : IT 82E-18 (early, grain type), IT 82D-812 (early, grain type), IT 82E-9 (early, grain type), IT 82D-752 (grain type), IT 82D-1228-16 (vegetable and grain type) and IT 82E-124 (early, synchronized maturity, grain type).

Tables 4 and 5 present the results for the trials conducted at Pumdi Bhumdi. In the High Production Potential lowlands 3 sets each containing five varieties were tested at 3 locations. The results are presented in Table 4. They are not very encouraging. None of the varieties yielded higher than 1.0 t/ha of green pods. The results of another trial conducted in the Rice-Mustard-Maize pattern on the same land type are presented in Table 5 and are

very encouraging. IT 82E-16 and IT 82E-13 yielded 7.5 and 7.8 t/ha, respectively. They also produced over 6 t/ha of bio-mass used for livestock feed. These two varieties will be further evaluated at Pumdi Bhumdi.

Tables 6 through 8 present the results of variety trials conducted at Khandbari. In the Rainfed Uplands in the Maize-Maize-fallow pattern cowpea was tested during the 2nd maize crop. The results are in Table 6. Out of 8 varieties none could yield higher than 2.0 t/ha. These varieties were tested at four locations. Table 7 presents the results for another six varieties tested at 3 locations. Results of this trial are also not very encouraging and the Standard Deviations from the mean yields are very high. One can observe in Table 8 the poor yield performances for the varieties tested at 3 locations in the Rice-Wheat-Mungbean pattern in the Rainfed Lowland Medium Production Potential. None of these varieties could yield 1.0 t/ha of green pods. At one location the crop was totally damaged by monkeys.

CONCLUSION

The results of 1985 testings indicate that there is scope for early maturity, bush type, multipurpose cowpea varieties. Varieties like IT 82 E-18, IT 82E-16 and IT 82E-13 produced upto 7.0 t/ha of green pods and 7-8 t/ha of bio-mass. They are grain type varieties. IT 82D-1228-16 can serve both purposes, grain and vegetable, while IT 82E-124 is found to have the most synchronized maturity. None of the tested varieties appreared promising at Khandbari. The methodology for on-farm testing and extension which the Farming Systems Program follows calls for testing, identification and extending of the identified technology into Production Programs. Here are some of the practical problems encountered during the testing phase and expected problems to come if mini production programs are to be organized with cowpea.

1) Seed Availability :

With very few exceptions most of the trials were harvested for green pods due to the following reasons : i) farmers could not wait until the physiological maturity of the crop. To do so could have delayed the planting of the succeeding crops, ii) spring and summer cowpeas matured during monsoon which resulted in very poor seed quality. The seeds produced were severely damaged by

insects in storage.

2) Stealing of green pods by herders, passersby and kids and crop damage by monkeys and stray animals posseses another threat to extend this crop beyond the kitchen garden. In such conditions it becomes extremely difficult to obtain reliable yield data from trial plots. This explains the wide variability in yields from replication to replication for the same variety.

3) Diseases and Insects. (A) Diseases: Pod/leaf blight and a thracnose. (B) Insects: Hairy cater pillar, thrips, aphids and pod borers. Insects pose a serious threat to the growing of cowpea.

These studies were conducted on the assumption that availability of short duration, determinant, high yielding and multipurpose cowpea varieties will help increase Land Utilization and Multiple Cropping Indices. The results have proved this assumption to be right. However, it is evident that good agronomic performances alone are not enough to increase the area under cowpea cultivation. The next important factor which should get due attention of the on-farm researcher, is socio-economic. The success of cowpea revolution will depend on how well we tackle agronomic and socio-economic problems associated with this crop in the years to come.

WI/BKS: ds
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Figure 1 : INTRODUCTION OF COWPEA IN EXISTING PREDOMINANT CROPPING PATTERNS AT VARIOUS FARMING SYSTEMS SITES

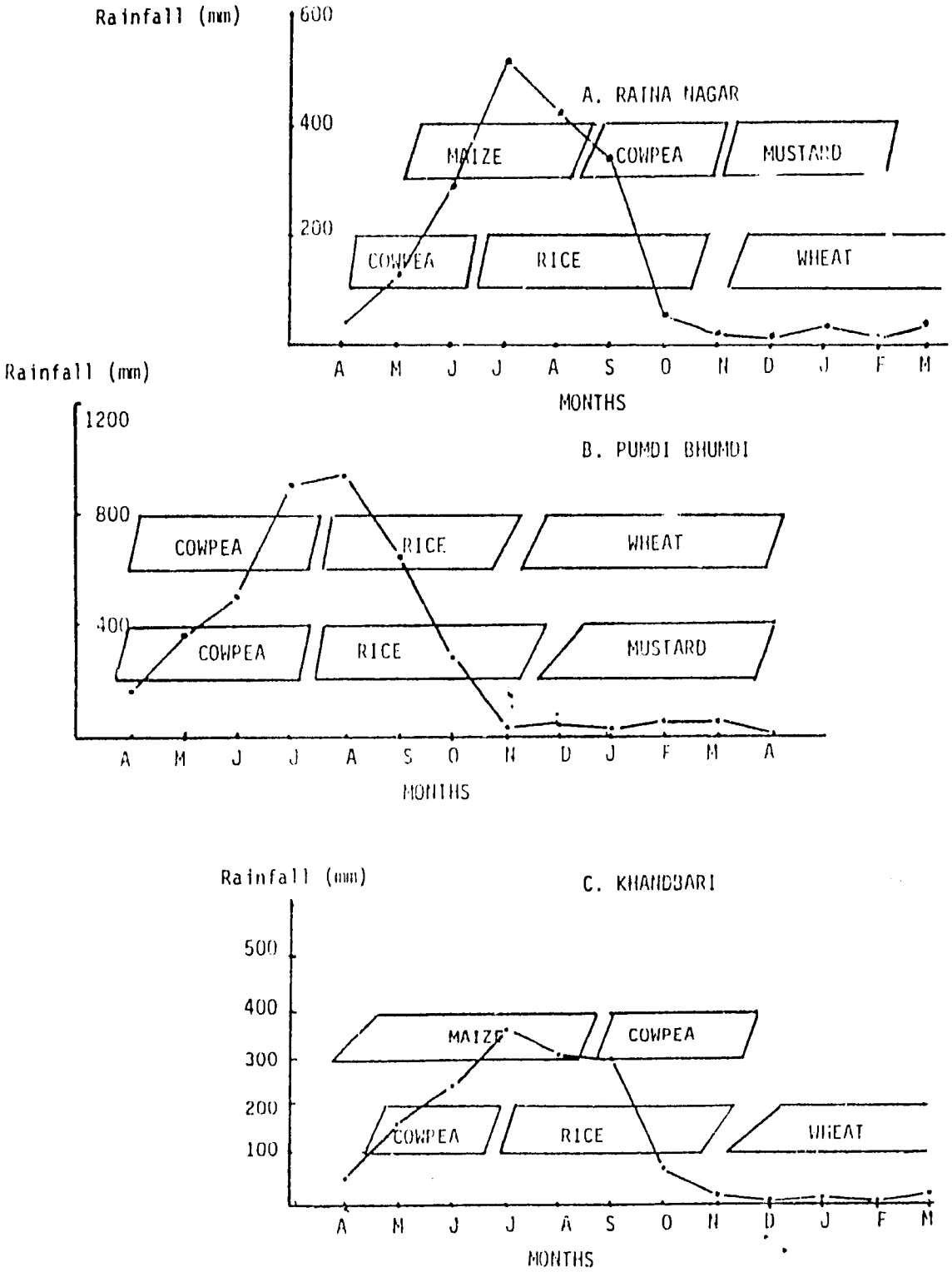

Table No. 1: COWPEA VARIETY TRIAL RESULTS FOR RATNA NAGAR DURING SUMMER SEASON, 1985

Cropping Pattern : Maize - Cowpea - Mustard
Land Type : Upland Rainfed
Fertilizer Rate : 20:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Bio-Mass Yield (T/ha)	Green Pods Yield (T/ha)						
		Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Mean	Sd
IT 82 D-812	6.96	3.30	5.90	3.40	2.80	3.00	3.68	1.26
IT 82 D-889	5.40	3.00	5.10	3.00	@	3.00	2.82	1.82
IT 82 E-9	2.95	1.70	3.40	@	1.4	2.90	1.88	1.30
IT 82 E-18	5.86	5.50	4.90	2.20	5.0	4.30	4.38	1.29
IT 82 D-880-5	2.87	*	4.70	@@	4.70	3.40	2.56	2.40
IT 82 E-16	5.76	3.00	3.2	@@	2.10	5.30	2.72	1.92
Date Seeded :	-	29/8/85	28/8/85	29/8/85	28/8/85	1/9/85		
Days to Harvest 1/		78	76	78	75	69		

* - Poor germination

1/ - All varieties at each location were harvested at same date.

@ - Picked up by farmer before sampling

@@ - Damaged by stray animals.

Table No. 2 : COWPEA VARIETY TRIAL RESULTS FOR RATNA NAGAR DURING SPRING SEASON 1985

Cropping Pattern : Rice - Wheat - Mung
Land Type : Lowland Irrigated
Fertilizer Rate : 20:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Bio-Mass Yield (T/ha)	Green Pods Yield (T/ha)			
		Farmer 1**	Farmer 2	Farmer 3	Mean 1/
CES 41-6	8.5	0.16	3.98	1.76	2.87[bc]
All Season	9.76	-	2.65	1.55	2.1[b]
IT 82 D-889	9.40	0.15	4.56	4.56	5.38[d]
IT 82 E-18	10.38	0.13	2.74	2.74	3.38[c]
IT 82 E-16	16.50	-	0.84	0.38	0.61[a]
*TVX-289-4G	17.10	-	-	-	-
Date Seeded:	-	11/4/85	14/4/85	14/4/85	-
Days to Harvest 2/	-	64	77	73	-

* - No pod formation
** - Not included in the AOV

Variety F - test - HS at 0.01
CV = 15.97 %
LSD (0.01) = 0.968 t/ha.

1/ - Means followed by the same letter do not differ significantly at the 1. level.

2/ - All varieties at each location were harvested at same date.

Table No. 3 : EARLY MATURITY COWPEA VARIETY TRIAL RESULTS FOR RATNA NAGAR DURING SUMMER SEASON, 1985

Cropping Pattern : Maize - Cowpea - Mustard
Land Type : Upland Rainfed
Fertilizer Rate : 20:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Bio-Mass Yield (T/ha)	Green Pods Yield (T/ha)			
		Farmer 1	Farmer 2	Mean	Sd
IT 84 E-124	7.30	2.3	2.4	2.35	0.07
IT 82 D-752	9.20	5.0	1.7	3.35	2.33
IT 82 D-1228-16	11.20	*	3.3	1.65	2.33
IT 82 D-889	11.6	2.8	3.3	3.05	0.35
Date Seeded :		6/9/85	3/9/85	-	-
Days to Harvest 1/		72	75		

* - Poor Germination

1/- All varieties at each location were harvested at same date.

Table No. 4: MEDIUM MATURITY COWPEA VARIETY TRIAL CONDUCTED AT PUMDI BHUMDI DURING SPRING SEASON, 1985

Cropping Pattern : Rice - Wheat - Maize
Land Type : Rainfed Lowland, High Production Potential
Fertilizer Rate : 20:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Average Bio-Mass Yield(t/ha)	Green Pods Yield (T/ha)				
		Farmer 1	Farmer 2	Farmer 3	Mean	Sd
TVX-4577-02D	8.08	0.30	0.21	0.12	0.21	0.09
TVX-3236-016	7.26	1.30	1.10	0.64	1.01	0.34
CP-4-2-3-1	3.16	NA	1.00	0.18	-	-
EG =-2	5.57	0.50	0.50	0.18	0.39	0.18
TVX-4677-028E	4.10	0.35	0.78	0.21	0.45	0.29
Date Seeded :		1/4/85	31/3/85	4/4/85	-	-
Days to Harvest 1/		107	112	95		

NA = Not Available

1/ - All varieties in each trial were harvested on same date.

Table No. 5 : RESULTS OF EARLY MATURITY COWPEA VARIETY TRIAL CONDUCTED AT PUMDI BHUMDI DURING SPRING SEASON, 1985

Cropping Pattern : Rice - Mustard - Maize
Land Type : Rainfed Lowland, Medium Production Potential
Fertilizer Rate : 40:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Average Bio-Mass Yield(T/ha)	Green Pods Yield (T/ha)					
		Farmer 1	Farmer 2	Farmer 3	Farmer 4	Mean	Sd
IT 82 E-16 1/	7.50	7.00	12.00	5.00	6.00	7.50	3.10
IT 82 E-41 2/	9.40 4/	NA	NA	1.50	NA	-	-
IT 82 E-13 1/	6.50	6.00	10.00	8.20	7.00	7.80	1.70
IT 82 D-889	4.40 4/	3.00	NA	3.50	2.00	2.10	1.50
Days Seeded:	-	27/3/85	28/3/85	25/3/85	24/3/85	-	-
Days to Harvest 3/		113	95	100	106		

1/ - Excellent pod and bio-mass production
2/ - Excellent bio-mass producer
3/ - All varieties in each trial were harvested at same date
4/ - Average of only three locations. At location 2 (F2) the seed germination was very poor.
NA - Not Available.

Table No. 6: COWPEA VARIETY TRIAL RESULTS FOR KHANDBARI DURING WINTER SEASON, 1985[1/]

Cropping Pattern : Maize - Maize - Fallow
Land Type : Rainfed Upland
Fertilizer Rate : 20:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Green Pods Yield (T/ha)[2/]				
	Farmer 1	Farmer 2	Farmer 3	Farmer 4	M e a n [3/]
IT 82 E-16	0.12	1.50	2.00	2.50	1.53^{bc}
IT 82 D-380-5	0.22	1.01	0.30	4.00	1.38^{b}
IT 82 D-812	0.30	0.31	1.30	2.50	1.23^{b}
IT 82 E-41	3.10	2.30	1.50	2.50	2.35^{c}
IT 82 D-889	0.23	4.0	2.20	2.50	2.22^{c}
IT 82 E-18	0.23	0.33	0.30	2.30	0.79^{ab}
IT 84 E-124	2.00	1.00	1.00	2.10	1.52^{bc}
All Season	0.25	0.40	0.30	0.40	0.34^{a}
Date Seeded :	15/8/85	15/8/85	15/8/85	15/8/85	
Days to Harvest[4/]	90	80	81	78	

Variety F - test - S at 0.05
LSD (0.05) = 0.71 t/ha
CV = 22.61

1/ - Trial was planted during second maize crop
2/ - Partially stolen from each location
3/ - Means followed by the same letter do not differ significantly at the 5% level.
4/ - All varieties in each trial were harvested at same date.

Table No. 7 : COWPEA VARIETY TRIAL RESULTS FOR KHANDBARI DURING SPRING SEASON 1985 1/

Cropping Pattern : Rice -Wheat - Mungbean
Land Type : Rainfed Lowland Medium Production Potential
Fertilizer Rate : 20:20:0 (N, P_2O_5, K_2O) kg/ha

Variety	Green Pods Yield (T/ha)				
	Farmer 1	Farmer 2	Farmer 3	Mean	Sd
EG BS2 3/	1.05	*	0.50	0.52	0.52
BS 7	1.26	2.10	0.43	1.26	0.84
LBBS - 1	1.54	0.70	1.50	1.25	0.47
BS 1 2/	1.73	3.20	2.00	2.31	0.78
BS 3	0.30	2.20	2.10	1.53	1.07
B6	0.90	1.25	0.85	1.00	0.23
Date Seeded :	26/4/85	2/5/85	27/4/85		
Days to Harvest 4/	65	66	66		

Variety F - Test - NS
CV = 55.80

* - Harvested for green fodder because it was getting late for rice transplanting

1/ - High yield variations from farmer to farmer is attributed to several factors. Due to pressing need for vegetables during spring season our trial plots attract not only farmer cooperators but also their neighbours to make few un-official pickings.

2/ - Early, impressive pod formation.

3/ - Late, excellent for bio-mass production.

4/ - All varieties at each location were harvested at same date.

Table No.8 : COWPEA VARIETY TRIAL RESULTS FOR KHANDBARI DURING SPRING SEASON '85[1/]

Cropping Pattern : Rice -Wheat - Mungbean
Land Type : Rainfed Lowland, Medium Production Potential
Fertilizer Rate : (N, P_2O_5, K_2O) kg/ha 20:20:0

Variety	Green Pods Yield (T/ha)				
	Farmer 1	Farmer 2	Farmer 3	Mean	Sd
TVX-133-16-D2	0.15	MD[2/]	1.56	0.82	0.95
CP-4-[illegible]	NA	MD	0.48	0.24	0.34
TVX-1850-016	NA	MD	0.20	0.10	0.14
TVX-3629	0.09	MD	0.39	0.24	0.21
All Season	0.10	MD	1.09	0.60	0.70
Date Seeded :	12/5/85	29/4/85	29/4/85	-	-
Days to Harvest [3/]	64	-	65	-	-

1/ - Very poor performance
2/ - Monkey damaged the standing crop.
3/ - All varieties in each trial were harvested at same date.

VARIETY ADOPTION : A FUNCTION OF AGRONOMIC AND SOCIO-ECONOMIC VARIABLES[1/]

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I. INTRODUCTION

This report briefly summarizes the performances of maize variety trials conducted at various Farming Systems sites in the summer seasons of 1984 and 1985. The trials were planted in the rainfed uplands with the following objectives.

o Identify varieties of high and stable productivity, suitable for the different agroclimatic and socio-economic conditions, and

o Provide feed-back to research stations about the strengths and weaknesses of the tested varieties.

II. RESEARCH METHODOLOGY

The trials were conducted at Pumdi Bhumdi, Khandbari and Lele [3/]. Each trial was replicated at five farms at each site in each year. The chemical fertilizer was applied at the rate of 60:30:0 (N, P_2O_5, K_2O) kg/ha in two split applications. The farmers applied compost according to their normal practices. A 100-200 m² plot (depending on the site) was assigned to each variety. Observations were taken at the various stages of the plant growth. Data were recorded for the green stover yields, days to crop maturity, number of markatable cobs and productive plants. Grain yield was estimated by harvesting cobs from a 20 m² sample area selected by the random procedure. The cobs were weighed (without husk) and grain moisture determined in a moisture meter. A correction factor was used to convert the cob weight from the recorded grain moisture content into dry grain weight at 15.5% moisture.

The cooperators were interviewed about their reactions to the grain type, maturity, drought tolerance, grain yield, storage, taste, color

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1/ - Paper Presented at the 13th Summer Crops Workshop held at JADP, Naktajhijh, Janakpur from March 10-13, 1986.

2/ - Asstt. Agri. Dev. Officer, Asstt. Soil Scientist, FSRD/Division, Khumaltar, and F.S. Agronomist, WI/ARP Project, respectively.

3/ - For more informations about the sites the reader is directed to the FSR Report No. 1 Published by FSRDD/ARPP, 1986.

and general acceptability of the varieties included in the tests. Their reactions were recorded on a 1 - 4 scale.

The grain yield data obtained from the trials were analyzed using Stability Tests[4/]. Using this test the variety trial conducted farms were divided into different production environments based on the average yields of the tested varieties. Environment then becomes a continuous quantifiable variable with a range equal to the range of average yields. Yield for each of the varieties are related to environment by simple linear regression:

(1) $Yi = a + be$

Where: Yi = Yield of variety i, and

e = environmental index (EI) equal to the average yield of all varieties at each location.

By fitting equation (1) independently for each variety, then plotting the yield response to environment for each variety on the same graph, it is possible to visually compare the yield and stability of different varieties.

III. RESULT AND DISCUSSION

A. Grain Yield Performance : Table 1, A through C Presents the results of the grain yields obtained at various sites. In 1984, in Pumdi Bhumdi, Manakamana-2 produced the highest grain yield which was significantly different at the 5% level from Manakamana-1, Khumal Yellow and the Local variety. The Local variety produced the lowest yield. In 1985, significant variety differences were not observed; however, all improved varieties gave higher yield than the Local Check. The results from Khandbari for 1984 showed a similar trend to that of Pumdi Bhumdi, Manakamana-2 yielding the highest among the four varieties, and the Local Check producing the lowest yield, 2.04 t/ha. During 1985 significant variety differences were not observed at Khandbari, but all improved varieties outyielded the Local Check. In Lele, in both years Manakamana-2 gave significantly higher yields than other varieties.

4/ - Adapted from a Publication entitled "Modified Stability Analysis of Farmer Managed On-Farm Trials" By Peter E. Hildebrand, 1982.

B. Stability Test: Table 2 presents the environmental index (EI) for the various sites where variety trials were conducted. In 1985 at Khandbari the production environment was less favourable by 36.3% compared to 1984. But for Lele the EI in 1985 improved considerably. Such improvement was also observed for Pumdi Bhumdi.

Figure 1, A through E, presents the grain yield performances of the different improved varieties in the different environments. In Pumdi Bhumdi during 1984 crop season Manakamana-2 produced the highest yield, consistently over a wide range of environments. Manakamana-1 ranked second followed by the Local Check. The correlation coefficients of 0.61 for Manakamana-2 in comparison with 0.43 for Manakamana-1 and 0.47 for Local indicate that there is merit to grow Manakamana-2 in "good environments" (better cultural practices, high rates of fertilizer application, fertile land etc.). Howevere, looking at the figure 1B for 1985 it appears that there is no difference between grain yields of Manakamana-2 and Manakamana-1 in the EI below 4.0 t/ha. The results for both years showed clearly that the Local variety could not compete with improved varieties, neither in good nor in bad environments.

In Khandbari (figure 1C), Manakamana-1 outyielded Manakamana-2. It is interesting to note that the regression line for Manakamana-2 indicates that in good environments (EI beyond 2.23 t/ha), this variety might produce higher yields while in the poor environments, Manakamana-1 will be superior to Manakamana-2 (this speculation, however, is not statistically significant). At Khandbari, as other sites, the Local Check produced the lowest yield across the various environments. In Lele (figure 1D), and in environments where EI = 4.85 t/ha, there is insignificant difference between the performance of Manakamana-1 and Manakamana-2, while in better environments (EI beyond 4.85 t/ha) it could be worth while using Manakamana-2 if the farmers like other characteristics of this variety.

Summary data for the complete range of production environments are presented in figure 1E. It is interesting to note that Manakamana-1 and Manakamana-2 produced almost the same yield (but higher than Local Check) in the poor environment (EI = 1.73 t/ha), while better

environments led to better performances of Manakamana-2. Manakamana-1 yields were found to be more stable over environments.

C. Farmers' Evaluation: Table 3 presents the results of the farmers evaluation of the different varieties. Altogether 30 farmers participated in this evaluation, and questions were asked concerning agronomic and socio-economic indicators affecting variety adoption.

Manakamana-1 received 19 "excelents" out of 30 responses for the grain type. It was seconded by the Local Check, the grain type of Khumal Yellow being described to be the poorest among all. For the maturity, Arun-4 was highly preferred by the respondents followed by the Local Check variety. Maturity of other varieties were described as "poor", "less acceptable", "long duration" etc. Manakamana-1 and Manakamana-2 were reported to have better drought tolerance during various stages of plant growth 5/. The grain yield of Manakamana-1 was more acceptable to the respondents than Manakamana-2 and others.

All the tested varieties except the Local Check were poor in storage. Manakamana-1 and Manakamana-2 were ranked in the same category (satisfactory). Khumal Yellow had the poorest storage capability among the different varieties tested. The taste of Manakamana-1 was very much liked by the farmers followed by Local and Arun-4. Khumal Yellow tasted poor. Effect of the tested varieties on the relayed finger millet yield has been found insignificant, however, the farmers complained about Manakamana-2 and Khumal Yellow causing negative influence on the finger millet yield.

The best indicator for the selection of varieties in this kind of analysis will be the total number of "excellents" and "goods" received for various varietal characteristics from the respondents; the rate of adoption being directly proportional to the numbers of varietal characteristics liked by the farmers. Based on this assumption the data presented in table 3 indicate that Manakamana-1 has received the highest score (excellents + goods = 168) followed

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5/ - CSP experiences in these areas indicate that drought can occur during all stages of maize plant growth, however, the most common is during/before knee-high and tasseling stages. Drought can last for 7 - 15 days.

by Manakamana-2 (160), and therefore the probability of their adoption is higher than any other variety. Of these two, Manakamana-1 has better chance for adoption. (It received 138 excellents against 54 for Manakamana-2.)

IV. CONCLUSION

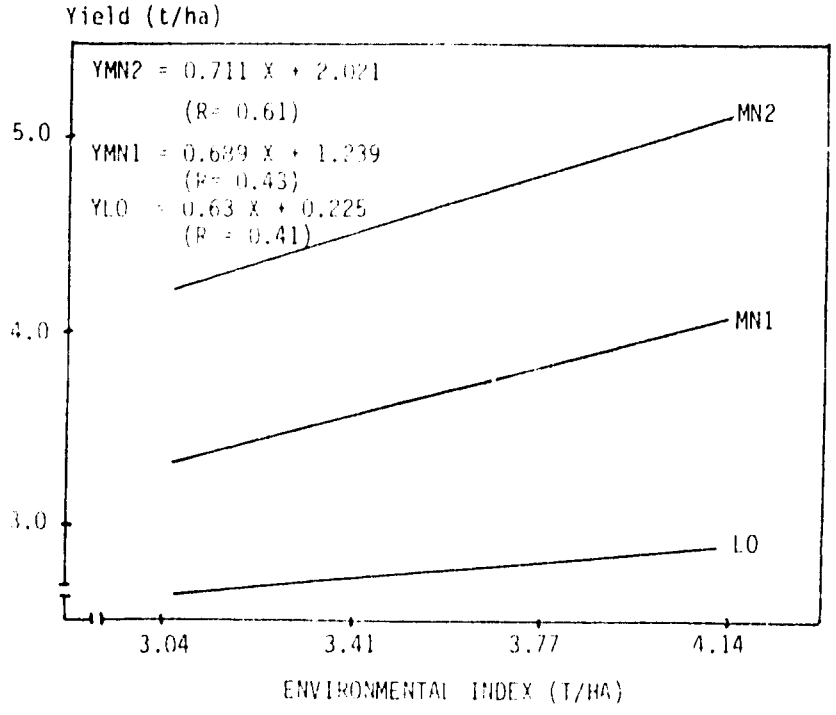
On-Farm variety evaluation has several merits. For the researcher such testings provide a unique opportunity to observe variety performances under varied agroclimatic conditions and management levels, which enables research priorities to be reoriented, if necessary, to keep them consistent with the farmers needs. For the farmers these testings serve as a "Technology Market" at home from where they can pick the most preferred varieties and adopt them where appropriate. Along with these merits varietal trials should result into varietal recommendations for specific production environments.

The data presented in this paper indicate how important is it to consider agronomic as well as socio-economic variables to make precise prediction about appropriate recommendation. Manakamana-1, certainly, is an outstanding variety for wide range of production environments; however, the adoption probability will be expected to rise dramatically if its maturity could be shortend by 7 - 10 days.

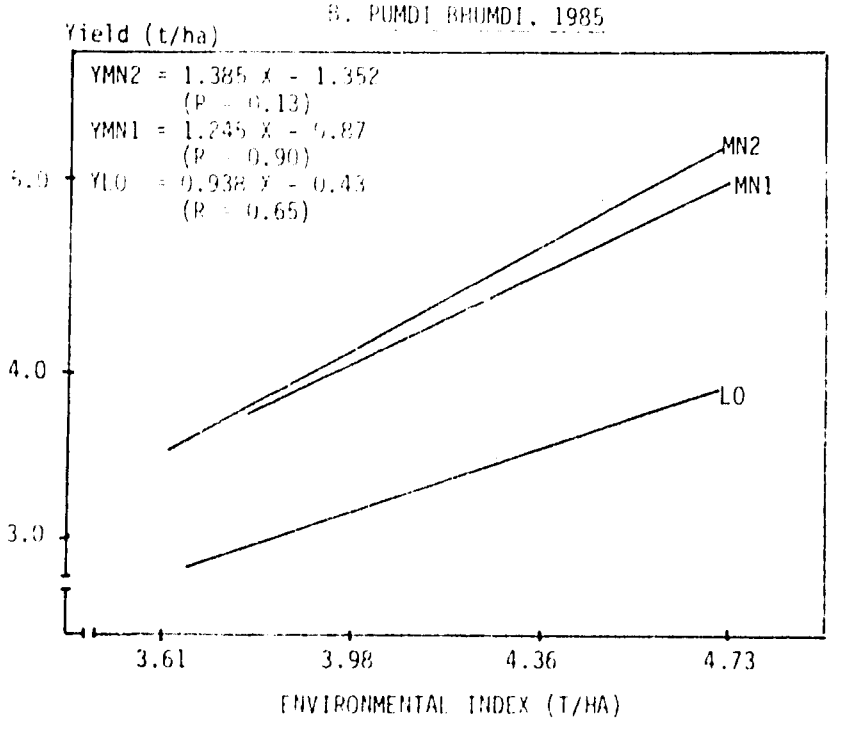
WI/BKS: ds
Feb 27, 1986

Figure 1: STABILITY TEST RESULTS

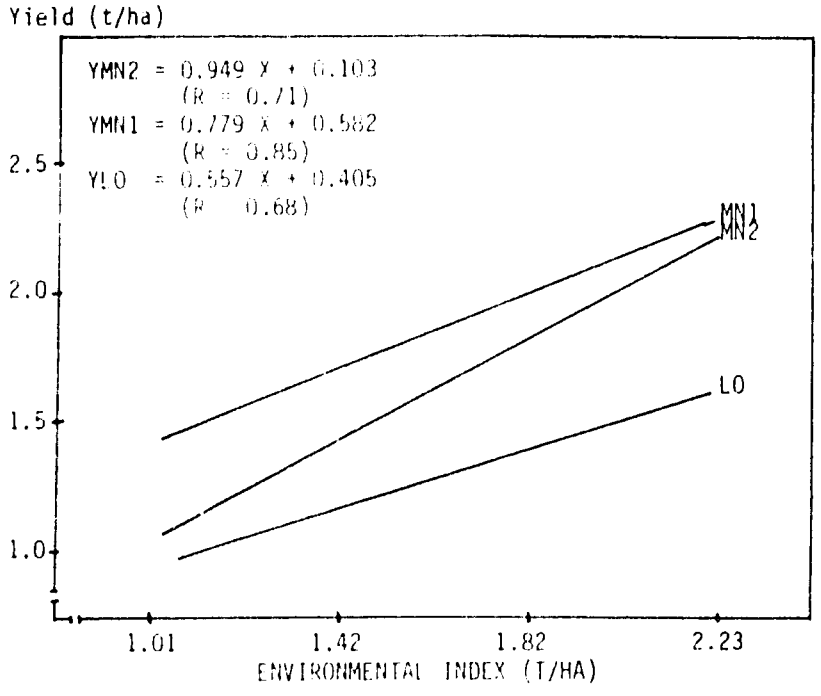
A. PUMDI BHUMDI, 1984



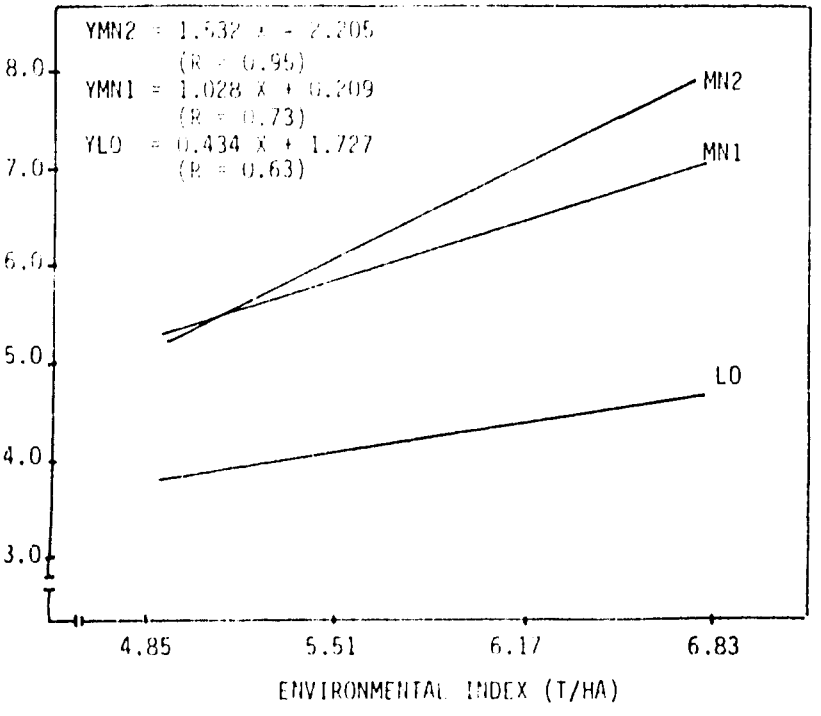
B. PUMDI BHUMDI, 1985



C. KHANDBARI, 1985



Yield (t/ha) D. TELE, 1985



E. LELE, KHANDBARI AND PUMDI BHUMDI (1984/85)

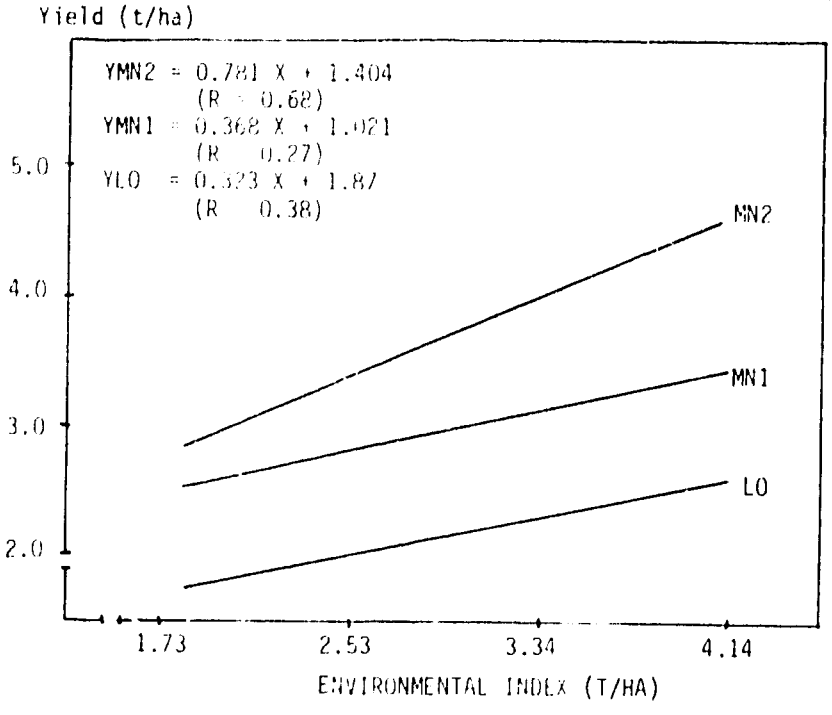


Table No. 1: MAIZE YIELD FROM VARIETY FFT CONDUCTED AT VARIOUS FARMING SYSTEMS SITES DURING SUMMER SEASONS OF 1984-1985

A. PUMDI BHUMDI, 1984

Variety	Farms Yield, T/ha					Variety Mean
	1	2	3	4	5	
Manakamana-1	3.34	4.81	3.02	3.72	3.83	3.74 [b]
Manakamana-2	4.86	4.72	4.34	3.91	5.20	4.61 [a]
Khumal Yellow	5.06	3.73	2.68	3.10	3.77	3.67 [b]
Local	3.31	2.25	2.10	2.91	2.02	2.52 [c]
Mean for Farm	4.14	3.88	3.04	3.41	3.71	3.64

Variety F - test - S at 0.05
LSD (0.05) = 0.85 t/ha.
CV = 17.38%

B. PUMDI BHUMDI, 1985

Manakamana-1	4.84	4.12	3.98	4.99	3.21	4.15
Manakamana-2	5.25	3.02	3.44	5.11	4.72	4.14
Khumal Yellow	5.36	4.06	3.06	4.21	3.66	4.41
Arun-4	4.45	4.20	4.79	4.67	4.09	4.47
Local	3.75	2.32	4.15	3.90	2.39	3.62
Mean for Farm	4.73	3.64	3.88	4.58	3.61	4.17

Variety F - test - NS
CV = 14.90 %

C. KHANDBARI, 1984

Manakamana-1	2.70	2.96	1.73	4.38	1.89	2.73 [a]
Manakamana-2	2.97	3.41	2.32	3.92	2.58	3.04 [a]
Khumal Yellow	2.83	3.01	2.36	4.18	2.58	2.99 [a]
Local	2.49	2.06	1.32	2.49	1.83	2.04 [b]
Mean for farm	2.75	2.86	1.93	3.74	2.22	2.70

Variety F - test - S at 0.01
LSD (0.01) = 0.64 t/ha.
CV = 12.50 %

D. KHANDBARI, 1985

Manakamana-1	2.31	2.08	1.14	2.21	1.37	1.92
Manakamana-2	2.66	2.01	1.26	1.15	1.60	1.74
Khumal Yellow	1.82	3.05	0.72	2.22	1.33	1.33
Arun-4	2.60	2.22	0.97	1.55	1.35	1.74
Local	1.54	1.78	0.98	1.14	1.38	1.36
Mean for Farm	2.19	2.23	1.01	1.65	1.50	1.72

Variety F test - NS
CV = 23.22 %

E. LELE, 1984

Manakamana-1	2.28	4.10	2.44	1.28	2.40	2.50
Manakamana-2	3.72	4.33	3.07	3.28	2.50	3.38 [a]
Khumal Yellow	2.57	1.76	2.14	1.10	2.71	2.06 [bc]
Local	2.48	2.84	1.45	1.26	1.32*	1.61 [c]
Mean for Farm	2.76	3.26	2.28	1.73	2.23	2.39

Variety F test - S at 0.05; LSD(0.05)=0.71 t/ha; CV=30.70 %.

* - This figure is obtained by missing plot techniques of data adjustment.

F. LELE, 1985

Manakamana-1	7.72	5.19	5.92	5.10	6.07	6.00 [a]
Manakamana-2	8.00	7.19	6.46	5.38	5.10	6.43 [a]
Arun-4	7.04	6.06	6.21	5.68	4.76	5.95 [a]
Local	4.62	4.53	3.76	4.49	3.47	4.17 [b]
Mean for Farm	6.85	5.74	5.59	5.16	4.85	5.64

Variety F - test - S at 0.01
LSD (0.01) = 1.16 t/ha.
CV = 11.37 %.

Table No. 2: ENVIRONMENTAL INDEX FOR PUMDI BHUMDI, LELE AND KHANDBARI BASED ON 1984 - 1985 MAIZE VARIETY FARMERS FIELD TRIAL RESULTS

Site	Environmental Index (T/ha) 1/			
	1984	1985	Difference (B - A)	%
Pumdi Bhumdi	3.63	4.16	+0.53	+14.60
Khandbari	2.70	1.72*	-0.98	-36.30
Lele	2.39*	5.64	+3.25	+135.98

* - Severe drought at tasseling stage.

1/- Environmental Index equals to the average yield of all treatments in all replications at each site.

Table No. 3: FARMERS' EVALUATION OF ON-FARM MAIZE VARIETY TRIALS CONDUCTED AT VARIOUS FARMING SYSTEMS SITES DURING SUMMER SEASON OF 1984 - 1985 1/

Evaluation Criteria 2/	Variety*/ Scale																			
	M-1				M-2				KY				A-4				LO			
	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1	4	3	2	1
Grain Type	19	9	1	1	9	18	0	3	4	14	7	5	10	8	7	5	17	9	3	1
Maturity	4	11	6	9	2	14	8	6	1	11	10	8	20	5	5	0	17	5	6	2
Drought Tolerance	16	10	3	1	16	9	3	2	12	9	8	1	10	6	10	4	0	6	9	15
Yield	23	4	2	1	8	17	4	1	11	9	7	3	9	13	3	4	7	3	8	12
Storage	4	14	5	7	4	18	4	4	1	11	9	9	9	6	4	11	24	5	1	0
Taste	21	7	2	0	5	21	3	1	0	18	4	8	10	10	7	3	18	9	3	0
Farmers' Acceptance	21	5	2	2	10	9	1	10	11	3	8	8	10	5	13	2	5	11	3	11
Total :	108	60	21	21	54	106	23	27	40	75	53	42	78	53	49	29	88	48	33	41

* - Variety: M-1 = Manakamana-1; M-2 = Manakamana-2; KY = Khumal Yellow; A-4 = Arun-4 and LO = Local

- Scale: 4 = Excellent; 3 = Good; 2 = Satisfactory and 1 = Poor.

1/ - The total number of respondents = 30.

2/ - The numbers presented for each evaluation criteria indicate the number of respondents.