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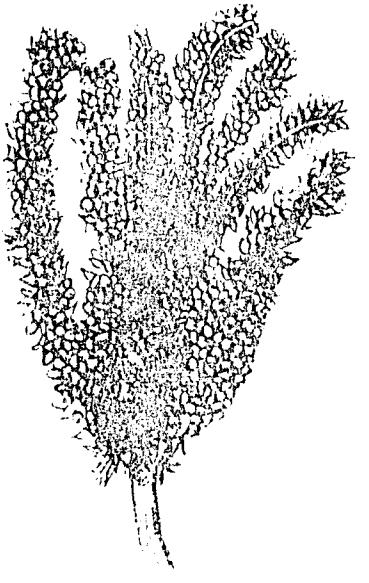
FINGER MILLET DEVELOPMENT PROGRAM

ANNUAL REPORT 1984



His Majesty's Government

Ministry of Agriculture

Department of Agriculture

Integrated Cereals Project

National Maize Development Program

Agronomy Division, Nepal

AID Project - Integrated Cereals

FINGER MILLET DEVELOPMENT PROGRAM
ANNUAL REPORT 1984

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HIS MAJESTY'S GOVERNMENT
MINISTRY OF AGRICULTURE
DEPARTMENT OF AGRICULTURE
INTEGRATED CEREALS PROJECT
NATIONAL MAIZE DEVELOPMENT PROGRAM
AGRONOMY DIVISION, NEPAL

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EXECUTIVE SUMMARY

This report summarizes the results from varietal and the component technology trials conducted on finger millet (*Eleusine coracana*) during the 1984 cropping season. There were basically five types of trials run over six locations and are summarized as follows:

EXPERIMENT	ENTRIES/ TREATMENTS	NO. OF LOCATIONS
1. Advanced Varietal Trial (AVT)	10	6
2. Advanced Varietal Trial Relay (AVT)	2+4 (Split plot)	2
3. Initial Evaluation Trial (IET)	16	4
4. Plant Population Trial	5+2 (Split plot)	3
5. Germplasm Observation Nursery	93	2
	TOTAL:	17

The advanced variety trial consisted of elite material as did the AVT (R) but the latter was specifically designed to test finger millet X two maize varieties and their interactions. The IET and Germplasm Observation Nursery tested recently introduced local material. The plant population tested 5 plant populations under two conditions, sole and relay. Almost all of the material used in the trials was of Nepalese origin.

Some of the varieties from the AVT have been advanced to farmer's field trials and seed multiplication programs. The top six yielders from the IET were advanced to the AVT and the top ten yielders from the germplasm observation nursery were advanced to the IET. The plant population trial showed the importance of maintaining high plant populations especially under relay conditions; however, an optimum plant population for either condition can not yet be recommended. Varietal performances are discussed in detail in the text.

INTRODUCTION

In Nepal, finger millet (Eleusine coracana) is cultivated on approximately 122,000 hectares. In table 1, the estimated area, production and average production by region and agro-ecological zone are summarized. Agro-ecological zones are summarized in table 2. According to the '78/79 statistics, the western region has the highest area under cultivation accounting for approximately 30% of the total. Kaski and Syangja districts rank highest (7000 ha) for area under cultivation, whereas Taplejung district has consistently recorded the highest production per unit area (1.64 t/ha). These statistics clearly show the importance finger millet plays in the Nepalese farming systems. However, it represents approximately 5% of the total (food) cropped area (rice, wheat, maize, millet and barley are considered food crops).

In general, compared to rice, maize and wheat, finger millet has been severely neglected in research and extension activities. In 1979, Oakhale-1 and Dalle-1 were released. Oakhale-1 was recommended for the mid-to-high hills and Dalle-1 for the mid-hills and inner terai. However, these varieties are not widely adapted and have proved to be unstable in some locations. In Lumle, Pakhribas and somewhat in Kakani, Oakhale-1 has been adopted by farmers.

In Nepal, finger millet is a multipurpose crop used for porridge, chapatis and alcoholic beverages. The fodder is highly valued and spent seed from brewing is often fed to livestock. (Spent seed is thought to be essential for successful hog raising.) In some areas, it is exclusively used as a staple food and in others it is often enjoyed by hard labourers who say they can maintain the entire day on one morning meal of it's porridge. The carbohydrate and protein chemical composition of finger millet (Kodo in Nepali) grain is 70% and 11% respectively (12). It is a staple food in some parts in Southern India and East and Central Africa (11). It also has excellent long storage capability without deterioration or attack by problem storage insects. In Nepal in the field, it is attacked by blast, leaf blight, smuts and stem borers. Blast (Pyricularia sp.) is by far the most serious disease in Nepal and occurs in pocket areas usually in higher hills.

As far as various cropping system practices it is usually grown as a sole crop in the terai and inner terai, while it is sequenced or relayed in low-to-mid-hill zones. The terai accounts for only 15% of the total finger millet area. In general, low-to-mid-hills, i.e. 800-1249 m.a.s.l., finger millet is closely sequenced after maize and before wheat. From mid-hills, i.e. 1250-1699 m.a.s.l., it is usually relayed with maize followed by wheat or fallow. From 1700 m.a.s.l. and above, up to 2500 meters, it is again grown as a sole crop in a two year, three crop cropping system. The relay

cropping system is by far the most predominant pattern accounting for at least 60% of the total cropped area of finger millet.

Breeding and selection for short duration and high yield (120 days and 2.0 t/ha) could be one viable future objective for Finger Millet Development Program (FMDP). Short duration could possibly increase cropping intensity by allowing for a third crop after maize/finger millet including, but not exclusive to wheat, grain legume (cowpea), oats etc. More fundamental research needs to be conducted on cropping systems X variety interaction, genetic competitive ability of genotypes, growth habit, components of yield, and genotype X environment interactions. Before breeding can be started it should be known whether special selection programs are necessary for intercropping or relaying. Correlations betwcen cultivar yields of finger millet in relay and sole crops are usually positive; we have found this in our experiments. However, it is not yet known if the different cultivars can be expected to be efficient in using varying levels of environmental resources. For example, the best genotypes under the optimum conditions of mono-cropping may not be those that will best suit the more limiting environments of multiple cropping (4). What may be required, therefore, is a multi-location selection strategy in which varietal selection is conducted separately for different environments. However, multi-environment selection strategy will be more costly, but may prove necessary and efficient because of the many agro-ecological niches of Nepal.

The main objectives of the FMDP are the following:

a) To initiate collection of a local and exotic finger millet germplasm for selection and for use in a future breeding program (possibly to include the world collection of *Eleusine coracana*);

b) To firmly establish and to continually maintain contacts with other countries where finger millet is cultivated in order to receive and exchange research information and valuable germplasm (India, Africa and Sri Lanka);

c) To develop stable varieties adapted to a wide zone of cultivation specifically and especially in the mid-hill;

d) To conduct multi-local varietal and other component technology trials including but not exclusive to plant population and fertilizer trials;

e) To identify yield components (ranked multiple criterion) to aid in a future breeding program under both relay and monoculture conditions;

f) To identify if cropping systems X cultivar interactions and genotype X environment interactions are significant and to what extent they should be accounted for when developing a sound breeding strategy for finger millet;

g) To develop a standardized evaluation system for finger millet for use in multi-location testing, selection, breeding etc.;

h) To integrate finger millet in the Farming Systems Program;

i) To conduct and carefully monitor farmer's field trials to test and better exploit existing varieties;

j) To develop varieties with short duration (120 days), resistance to lodging, stable, high yielding and good quality;

k) To identify, obtain and efficiently use computer software and hardware for ease in the compilation and analysis of data.

Table No. 1: ESTIMATED AREA AND PRODUCTION OF FINGER MILLET THROUGHOUT NEPAL 2035/036 (1973 / 1979)

Area in hectare
Production in MT.

Development Area / Districts	Finger Millet Area	Finger Millet Production	Average Production t/ha
I. EASTERN REGION			
A. Mid-To-High Hill Agro-Eco. Zone			
01. Taplejung	1400	2300	1.64
02. Sankhuwasabha	2310	2860	1.23
03. Solukhumbu	1000	1100	1.10
Total :	4710	6260	1.33
B. Mid-Hill Agro-Eco. Zone			
01. Panchthar	3730	3360	0.90
02. Illam	2430	2860	1.17
03. Terahthum	2120	2790	1.32
04. Dhankuta	4210	3970	0.94
05. Bhojpur	2000	2000	1.00
06. Khrtang	1110	1260	1.14
07. Okhaldhunga	2200	2040	0.93
08. Udaypur	1400	1180	0.84
Total :	19260	19260	1.00
C. Terai and Inner Terai Agro. Eco. Zone			
01. Jhapa	900	820	0.91
02. Morang	1000	950	0.95
03. Sunsari	1020	1140	1.11
04. Saptari	870	720	0.83
05. Siraha	2190	1420	0.65
Total :	6070	5050	0.83
EASTERN REGION TOTAL :	29980	30570	1.02
II. CENTRAL REGION			
A. Mid-To-High Hill Agro-Eco. Zone			
01. Dolakha	900	600	1.50
02. Sindhuli	2930	3140	1.07
03. Rasuwa	480	460	0.96
Total :	4310	4200	0.97

Table No.1 Continued:

B. Mid-Hill Agro-Eco. Zone

01. Ramechhap	2370	1980	0.80
02. Sindhuli	2370	2400	1.01
03. Kabhre	1990	2490	1.25
04. Bhaktapur	180	180	1.00
05. Lalitpur	1280	1100	0.79
06. Kathmandu	1400	1300	0.86
07. Nuwakot	1800	2600	1.44
08. Dhading	2010	2060	1.02
09. Makawanpur	2400	3360	1.40
Total :	15480	17390	1.12

C. Terai and Inner Terai Agro-Eco. Zone

01. Dhanusha	2730	2530	0.93
02. Mahottari	1420	1420	1.00
03. Sarlahi	680	570	0.84
04. Rautahat	550	480	0.87
05. Bara	280	260	0.93
06. Parsa	300	290	0.97
07. Chitwan	1200	1100	0.92
Total :	7160	6650	0.93
CENTRAL REGION TOTAL :	26950	28280	1.05

III. WESTERN REGION

A. Mid-To-High Hill Agro-Eco. Zone

01. Manang	550	570	1.04
02. Mustang	550	680	1.24
TOTAL :	1100	1250	1.14

B. Mid-Hill Agro-Eco. Zone

01. Gorkha	2700	2130	0.79
02. Lamjung	5950	7170	1.21
03. Tanahu	5420	6800	1.25
04. Kaski	7000	7700	1.10
05. Parbat	2250	2600	1.12
06. Syangja	7000	8400	1.20
07. Palpa	1940	1550	0.80
08. Myagdi	800	800	1.00
09. Baglung	1500	1770	1.18
10. Gulmi	1800	2230	1.24
11. Arghakhanchi	1800	2100	1.17
TOTAL :	38160	42980	1.13

Table No.1 Continued:

C. Terai and Inner Terai Agro-Eco. Zone			
01. Nawalparasi	1380	4110	0.80
02. Kapilvastu	450	390	0.87
02. Rupandehi	640	480	0.75
Total :	2470	1980	0.80
WESTERN REGION TOTAL :	41730	46210	1.11
IV. FAR-WESTERN REGION			
A. Mid-To-High Hill			
01. Dolpa	650	750	1.15
02. Kalikot	700	790	1.13
03. Mugu	450	500	1.11
04. Humla	700	800	1.14
05. Jumla	1300	1140	0.88
06. Bajura	1000	1250	1.25
07. Bajhang	970	1200	1.24
08. Darchula	620	800	1.29
TOTAL :	6390	7230	1.13
B. Mid-Hill Agro-Eco-Zone			
01. Rukum	200	250	1.25
02. Rolpa	620	720	1.16
03. Pyuthan	1200	1400	1.17
04. Salyan	4300	4700	1.09
05. Jajarkot	1300	1580	1.22
06. Dailekh	1500	1800	1.20
07. Surkhet	550	600	1.09
08. Achham	900	1060	1.18
09. Doti	1300	1580	1.22
10. Baitadi	900	1060	1.18
11. Dadeldhura	1850	2220	1.20
TOTAL :	14620	16970	1.16
C. Terai and Inner Terai Agro-Eco. Zone			
01. Dang	400	480	1.2
02. Banke	940	930	0.99
03. Bardiya	500	550	1.10
04. Kailali	1400	1400	1.00
05. Kanchanpur	500	560	1.12
TOTAL :	3740	3920	1.05
FAR-WESTERN REGION TOTAL :	24750	28120	1.17
NEPAL :	123410	133140	1.08

Source: Agricultural Food and Marketing Services, Kathmandu

Table No.1A: AREA IN PRODUCT. BY REGION AND RANK

			RANK
I.	EASTERN REGION AREA CULTIVATED	29,980	II
II.	CENTRAL REGION AREA CULTIVATED	26,950	III
III.	WESTERN REGION AREA CULTIVATED	41,730	I
IV.	FAR-WESTERN " " "	24,750	IV

Table No.1B: DISTRICTS BY REGION ABOVE 2350 HA AREA IN CULTIVATION

I. EASTERN REGION

A. Mid-Hill Agro-Eco. Zone

01.	Panchthar	3730
02.	Dhankuta	4210
03.	Illam	2430
04.	Sankhuwasabha	2310

II. CENTRAL REGION

A. Mid-Hill Agro-Eco. Zone

01.	Sindhuli	2370

B. Terai and Inner Terai Agro. Eco. Zone

01.	Dhanusha	2730

III. WESTERN REGION

A. Mid-Hill

01.	Kaski	7000
02.	Syangja	7000
03.	Lamjung	5950
04.	Tanahu	5420
05.	Gorkha	2700

III. FAR-WESTERN REGION

A. Mid-Hill Agro.-Eco. Zone

01.	Salyan	4300
02.	Dadeldhura	1850
03.	Dailekh	1500

GRAND TOTAL : 53500 = 43.4 % of total.

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Table No.2: GENERALIZED AGRO-ECOLOGICAL ZONES

A.	Terai and Inner Terai	:	0 - 799 m.a.s.l.
B.	Mid-Hill	:	800 - 1499 m.a.s.l.
C.	High-Hill	:	1500 - 2450 m.a.s.l.

II. ADVANCED VARIETAL TRIAL

The objectives of this trial were to test ten experimental lines of diverse geographic origin (Nepal and India) under conditions of monoculture (relay at Pakhribas) at six locations in order to isolate the lines that perform well at each site. The secondary objectives of the AVT were to identify a stable variety and to observe the quantitative and qualitative agronomic characteristics of each variety.

Varieties Under Study :

01.	NE-94	02.	NE-1703-34	03.	Rampur Local
04.	Oakhale-1	05.	Dalle-1	06.	NE-6401-26
07.	NE-3801-2	08.	IE-143 (India)	09.	NE-1104-13
10.	Local Check				

Discussion :

IIa. Khumaltar

Variety mean performances are presented in tables 3 and 4 while varietal characteristics and details of trial are presented in tables 5 and 6. Analysis of data for these trials were aided by computer packages (8, 9).

Varietal performances at Khumaltar were quite different than those from other locations (see table 7). NE-94, NE-1703-34 and NE-3801-2 performed the best under monoculture conditions yielding 1899, 1728 and 1467 kg/ha of grain respectively. Varieties were positively correlated with harvest index R= 0.56, N= 40, P= 0.01. Mean (sun-dried) forage yields ranged from the highest 8.7 to the lowest 2.7 t/ha. Rampur Local recorded the highest number of productive tillers/plant but was thermosensitive to Kathmandu Valley; however, NE-94 had the second highest number of productive tillers/plant and recorded the highest yield. IE-143 was earliest in days to panicle emergence but was a low yielder. NE-94 and NE-1703-34 and NE-3801-2 seemed to be well adapted to Khumaltar conditions, but did not perform well overall the 6 sites (see pooled analysis, table 7, and 7A and stability analysis). NE-94 gave a relatively low mean forage yield and Dalle-1, NE-3801-2, NE-6401-26, NE-1104-13 and Rampur Local gave the top five mean forage yields ranging from 8.7 to 6.4 t/ha (see table 4). The grain mean for all varieties at Khumaltar was 1281 kg/ha (site mean).

III. AVT, RAMPUR MAIZE STATION

Mean grain performances and details of trial are presented in tables 8 and 9; agronomic characteristics are summarized in table 10. The two local checks, Rampur Local and NE-3 (Local Check No. 2) proved to be superior. Rampur

Local differed significantly from all other varieties; NE-3 and IE-143, ranked 2 and 3 did not differ significantly from each other. Oakhale-1 recorded lowest mean yield. Dalle-1 had the highest mean seed weight/head (N= 10), and Rampur Local had the second highest (7.0 grams). Days to anther exertion occurred about 6 days later than days to 50% panicle emergence at Rampur. The mean grain yield for all varieties was high (1216 kg/ha)

IV. AVT, KABHRE AGRICULTURE FARM

NE-1104-13, NE-3801-2 and Kabhre's Local Check variety gave the 3 highest mean yields, 2355, 2093 and 1974 kg/ha respectively (see table 12). Details of AVT Kabhre and summary of agronomic characteristics are presented in tables 11, 13 and 14. The above mentioned varieties, however, did not differ significantly from NE-6401-26, Oakhale-1 and Dalle-1 at p. 0.01 by Duncan's Multiple Range Test (DMRT). High grain yields were generally well associated with high forage yields. Also, higher mean seed wiight/panicle (N= 10) was well associated high mean grain yield. Rampur Local gave highest number of productive tillers/plant but was thermosensitive and very late (192 days to harvest). NE-94 performed poorly here but had a high number of productive tillers/plant and was relatively early. Kabhre recorded the highest grain site mean 1462 kg/ha; 4572 kg/ha was recorded for forage site mean. There was high plot to plot variation in forage yield due to variation in plant stand and perhaps uneven sun-drying.

V. AVT, KAKANI AGRICULTURE FARM

Kakani farm is considered a poor environment (site mean 535 kg/ha) due to low fertility, high altitude (1830 m) and blast and septoria disease persistence. Low rates of photosynthesis, and low rates of soil nutrients (possible due to low rate of organic matter decomposition) are also contributing factors to low yields at Kakani.

In table 15, results and details of AVT conducted at Kakani are presented. Mean yields did not differ significantly at the 0.05 p. level and a 73% C.V. was recorded. Poor plant stand, *Septoria* and poor management were contributing factors to low yields. NE-6401-26, Local Check, and Oakhale-1 recorded highest mean grain yields (832, 790 and 783 kg/ha respectively).

VI. AVT AT PAKHRIBAS AGRICULTURE CENTER

At Pakhribas, the AVT was conducted under relay conditions and results, details and summaries are presented in tables 16 through 20. At Pakhribas, Oakhale-1 was significantly higher in mean yield (P= 0.01) by DMRT than both PAC hill

(Local Check) and NE-6401-26. Mean grain yields for these three varieties were 1614, 1328 and 1063 kg/ha respectively. Despite relay conditions with maize, PAC recorded a site mean of 759 kg/ha. There was no observed finger millet X maize interaction (0.05 p.), however, combined maize and finger millet grain yields gave results similar to those of finger millet yields alone. Lodging was observed in all varieties. High grain yielders were associated with relatively taller plant types.

VII. AVT AT LUMLE AGRICULTURE CENTER

Kalo Bhunde, Oakhale-1, NE-3801-2 and NE-6401-26 recorded highest mean seed yields (2238, 1775, 1663 and 1500 kg/ha) and did not differ significantly from one another (0.01) p. by DMRT. Mean results of grain, forage yields, details of trial and summary of agronomic characteristics are presented in tables 21 through 24. Mean grain yield at Lumle was highly correlated with mean forage yield (R= 0.95) and harvest index. Rampur Local variety was rejected due to it's lateness and thermosensitivity. Mean grain yield was well associated with mean number of rachi/panicle and plant height. Anther exertion occurred approximately 11 days after 50% panicle emergence at Lumle. Lumle recorded a site mean of 983 kg/ha (grain).

VIII. AVT, STABILITY ANALYSIS

Genotype X environment interactions limit the effectiveness of selection when selection is based solely on the mean performance of cultivars (2, 3, 6). Linear regression of cultivar means on the mean of all varieties for each site (site mean) are shown graphically (13) in figures 1 through 10. Only description of environments (based upon site mean) either good or poor can be identified by the method employed here. Also this simple model can not explain very accurately genotype environment interactions, nor can it accommodate or account for heterogeneous covariate factors such as fertility, plant management, cultural practices (see Kang and Miller (7) for methods that accommodate these differences, and improve genotype X environment interaction and stability analysis). Despite these drawbacks, the analysis used here is a useful tool for quickly reviewing all varieties graphically (13).

The method can describe a variety as stable, but should be used in conjunction with other methods of analysis and evaluation of varieties.

A stable variety has been often used to mean a variety that performs relatively the same (with an acceptable yield to the farmer) over a given range of environments (2). In Nepal where a farmer must be able to rely on the yield of his or her crop year after year in order to eat (i.e. subsistence

farming), and where environments, especially those designated for finger millet, are usually considered poor or limiting a stable variety could be of greater importance than a variety does well in some years and poor in others (within and between season X environment X variety interaction). Also, there are compounding limiting factors for finger millet since it is often associated with maize. However, a farmer may be interested in a variety that does very well in a not so poor environment, i.e. unstable variety, if he has such an environment.

In this analysis, a variety is stable if it has a relatively low slope, 0.6-0.8, and a high intercept. Oakhale-1 and NE-6401-26, figures 1 and 10, are considered stable. Oakhale-1 has very low slope, however, it has a relatively high intercept. NE-6401-26 has a higher slope (0.6) and relatively high intercept (534). (Another component of the analysis that should be taken into consideration is the magnitude of the standard error (s.e.) (2, 7.) On the other hand, with exception to Rampur Local which is highly adapted to the terai zone, NE-1104-13 gave the highest mean yield (2354 kg/ha, figure 8, and the highest slope 1.7. NE-94 had the second highest slope and the lowest intercept, figure 2. Thus, by this analysis these latter two varieties are considered unstable, NE-94 being the most unstable. NE-3801-2 possesses average stability (b= 1.26) (intcp.= -119) (s.e.= 512). Standard errors ranged from as low as 192 (Dalle-1) and as high as 927 (Rampur Local). The Local Check varieties were different for each location so they can not be validly analyzed. (Note: Special care must be taken when comparing the angles of the different slopes since the numbers that define the Y-axis change from graph to graph).

IX. AVT, POOLED ANALYSIS

In tables 7 and 7A pooled analysis of gain and forage yield of AVT are presented. Tables 25 through 29 summarize some of the characteristics by location.

Conclusion for Advanced Varietal Trial (AVT) :

Based on these analyses, Dalle-1, Oakhale-1, NE-3801-2, NE-6401-26, and NE-1104-13 will be further tested at hill stations. Some of these varieties will be further evaluated in farmer's field trials. Except for the local checks the rest of the varieties will be put into the observation nursery. Some of the best varieties from the IET will replace the discarded varieties from the AVT (see IET Discussion). At Rampur, Dalle-1, IE-143, Rampur Local, NE-3, NE-1703-34, and NE-1104-13 will be further evaluated. NE-3 and Rampur Local are being further evaluated in farmer's field trials for the terai and inner terai.

With exclusion to Rampur Local, NE-1104-13, NE-3801-2, NE-6401-26, NE-1703-34, NE-1102-12, NE-1001-1, and NE-1304-1 will be tested over all hilly locations for stability and adaptation analysis. The latter 3 have been advanced from IET 1984 (see IET Discussion XI). (For more details of 1985 FMDP, see(17). For detailed information on the methodology used in these trials for recording the observations and the morphological characteristics of varieties and treatments the reader is referred to Tamulonis and Singh, 1984 (16).

Table No.3a : Environmental indices

	Site Means (Grain) kg/ha
A. Khumaltar Farm	1281
B. Rampur Maize Station	1215
C. Kabhre Farm	1462
D. Kakani Farm	535
E. Pakhribas Agri. Centre	758
F. Lumle Agri. Centre	983

Figures 1-10: Stability Analysis :

Each figure represents a regression line showing the relationship of an individual variety mean yield and mean of 10 varieties grown at each site over 6 sites. (Each figure represents one variety.)

Figure 1

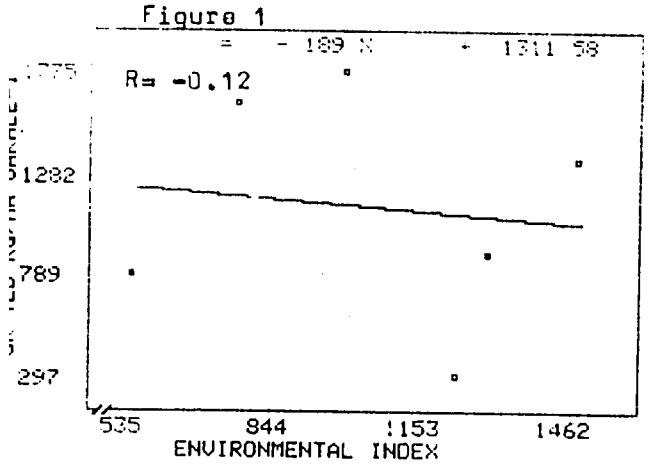


Figure 2

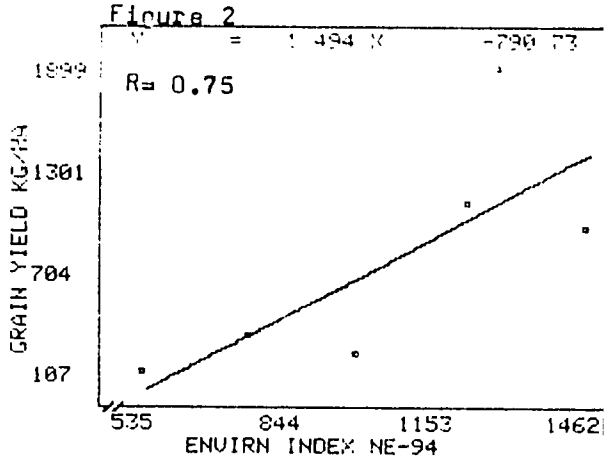
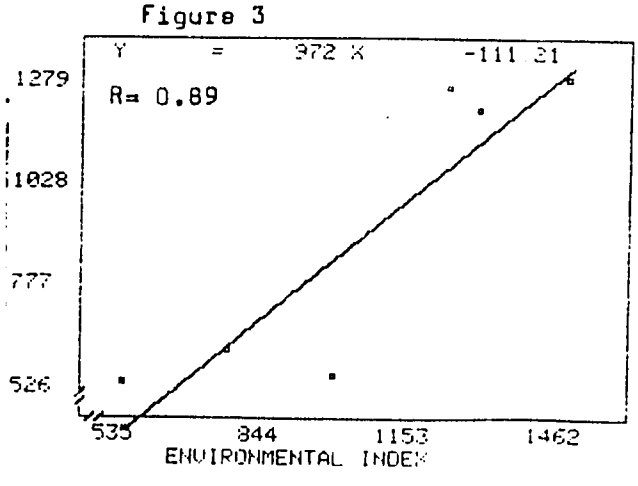


Figure 3



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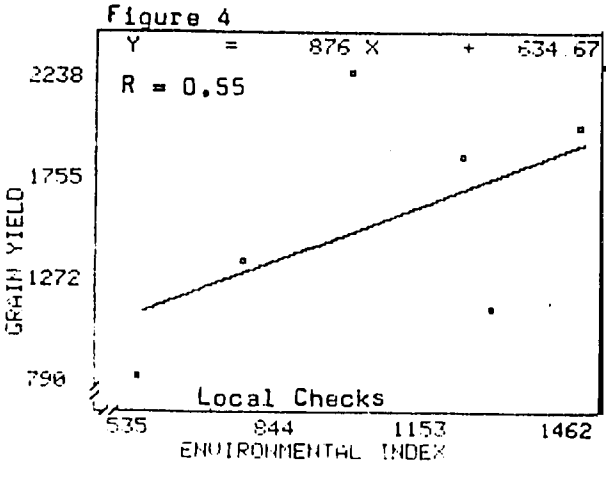

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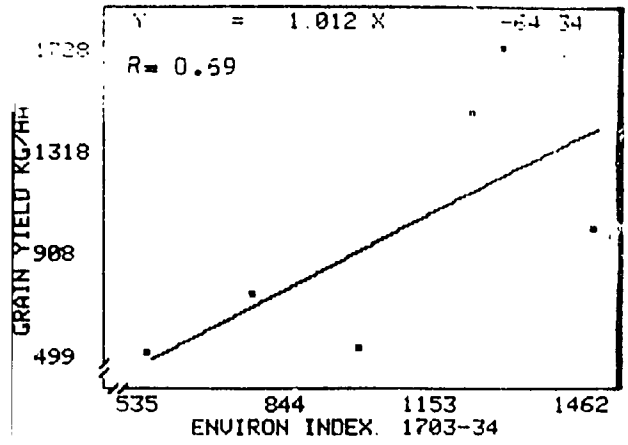
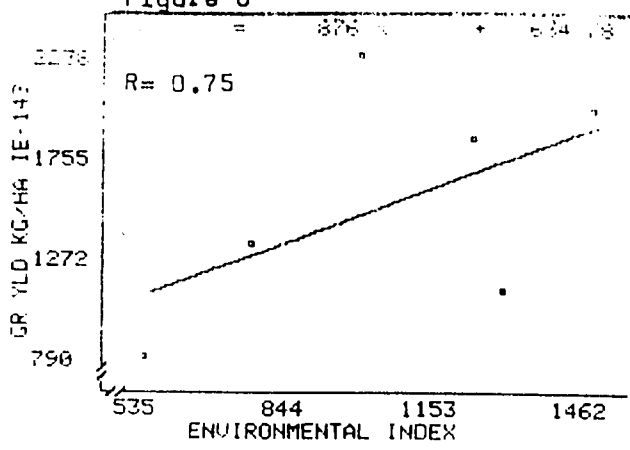


Figure 6



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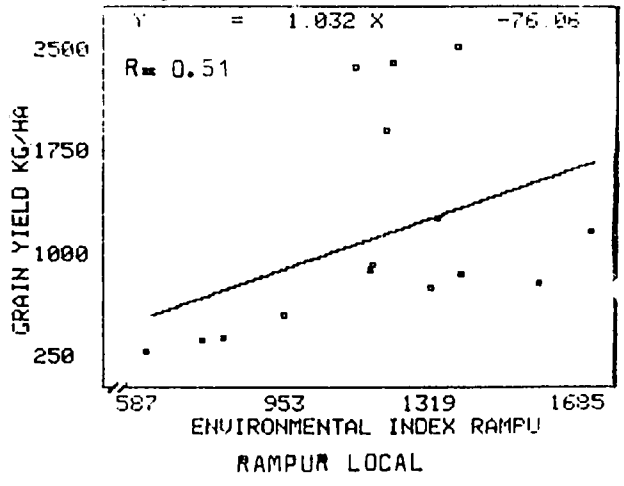

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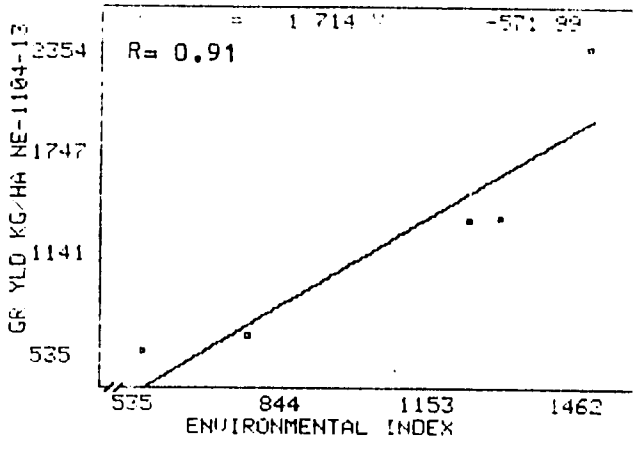

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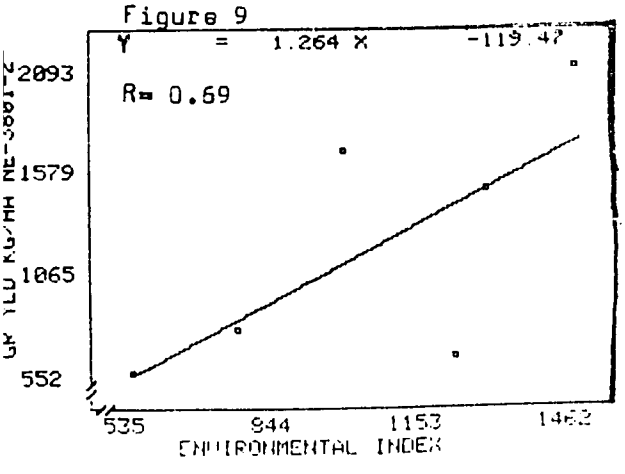

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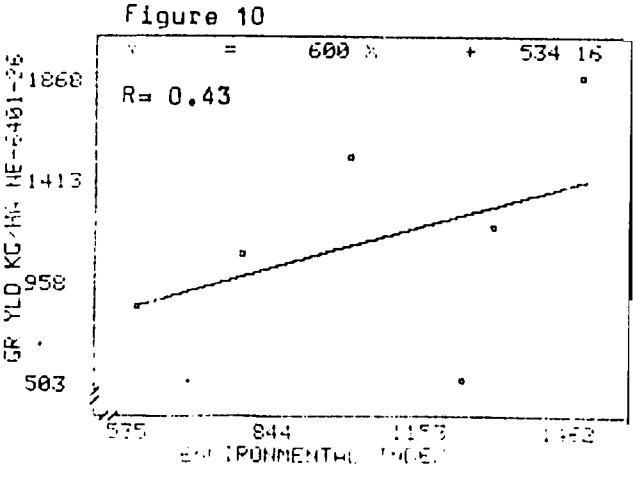

Table No. 3: DUNCAN'S MULTIPLE RANGE TEST (DMRT)

Khumaltar (0.01) P. Level

Variety	Mean Grain Yield (Rounded) Kg/ha									
	NE-94	NE-1703-34	NE-3801-2	NE-1104-13	Dalle-1	NE-6401-26	IE-143	Local Check	Rampur Local	Dakhale-1
Rank	I	II	III	IV	V	VI	VII	VIII	IX	X
Yield	1899	1728	1467	1329	1198	1182	1136	1110	904	880

Any variety under the same line did not differ significantly at the 0.01 level of probability.

****

Table No. 4: DUNCAN'S MULTIPLE RANGE TEST (DMRT)

Khumaltar

Variety	Mean Straw Yield (Rounded) Kg/ha									
	Dalle-1	NE 3801-2	NE 6401-26	NE 1104-13	Rampur Local	Local Check	Dakhale-1	NE-1703-34	NE-94	IE-143
Rank	I	II	III	IV	V	VI	VII	VIII	IX	X
Yield	8730	8589	8282	8044	6427	5606	4054	4018	3723	2778

Any variety under the same line did not differ significantly at the 0.01 level of probability.

Table No. 5 : SUMMARY OF AGRONOMIC CHARACTERISTICS FOR ADVANCED VARIETAL TRIAL , 1984

Location: Khumaltar

Variety	Days to Panicle Emergence	Plant Ht. 95% (CL)x M=20 r= 4 (cm)	Days to 95% Brown Pan.	No. of Tillers/ Plant	No. of Heads/ Plot(CL) N=4 r=4	1000 Grain Weight Grams*	No. of Rachi/ Main Ear (CL) M=40 r= 4	Length of Main Rachis (cm) (CL) M=40 r= 4	Wt. of N=4 r=4 per Head ie. Grams (CL)	Mean Grain Yield kg/ha Rank*	Mean Straw Yield kg/ha Rank+	Harvest Index Rank
01.NE-1703-34	83	66±4.0	118	2.8±0.6	NR	3.77IV	NR xx	NR	NR	1728	4018	0.30 II
02.NE-94	85	55±5.0	134	3.0±0.6	NR	3.32VI	NR	NR	NR	1699	3723	0.33 I
03.IE-143	76	58±5.2	115	3.2±0.5	NR	3.83III	NR	NR	NR	1136	2778	0.29III
04.NE-1104-13	104	83±4.8	156	2.1±0.5	273±61	3.94II	5.5±0.3	6.1±.2	3.7±1.2	1329	8044	0.14 VI
05.Dalle-1	105	84±3.9	155	2.0±0.4	257±64	4.16I	5.9±0.3	7.0±.2	3.9±0.8	1198	8730	0.12 X
06.Local Check	107	75±3.5	153	2.7±0.5	NR	2.78IX	NR	NR	NR	1110	5606	0.17 IV
07.NE-6401-26	113	74±5.7	154	2.8±0.5	277±57	3.21VIII	5.5±0.3	7.6±.3	3.2±0.4	1182	8292	0.13 IX
08.Oakhale-1	117	71±6.1	159	2.7±0.5	220±35	2.80X	5.2±0.2	7.8±.2	3.4±0.7	880	4054	0.18VIII
09.NE-3801-2	116	80±4.8	153	2.8±0.6	423±66	3.67V	5.7±0.3	6.9±.3	2.7±1.0	1467	8589	0.15V
10.Rampur Local	160	128±4.7	203	5.2±0.7	NR	3.27VII	NR	NR	NR	904	6427	0.12VII
CV %										16.33	28.69	27.66
LSD (kg/ha)										410	3507	0.11

Site Grain Mean=1281
Site Straw Mean=6238

* - Rank: II, I, VII, IV, V, VIII, VI, X, III and IX respectively from serial no. 1 to 10

\+ - Rank: VIII, IX, X, IV, I, VI, III, VII, II and V respectively from serial no. 1 to 10

x - 95% confidence limits (CL) are given were appropriate

xx - NR = Not Recorded.

N = Number of Observations
r = Number of repititions

Table No. 6 : A5. DETAILS OF ADVANCED VARIETAL TRIAL AT KHUMALTAR

Trial Number	: 1
Design	: R.B.D.
Plot Size	: 4 X 2 m
	10 rows 4 m long 6.4 m^2 harvested area
Spacing	: 20 X 10 cm
Replications	: 4
Seeding Date	: 29/5/1984
Transplanting Dt.	: 25/6/1984
Seddlings Age	: 28 days
Fertilizer	: 40:40:20 (N, P_2O_5, K_2O)
	20:40:20 Basal
	20: 0: 0 Top-dress
Elevation	: 1145 M.A.S.L.
Harvested Area	: 1.6 m^2
Soil Texture	: Silt Loam
Previous Crop	: Wheat

Table No. 7 : POOLED GRAIN YIELD ANOVA ALL LOCALES

SOURCE	SS	DF	MS	F	P
TRTMTS	3127612.350	7	446801.764	1.942	.091 NS
RE	4236878.690	5	847375.738	3.684	.008
ERROR	8050947.640	35	230027.076		
TOTAL :	15415438.700	47			

Locations/ Varieties	Khumaltar	Rampur	Lumle	Pakhribas	Kabhre	Kakani	Mean Performance Over All Sites
NE-94	1899.00	1098.00	213.00	307.00	952.00	107.00	762.67
NE-1703-34	1728.00	1458.00	513.00	731.00	999.00	499.00	988.00
NE-6401-26	1182.00	503.00	1500.00	1063.00	1868.00	832.00	1158.00
Oakhale-1	880.00	297.00	1775.00	1614.00	1342.00	783.00	1115.17
Dalle-1	1196.00	1256.00	538.00	601.00	1279.00	526.00	899.67
NE-3801-2	1467.00	629.00	1663.00	766.00	2093.00	552.00	1195.00
IE-143	1136.00	1503.00	237.00	193.00	866.00	201.00	689.33
Local Check	1110.00	1833.00	2238.00	1328.00	1974.00	790.00	1545.50
	1325.00	1072.13	1104.63	825.38	1421.63	536.25	
Rampur Local	904.00	2274.00	NR	357.00	899.00	NR	
NE-1104-13	1317.00	1309.00	NR	629.00	2354.00	525.00	

CV = 45.94%

LSD = NS

NR = Not Recorded.

ANOVA Based on 8 varieties

Table No. 7A: POOLED FORAGE YIELD (KG/HA) ANOVA FOR THREE LOCATIONS

ANOVA+ Source	SS	Df	MS	F	P
Treatments	9508966.7	7	13584238.0	2.79	0.05
Reps.	48087000.0	2	24043500.0	4.95	0.05
Error	680633000.0	14	4861664.0		
Total	211240000.0	23			

Locations/	Khumaltar	Kabhre	Lumle	Mean	Rank
NE-94	3723	2200	786	2236	7
NE-1703-34	4018	1917	1106	2347	6
NE-6401-26	6282	6400	1200	5294	4
Oakhale-1	4054	3233	1625	2971	5
Dalle-1	8730	4283	9500	7504	1
NE-3801-2	8589	5883	1456	5309	3
IE-143	2778	1133	750	1554	8
Local Check	5606	9983	1838	5809	2
NE-1104-13	8044	5117	NP*	6581	
NE-1305-55	NP	NP	925	925	
Rampur Local	6427	3917	(Late)	5172	

CV = 53.41%
LSD = 3662 kg/ha.

* - NP = Not Planted

+ - ANOVA based on 8 varieties.

Table No. 8 : DETAILS OF ADVANCED VARIETAL TRIAL AT RAMPUR

Trial Number : 2
Design : R.B.D.
Plot Size : 4 X 2 m 10 rows 4m long 6.4 m^2 harvested area
Spacing : 20 X 10 cm
Replications : 4
Seeding Date : 7/2/1984
Transplanting Date: 8/3/1984
Seedlings Age : 30 days
Fertilizer : 40:40:20 (N, P_2O_5, K_2O)
20:40:20 Basal 3/6/1984
20: 0: 0 Top-dress 1/9/1984
Elevation : 228 m.a.s.l.
Soil Texture : Sandy Loam
Previous Crop : Finger Millet

Varieties Under Study at Rampur

1.	Rampur Local	6.	Dallo-1
2.	Local Check	7.	NE-94
3.	IE-143	8.	NE-3801-2
4.	NE-1703-34	9.	NE-6401-26
5.	NE-1104-13	10.	Oakhalo-1

****

Table No. 9 : ADVANCED VARIETAL TRIAL MONOCULTURE, RAMPUR

Mean Square = 21,692.689
CV % = 12.11
LSD(0.01) P. = 288.59
DMRT Mean grain yield rounded (kg/ha)

Variety	Rampur Local	Local Check	IE-143	NE-1703-34	NE-1104-13	Dallo-1	NE-94	NE-3801-2	NE-6401-26	Okhalo-1
Rank	I	II	III	IV	V	VI	VII	VIII	IX	X
Yield	2274	1633	1503	1458	1309	1256	1098	629	503	297

Any variety under one line indicates they did not differ significantly from each other at (0.01) probability level.

Table No. 13 :

SUMMARY OF AGRONOMIC CHARACTERISTICS OF ADVANCED VARIETAL TRIAL, 1 9 8 4

Location: Rampur

Variety	Days to Panicle Emergence	Days to Anther Exertion	Days to Maturity (Date of Harvest)	No. of Production Tillers/ Plant	Mean No. of Heads Harvested/ Plot (CL) 95% M=4 r=4	Seed Wt./ Head/ Grams	Plant Ht. (cm)	Mean Grain Yield and Rank (kg/ha)
Rampur Local	108	116	165	2	464±26	7.0	128	2274 I
Local Check (NE-3)	67	73	109	1	310±31	4.0	85	1833 II
IE-143	64	70	109	1	284±37	6.0	83	1503 III
NE-1703-34	67	73	109	1	216±94	5.0	88	1458 IV
NE-1104-13	65	93	142	1	259±57	5.5	119	1309 V
Dalle-1	84	93	142	1	250±31	8.5	117	1256 VI
NE-94	82	89	129	1	172±24	6.5	106	1098 VII
NE-3801-2	86	93	122	1	222±30	5.3	82	629 VIII
NE-6401-26	89	94	129	1	205±21	6.3	94	503 IX
Oakhale-1	82	98	129	1	131±20	4.5	86	297 X

C.V. % = 12.11

LSD (0.01) P 289 kg/ha

No straw yield was taken due to lack of appropriate balance.

Site Grain Mean= 1216

Lodging was observed in Rampur Local, 3 on a scale 0 - 5.

Table No.11: DETAILS OF ADVANCED VARIETAL TRIAL AT KABHRE

Trial Number	: 3
Design	: R.C.B.D.
Plot Size	: 4 X 2m 10 row 4m long 6.4 m^2 net harvested
Spacing	: 20 X 10 cm
Replications	: 3
Seeding Date	: 12/6/1984
Transplanted Date	: 17/7/1984
Seedlings Age	: 35 days
Fertilizer	: 40:20:0 (N, P_2O_5 and K_2O)
	20:20:0 Basal 17/7/1984
	20: 0:0 Top-dress 1/11/1984
Elevation	: 1700 m.a.s.l. south facing
Soil Texture	: Medium
Previous Crop	: Maize
Fertilizer to Previous Crop	: 80:40:0

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Table No.12: ADVANCED VARIETAL TRIAL MONOCULTURE AT KABHRE

CV = 37.53%
LSD = 941.30 (0.05) P kg/ha (S)
DMRT= (0.05) P mean grain yield (kg/ha) (rounded)

Variety	NE-1104-13	NE-3801-2	Local Check	NE-6401-26	Oakhale-1	Dalle-1	NE-1703-34	NE-94	Rampur Local	IE-143
Rank	I	II	III	IV	V	VI	VII	VIII	IX	X
Yield	2355	2093	1974	1868	1342	1279	999	952	899	866

Any variety under one line indicates they did not differ significantly from each other at the (0.05) P level by DMRT.

****

Table No. 13: ADVANCED VARIETAL TRIAL, 1984 (MONOCULTURE)
Location : Kabhre Farm
CV = 57.72%
LSD = 6445 kg/ha (Mean Yield Rounded) kg/ha

Variety	Local Check	NE-6401-26	NE-3801-2	NE-1104-13	Dallo-1	Rampur Local	Oakh-ale-1	NE-94	NE-1703-34	IE-143
Rank	I	II	III	IX	V	VI	VII	VIII	IX	X
Yield	9983	6400	5883	5117	4283	3917	3233	2200	1917	1133

Any variety under one line indicates they did not differ significantly at the 0.01 level of probability by LSD.

Table No.14: SUMMARY OF AGRONOMIC CHARACTERISTICS FOR ADVANCED VARIETAL TRIAL, 1984

Location: Kabhre Farm

Variety	Mean Days to Pan. Emergence	Mean Days to 75% Brown Pan.	No. of Prod./ Tillers/ Plant Mean	Mean No. of Heads Harvested Plot	Mean Seed Wt./ Pan. (g)	Shattering Behaviour 0-5	Mean Plant Pop./ ha X 1000	Mean Plant Ht. (cm)	Mean Straw Yield and Rank (kg/ha)	Mean Grain Yield and Rank (kg/ha)	Mean Harvest Index
01.NE-1104-13	95	153	1.5	373±97	3.8	2	431	76	5117IV	2355I	.32
02.NE-3801-2	98	158	2.1	399±71	4.1	3	391	63	5883III	2093II	.26
03.Local Chk	99	153	1.4	356±195	3.6	1	319	68	9983I	1974III	.16
04.NE-6401-26	96	153	1.9	356±179	1.6	1	359	54	6400II	6400IV	.22
05.Dakhale-1	98	155	1.6	395±147	2.9	1	350	47	3233VII	1342V	.29
06.Dalle-1	97	159	1.3	259±198	2.9	1	372	57	4283 V	1279VI	.23
07.NE1703-34	91	133	2.1	340±75	1.5	3	331	46	1917IX	999VII	.34
08.NE94	84	132	2.7	436±40	1.7	1	391	44	2200VIII	952VIII	.30
09.Rampur L.	129	196	3.0	524±308	1.4	2	402	55	3917VI	899IX	.19
10.IE-143	86	132	2.6	427±125	1.2	1	388	48	1133X	866X	.43
						$\bar{X}$ =	377;	CV % =	52.72	37.53	
								LSD =	6445kg/ha	941 kg/ha	

Site Grain Mean=1462 kg/ha

Site Straw Mean=4752 kg/ha

No lodging was observed in any of the varieties.

Table No. 15 : FINGERMILLET ADVANCED VARIETAL TRIAL, 1984

Location: Kakani

Trial No. : 4
Design : R.C.B.D.
Replication : 4
Plor Size : 6 m^2 (10 rows 20 cm apart 3 m long)
Net harvested area - 4.8 m^2
Treatments : 10
Fertilizer : 40:40:20 N, P_2O_5, K_2O
20:40:20 Basal application
20: 0: 0 Top-dressing
Seeding Date : May 10, 1984 (2041/1/28)
Seedling Age : 38 days
Transplanting Date : July 6, 1984 (2041/3/23)

Sl. No.	Treatments	Grain Yield kg/ha	Days to Panicle Emergence	Days to Maturity	Plant Ht. cm.	Disease (Septaria leaf spot) 0-5
01.	NE94	107IX	92	175	40	3
02.	NE-3801-2	552IV	95	184	48	3.7
03.	NE-1703-34	499VII	89	175	33	3
04.	IE143	201VIII	99	175	43	3
05.	NE-1104-13	525VI	94	173	41	4
06.	Oakhale 1	783III	89	184	25	3.2
07.	Local Check	790II	93	187	32	3.7
08.	Rampur Local	-	120	-	35 ??	4.2
09.	Dalle-1	526V	95	187	36	2.5
10.	NE-6401-26	832I	98	184	37	3.5

Site Grain Mean X 535
ANOVA

F = 1.6 (NS)
CV= 73%

Table No. 16: ADVANCED VARIETAL TRIAL RELAYED WITH MAIZE

Location : Pakhribas Agri. Center (PAC)

LSD = 246.67
CV = 16.59%
DMRT = AVT PAC Mean Grain Yield (Rounded kg/ha)

Variety	Oakh-ale-1	PAC Hill	NE-6401-26	NE-3801-2	NE-1703-34	NE-1104-13	Dalle-1	Rampur Local	NE-94	IE-143
Rank	I	II	III	IV	V	VI	VII	VIII	IX	X
Mean Yield	1614	1328	1063	766	731	629	601	357	307	193

Any variety under one line indicates they did not differ significantly at the (0.01) p. level.

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Table No. 17: ADVANCED VARIETAL TRIAL

Location : Pakhribas Agri. Center (PAC)

Maize Grain Yield (kg/ha) Variety: Arun-2, Maize Yield alone in association with different varieties of finger millet.

LSD = NA
CV = 21.21%
DMRT = NA
Variety interaction was not observed

Variety	PAC Hill	NE-94	Oakh-ale-1	NE-1703-34	Rampur Local	Dalle-1	NE-3801-2	NE-1104-13	NE-6401-26	IE-143
Rank	1	II	III	IV	V	VI	VII	VIII	IX	X
Yield	2980	2872	2801	2695	2643	2578	2467	2388	2297	2066

****

Table No. 18: ADVANCED VARIETAL TRIAL, 1984
COMBINED MAIZE AND FINGERMILLET GRAIN YIELD (KG/HA)

Maize Variety: Arun-2

Location : Pakhribas Agri. Center (PAC)

CV = 17.42%
LSD = (0.01) p. = 1137.44 (kg/ha)
DMRT =

Variety	Oakh-ale-1	PAC Hill	NE-1703-34	NE-6401-26	NE-3801-2	NE-94	Dalle-1	NE-1104-13	Rampur Local	IE-143
Rank	I	II	III	IV	V	VI	VII	VIII	IX	X
Yield	4415	4309	3426	3361	3233	3179	3129	3017	3000	2259

Table No. 18: SUMMARY OF AGRONOMIC CHARACTERISTICS FOR THE ADVANCED VARIETAL TRIAL 1984

Location: Pakhribas Agricultural Centre (PAC)

Variety	Days to Panicle Emergence	Days to 95% Brown Pan.	Plant Ht. Cm.	Shattering Low, Mid, High	Lodging 0 - 5	Maize Yield kg/ha and Rank	Finger Millet and Maize kg/ha and Rank	Finger Millet Alone Yield kg/ha and Rank
Oakhale-1	128	195	80	L	4	2801 III	4415 I	1614 I
PAC Hill	140	202	83	L	4	2980 I	4268 II	1328 II
NE-6401-26	124	190	77	L	4	2297 IX	3560 IV	1063 III
NE-3801-2	127	194	66	L	4	2467 VII	3233 V	766 IV
NE-1703-34	99	161	57	L	4	2695 IV	3426 III	731 V
NE-1104-13	109	169	56	L	4	2388 VIII	3017 VIII	629 VI
Dalle-1	102	178	68	L	4	2578 VI	3129 VII	601 VII
Rampur Local	165	NR	68	L	4	2643 V	3000 IX	357 VIII
NE-94	93	156	46	L	4	2872 II	3179 VI	307 IX
IE-143	80	151	48	L	4	2066 X	2259 X	193 X
						NS	HS	HS
					CV =	21.18%	5.51%	16.59%
					LSD =	-	1137kg/ha	247 kg/ha

Site Grain Mean = 758

NR = Not Recorded.

Table No.19 : DETAILS OF ADVANCED VARIETAL TRIAL AT PAC

Trial Number	:	5
Design	:	R.C.B.D.
Plot Size	:	2 X 2 m 10 rows
Spacing	:	20 X 10 cm Maize: 1 X 0.25m two rows/plot
Replications	:	4
Seeding Date	:	10/5/1984
Transplanting Date	:	24/6/1984
Seedlings Age	:	45 days
Fertilizer	:	Maize: 60:30:0 N, P_2O_5, K_2O; FYM: 10 t/ha incorporated before planting maize 30:30:0 Basal 30: 0:0 At Knee-High Stage Millet: None
Elevation	:	1750 m.a.s.l. north face , Terrace name: Dhaulagiri
Soil Treatment	:	BHC dust (5%) @20 kg/ha incorporated
Seeding Date	:	Maize: 24/4/1984 75% silking: 11/7/1984
Days to Silking	:	79
Days to Mat.	:	133
Insecticide Application (General Systemic)	:	21/5/1984 furadan 2-3 grams/plant

****

Table No. 21 : DETAILS OF TRIAL OF ADVANCED VARIETAL TRIAL AT LUMLE

Trial Number	: 6
Design	: R.C.B.D.
Plot Size	: 2 X 1 m
Spacing	: 20 X 10 cm
Replications	: 4
Seeding Date (Nursery)	: 5/5/1984
Transplanting Date	: 26/6/1984
Seedlings Age	: 52 days
Fertilizer	: 40:40:20 - ½ N and all P:K basal ½ N top-dress 6 weeks after transplanting
Elevation	: 1675 m.a.s.l.
Rainfall	: 5143 mm.

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Table No. 22 : ADVANCED VARIETAL TRIAL, LUMLE

CV = 51.47%
LSD = 1,030.91
DMRT (Grain Yield Rounded) kg/ha

Variety	Kalo Bhundeale-1	Oakh-	NE-3801-2	NE-6401-26	Dalle-1	NE-1703-34	IE-143	NE-94	NE-1305-55
Rank	I	II	III	IV	V	VI	VII	VIII	IX
Yield	2238	1775	1663	1500	538	513	237	213	175

Any variety under one line indicates they did not differ significantly at the (0.01) probability level.

****

Table No. 23: AVT STRAW YIELD (KG/HA) X (10)*, LUMLE

CV = 8.74% (HS)
LSD = 204.31 (0.01)
DMRT (Straw Yield X 10 Rounded) kg/ha

Variety	Kalo Bhundeale-1	Oakh-	NE-3801-2	NE-6401-26	NE-1703-34	Dalle-1	NE-1305-55	NE-94	IE-143
Rank	I	II	III	IV	V	VI	VII	VIII	IX
Yield	1838	1625	1456	1200	1106	950	925	786	750

Any variety under one line indicates they did not differ significantly at the (0.01) probability level.

Table No. 24: SUMMARY OF AGRONOMIC CHARACTERISTICS FOR ADVANCED VARIETAL TRIAL, 1984

Location: Lumle

Variety	Days to Panicle Emergence M=4 r=4	Days to Anther Exertion	Days to Maturity	No. Prod. of Tillers/per plant	No. of Rachi/ Main Ear M=4 r=4 (CL)	Plant Ht. cm. M=4 r=4	Straw Yield Mean & Rank	Grain Yield Mean & Rank	Harvest Index and Rank
Kalo Bhunde	125	136	192	3	8±1.3	90±11	18380I	2238I	.11 I
Dakhale-1	133	145	189	2	5±1.0	87± 5	16250II	1775II	.10 III
NE-3801-2	119	131	182	2	5.5±1.0	88± 4	14560III	1663III	.10 III
NE-6401-26	108	115	188	2	6.0±1.8	84±11	12000IV	1500IV	.12 II
Dalle-1	120	136	188	2	5.3±0.8	78±19	9500VI	538V	.05 IV
NE-1703-34	91	105	149	4	5.0±1.3	73± 9	11060V	513VI	.04 V
IE-143	72	82	147	2	4.0±2.3	33± 9	7500IX	237VII	.03 VI
NE-94	100	110	144	3.5	4.3±0.8	52± 4	7860VIII	213VIII	.03 VI
NE-1305-55	100	110	146	3.5	4.8±0.8	59± 5	9250VII	175IX	.02 VII
CV =							14.47%	51.47%	30.63%
LSD=							338 kg/ha	1001kg/h	0.23

(CL)= 95% confidence limit.

Site Grain Mean= 983 kg/ha

Site Straw Mean= 11811 kg/h

Table No. 25: CHARACTERISTICS OF ADVANCED VARIETAL TRIAL BY BY LOCATION 1984

Characteristic
Days to 50% Panicle Emergence

Variety	Khumal-tar	Rampur	LAC	PAC	Kabhre	Kakani
NE-94	85	82	100	93	84	92
NE-1703-34	83	67	91	99	91	89
NE-6401-26	113	86	108	124	96	98
Oakhale-1	117	82	133	128	98	89
Dalle-1	105	84	120	102	97	95
Rampur Local	160	108	NR	165	129	NR
NE-3801-2	116	86	119	127	98	95
IE-143	76	64	72	80	86	99
NE-1104-13	104	85	NP	109	95	94
Local Check	107	67	125	140	99	93
NE-1305-55	-	-	100	-	-	-

N.B.: Local Check differs at each location

NP = Not Planted
NR = Not Recorded

****

Table No. 26: CHARACTERISTICS OF AVT BY LOCATION, 1984

Characteristics:
Mean Days to Maturity:

Variety	Khumaltar	Rampur	LAC	PAC	Kabhre	Kakani
NE-94	134	129	144	156	132	175
NE-1703-34	118	109	149	161	133	175
NE-6401-26	154	129	188	190	153	184
Oakhale-1	159	129	189	195	155	184
Dalle-1	155	142	188	178	159	187
Rampur Local	203	165	NR	NR	196	NR
NE-3801-2	153	122	182	194	158	184
IE-143	115	109	147	151	132	175
NE-1104-13	156	142	NP	169	153	178
Local Check	153	109	192	202	153	187
NE-1305-55	-	-	146	Relay	-	-

N.B.: Local Check differs at each location

NP = Not Planted
NR = Not Recorded

Table No. 27: CHARACTERISTICS OF AVT BY LOCATION, 1984

Characteristics:
Plant Height (cm)

Var./Loc.	Khumaltar	Rampur	LAC	PAC	Kabhre	Kakani
NE-94	55	106	52	46	44	40
NE-1703-34	66	88	73	57	46	33
NE-6401-26	74	94	84	77	54	37
Oakhale-1	71	86	87	80	47	25
Dalle-1	84	117	70	68	57	36
Rampur Local	128	120	88	60	55	39
NE-3801-2	80	82	NR	66	63	48
IE-143	58	83	53	40	40	43
NE-1104-13	83	119	NP	56	76	41
Local Check	75	85	90	83	68	32
NE-1305-55	-	-	59	-	-	-
				Relay		

N.B.: Local Check differs at each location

NP = Not Planted
NR = Not Recorded

****

Table No. 28: CHARACTERISTICS OF AVT BY LOCATION, 1984

Characteristics:
Number of Production Tillers/Plant

Var./Loc.	Khumaltar	Rampur	LAC	PAC	Kabhre	Kakani
NE-94	3.0	2	3.5	NR	2.7	NR
NE-1703-34	2.8	1	4	NR	2.1	NR
NE-6401-26	2.8	1	2	NR	1.9	NR
Oakhale-1	2.7	1	2	NR	1.6	NR
Dalle-1	2.0		2	NR	1.3	NR
Rampur Local	5.2	1	3	NR	3.0	NR
NE-3801-2	2.8	1	2	NR	2.1	NR
IE-143	3.2	1	2	NR	2.6	NR
NE-1104-13	2.1	1	NP	NR	1.5	NR
Local Check	2.7	1	3	NR	1.4	NR
NE-1305-55	-	-	3.5	NR	-	-

N.B.: Local Check differs at each location

NP= Not Planted
NR= Not Recorded.

Table No. 29: DISEASE REPORT FOR DIFFERENT LOCATIONS FOR THE AVT, 1984

Diseases by Location	Khumaltar 0 - 5 Scale			Kakani 0 - 5 Scale	
Variety	Blast	Tip Leaf Blight	Septoria	Septoria	Blast
NE-3001-2	0	2	0	3.7	0
Local Check	1	0	0	3.7	0
Rampur Local	0	1	0	4.2	0
NE-6401-26	0	1	0	3.5	0
NE-94	0	2.5	0	3	0
Dalle-1	1	1	0	2.5	0
NE-1104-13	0	1	0	4	0
NE-1703-34	0	2	0	3	0
Oakhale-1	0	1	0	3.2	0
IE-143	0	2.5	0	3	0

At Kakani, incidence of Septoria was found as the major infection covering 40 % of leaf surface. Leaves nearest to the panicle scored higher than lower leaves. Septoria did not occur at Khumaltar.

X. INITIAL EVALUATION TRIAL (IET)

The objectives of this study were to test 16 experimental lines of diverse Nepali geographic origin at 4 locations in order to isolate the lines which perform the best at each locality. Quantitative and qualitative evaluation of agronomic characteristics of each variety were also observed. The secondary objective were to measure the relative efficiency of the balanced lattice design over the randomized block design (two locations, Khumaltar and Pakhribas).

Varieties Under Study :

01.	NE-1304-1	02.	NE-1002-12	03.	NE-86
04.	NE-109	05.	NE-1001-1	06.	NE-20
07.	NE-52	08.	NE-1305-55	09.	Dalle-Local
10.	NE-6401-21	11.	NE-1305-46	12.	NE-2101-21
13.	NE-1102-12	14.	NE-1704-2	15.	NE-50
16.	Local Check				

Locations :

01.	Rampur	02.	Khumaltar	03.	Pakhri as
04.	Lumle				

XI. IET VARIETAL PERFORMANCE (ALL LOCATIONS)

Discussion :

In tables 30 through 44 mean varietal performance, summary of agronomic characteristics and details of trials are summarized. At Khumaltar, NE-6401-21, NE-1001-1, NE-109 and NE-2101-21 recorded the four highest yields (1220, 1215, 1167 and 1165 kg/ha respectively) but none of the varieties differed significantly (0.05 p.). At Khumaltar, low mean yields may have been due to high age of seedlings and dry conditions of soil at time of transplanting (see table 33). Forage yields differed significantly (0.01 p.) and yields for the top 4 were 13.3, 10.7, 10.7 and 10.4 t/ha respectively (see table 31). At Khumaltar, the gain in efficiency of the balanced lattice design over the R.B.D. was only 5% for grain and 0.5% for forage. The negligible gain may be due to low plot to plot heterogeneity at Khumaltar. At Rampur, mean grain yields differed significantly at the (0.01 p.). NE-1704-2, NE-52, NE-6401-21 and NE-6401-22 recorded the top highest mean yields (1306, 1034, 985 and 963 kg/ha respectively). The experiment was analyzed as C.R.B.D. because only 4 replications were planted (see tables 34 through 36 for summary).

At Lumle, the Local Check variety, Kalo Bhunde, NE-1102-12, NE-2101-21 and NE-1001-1 recorded the highest mean yields (1825, 1738, 1725 and 1463 kg/ha respectively). Both grain and forage yields differed significantly at the (0.01 p.), see tables 37 and 38. The four highest grain yielders

also recorded the four highest forage yields (13.2, 12.9, 12.3 and 11.5 t/ha respectively). At Lumle, anther exertion usually occurred 10 days after 50% panicle emergence whereas at Rampur, it occurred 6 days later. Only 2 reps were planted at Lumle so the trial was analyzed as a R.B.D.

At Pakhribas, the four highest yielders (Oakhale-1, PAC-Hill, NE-1304-1 and NE-1102-12) recorded yields of 3485, 3121, 2726, and 2711 kg/ha respectively. Both grain and forage yields were significant at the (0.01 p.). There was an 87% increase in efficiency over the C.R.B.D. by use of the balanced lattice indicating the design's usefulness especially at this site. There was a high association between grain and forage yields at Pakhribas.

Conclusion :

For the IET, NE-1304-1, NE1102-12, NE1301-1, NE2101-21, and 1002-12 have been advanced to the AVT for hill stations. At Rampur, 1704-2, NE-52, NE-6401-21, NE-6401-22, NE-20, and NE-1305-55 have been advanced to the AVT for 1985.

Table No. 30:

INITIAL EVALUATION TRIAL, KHUMALTAR

Grain Yield Comparisons (kg/ha)
(Adjusted Treatment Means)

Variety	NE-6401-26	NE-1001-1	NE-109	NE-2101-21	NE-1704-2	NE-1305-46	Local Check	NE-20	NE-52	NE-1305-55	NE-1304-1	NE-1102-12	NE-86	NE-1002-12	NE-50	Dalle-Local
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yield	1220	1215	1167	1165	1148	1136	1077	1050	1047	983	970	894	848	812	721	576

NS
CV = 32.04%

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Table No. 31:

INITIAL EVALUATION TRIAL, KHUMALTAR

Straw Yield Comparisons (kg/ha)
(Adjusted Treatment Means)

Variety	NE-2102-21	NE-1304-1	Dalle Local	NE-1001-1	NE-1002-12	NE-1102-12	Local Check	NE-1305-46	NE-1305-55	NE-50	NE-86	NE-6401-21	NE-109	NE-20	NE-52	NE-1704-2
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yield	13250	10749	10722	10401	9129	8715	7700	5658	5245	5065	4081	4563	3362	2835	2709	1696

CV = 30.54 %
HS

Any variety under one line indicates they did not differ significantly at the (0.01) probability by Duncan's Multiple Range Test (DMRT).

Table No. 32:

SUMMARY OF AGRONOMIC CHARACTERISTICS
IET, KHUMALTAR

Variety	Days to 50% Pan. Emergence	Days to Maturity	Plant Population X 1000	1000 Grain Wt. (g)	Adjusted Straw Wt. Yield and Rank	Adjusted Grain Yield and Rank
NE-6401-21	76	150	425	2.55	4563 (12)	1220 (1)
NE-1001-1	98	144	428	3.20	10401 (4)	1215 (2)
NE-109	70	118	450	2.86	3362 (13)	1167 (3)
NE-2101-21	97	145	411	3.62	13250 (1)	1165 (4)
NE-1704-2	66	149	431	2.73	1696 (16)	1148 (5)
NE-1305-46	89	132	420	2.46	5658 (8)	1136 (6)
Local Check	110	168	379	3.39	7700 (7)	1677 (7)
NE-20	67	115	461	3.62	2835 (14)	1050 (8)
NE-52	68	115	408	3.26	2789 (15)	1047 (9)
NE-1305-55	81	132	439	2.62	5245 (9)	983(10)
NE-1304-1	100	160	433	2.73	10479 (2)	970(11)
NE-1102-12	99	147	410	2.32	8715 (6)	894(12)
NE-86	75	125	448	3.32	4831 (11)	848(13)
NE-1002-12	104	157	428	2.36	9129 (5)	812(14)
NE-50	94	128	409	3.12	5065 (10)	721(15)
Dalle Local	101	160	433	3.37	16722 (3)	576(16)
				Significance	HS	NS
				LSD	4330 kg/ha	-
				CV	38.54 %	32.04 %

Table No. 33: DETAILS OF IET AT KHUMALTAR FARM

Trial Number	: 7
Design	: Balanced Lattice (4 X 4)
Plot Size	: 2 X 2 m (net 3.6 m^2)
Spacing	: 20 X 10 cm
Replications	: 5
Seeding Date	: 4/6/1984
Transplanting Date	: 17/7/1984
Seedlings Age	: 44 days
Fertilizer	: 40:40:20 N, P_2O_5, K_2O 20:40:20 Basal 20: 0: Top-dress
Soil Texture	: Silt Loam
Elevation	: 1372 m.a.s.l.
Observations	: No rain for five days after transplanting seedling age 15 days late, water logging in 5th rep.

Table No. 34 : DETAILS OF IET AT RAMPUR MAIZE STATION, CHITWAN

Trial Number : 8
Design : R.C.B.D.
Plot Size : 2 X 2 m; Net Harvested Area: $4m^2$; Spacing : 20 X 10cm 10 rows 2m long
Replications : 4; Seeding Date: July 8, 1984; Transplanting Date: August 9, 1984
Seedling Age : 32 days; Fertilizer: 40:40:20 N, P2O5, K2O
20:40:20 Basal, August 9
20: 0: 0 Top-dress, August 30.
Previous Crop : Finger Millet; Soil Texture: Sandy Loam; Elevation: 228 m.a.s.l.

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Table No 35: DUNCAN'S MULTIPLE RANGE TEST (DMRT) - IET 1984, RAMPUR (GRAIN YIELD, KG/HA)

Variety	NE-1704-2	NE-52	NE-6401-21	NE-6401-22	NE-20	NE-1305-46	NE-56	NE-1001-1	NE-109	NE-50	NE-1305-55	NE-86	NE-3 Local Check	NE-1002-12	NE-1304-1	NE-2101-21
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yield	1306	1034	985	963	961	945	915	915	905	903	788	726	725	701	485	389

Any variety under one line indicates they did not differ significantly at the (0.01) probability by Duncan's Multiple Range Test (DMRT).

Table No. 36: SUMMARY OF AGRONOMIC CHARACTERISTICS FOR IET 1984

Location: Rampur

Variety	Days to 50% Panicle Emergence	50% Anther Exertion	Plant Ht. at Mat.(cm)	No. of Prod. Tillers/Plant Mean	Seed Wt. Pan. Mean Grams	## of Heads Harvested/ Plot (CL)	Grain Yield Mean and Rank
NE-1704-2	68	74.5	76	2	4.5	+ 199±34	1306 (1)
NE-52	60	67	75	2	4.5	+ 180±42	1034 (2)
NE-6401-21	64	71	91	2	5.3	+ 210±45	985 (3)
NE-6401-22	68	75	76	1	6.0	+ 170±11	963 (4)
NE-20	58	63	74	2	4.8	+ 194±35	961 (5)
NE-1305-46	74	80	87	1	6.0	+ 191±29	945 (6)
NE-56	68	74	76	1	4.3	- 154±40	915 (7)
NE-1001-1	96	102	99	2	5.8	+ 174±30	915 (7)
NE-109	67	74	74	2	5.3	+ 169±27	905 (8)
NE-50	74	81	76	2	5.3	+ 175±42	903 (9)
NE-1305-55	72	78	83	1	6.0	- 154±11	788 (10)
NE-86	74	81	76	1	4.5	- 154±49	726 (11)
Local Check (NE-3)	64	71	72	1	4.0	- 147±36	725 (12)
NE-1002-12	84	91	86	1	6.0	- 166±73	701 (13)
NE-1304-1	94	102	83	1	7.0	- 119±10	485 (14)
NE-2101-21	98	105	83	1	5.0	- 127±32	389 (15)

$\bar{X}$=160±13; Significance HS

CV = 25.76 %

LSD= 400 kg/ha

Table No. 37 : INITIAL EVALUATION TRIAL AND VARIETAL COMPARISONS, LUMLE

Grain Yield (kg/ha)

Variety	Kalo Bhu-nde	NE-1102-12	NE-2101-21	NE-1001-1	NE-1304-1	NE-1002-12	NE-50	NE-1305-46	Dalle Local	NE-109	NE-20	NE-6401-26	NE-6401 21	NE-86	NE-52	NE-1704-2
Rank	1	2	3	4	5	6	7	8	9	10	10	11	12	13	14	15
Yield Mean/kg/h	1825	1730	1725	1463	1425	1330	1230	1075	1000	975	975	830	750	730	575	350

Varieties under one line indicates they did not differ significantly at the (0.01) probability level by L.S.D.

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Table No. 38 : INITIAL EVALUATION TRIAL AND VARIETAL EVALUATION, LUMLE AGRI. CENTRE

STRAW YIELD COMPARISONS

Variety	NE-2101-21	Kalo Bhu-nde	NE-1102-12	NE-1001-1	NE-1002-12	NE-1304-1	Dalle Local	NE-50	NE-6401-21	NE-1305-46	NE-109	NE-86	NE-20	NE-6401-26	NE-52	NE-1704 2
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yield kg/ha Mean	13250	12875	12315	11500	10875	10630	10000	8475	7590	6525	6440	5595	5315	4500	4340	2315

Any variety under one line indicates they did not differ significantly at the 0.01 probability level by L.S.D.

Table No. 39: SUMMARY OF IET AGRONOMIC CHARACTERISTICS AT LUMLE

Variety	Days to Pan. Emer.	Days to Anther Exert.	Days to Matu-rity	Plant Stand/ Plot	Shatt-ering %	Lod-ging %	Brown Rust 0-9	Plant Height (cm)	Mean Straw Yield(kg/ha) and Rank	Mean Grain Yield kg/ha and Rank
Kalo Bhunde	130	140	185	197	2	8	4	72	12875 (2)	1825 (1)
NE-1102-12	130	140	184	198	2	6	5	81	12315 (3)	1738 (2)
NE-2101-21	122	132	170	196	3	7	2	82	13250 (1)	1725 (3)
NE-1001-1	120	130	185	183	3	6	4	72	11500 (4)	1463 (4)
NE-1304-1	134	144	185	200	1	7	4	74	10630 (6)	1425 (5)
NE-1002-12	129	139	185	198	2	6	5	81	10875 (5)	1338 (6)
NE-50	100	109	149	138	3	5	6	59	8475 (9)	1238 (7)
NE-1305-46	100	110	147	136	2	5	7	57	6525 (10)	1075 (8)
Dalle Local	140	150	194	198	1	7	5	75	10000 (7)	1000 (9)
NE-109	90	100	146	193	2	5	4	75	6440 (11)	975 (10)
NE-20	94	104	140	179	2	5	4	48	5315 (13)	975 (10)
NE-6401-26	92	102	149	191	2	5	5	60	4500 (14)	838 (11)
NE-6401-21	96	104	150	193	3	4	5	54	7590 (9)	750 (12)
NE-86	99	109	152	154	2	5	5	57	5595 (12)	738 (13)
NE-52	76	91	140	157	2	5	6	45	4340 (15)	575 (14)
NE-1704-2	81	91	136	149	3	4	4	33	2315 (16)	350 (15)
							Significance		HS	HS
							CV =		26.10%	21.63%
							LSD =		6371 kg/ha	718 kg/ha

Pan. = Panicle
Emer. = Emergence
Exert.= Exertion

Table No. 40: DETAILS OF IET AT LUMLE

Trial Number	: 9
Design	: R.C.B.D.
Plot Size	: 2 X 2m
Spacing	: 20 X 10cm
Replications	: 2
Seeding Date	: 5/5/1984
Transplanting Date	: 27/6/1984
Seedlings Age	: 58 days
Fertilizer	: 40:40:20 $N:P_2O_5:K_2O$
	20:40:20 Basal
	20: 0: 0 Top-dress
Manure*	: 10 t/ha, 26/6/1984
Previous Crop	: Lentil
Land Type	: Upland, Medium Production Potential
Elevation	: 1465m to 1830m.a.s.l.
	south facing slope.

Table No. 41:

INITIAL VARIETY TRIAL, PAKHRIBAS AGRI. CENTRE
Duncan's Multiple Range Test
By Balanced Lattice Analysis

(Grain Yield (kg/ha)

Variety	Oakh-ale-1	PAC Hill	NE-1304-1	NE-1102-12	NE-1001-1	NE-1002-12	NE-1305-46	NE-1305-55	NE-6401-26	NE-2101-21	NE-20	NE-109	NE-50	NE-52	NE-1704-2	NE-86
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yield kg/ha	3405	3121	2726	2711	2594	2535	2481	2473	2395	2331	2282	2240	2167	2067	1967	1790

Any variety under one line indicates that they did not differ significantly at the (0.01) probability level by the Duncan's Multiple Range Test (DMRT).

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Table No. 42:

INITIAL EVALUATION TRIAL, PAKHRIBAS AGRI. CENTRE
Duncan's Multipke Range Test (Unadjusted) Grain Yield (kg/h)
By C.R.B.D. Analysis

Variety	Oakh-ale-1	Loc. Ck. PAC Hill	NE-1001-1	NE-1304-1	NE-1305-46	NE-1102-12	NE-1002-12	NE-1305-55	NE-6401-21	NE-2101-21	NE-109	NE-20	NE-50	NE-1704-2	NE-52	NE-86
Rank	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Yield kg/ha	3297	2972	2776	2746	2700	2609	2599	2593	2571	2446	2295	2121	1961	1920	1843	1836

Any variety under one line indicates that they did not differ significantly from each other at the (0.01) probability level by Duncan's Multiple Range Test (DMRT).

Table No. 43: SUMMARY OF AGRONOMIC CHARACTERISTICS FOR IET, 1984 (PAC)

Variety/ Characte-ristics	Days to Panicle Emergence	Days to 95% Maturity	Shatt-ering %	Lodging Scale 1 - 5	Rat Dama-ge %	Plant Ht. (cm)	Straw Yield and Rank (Mean) kg/ha	Grain Yield and Rank (Adj.) Mean (kg / ha)
Oakhale-1	113	175	4	3	4	107	26533 (3)	3485 (1)
PAC Hill	125	179	1	2	2	111	23053 (5)	3121 (2)
NE-1304-1	114	175	2	2	2	105	28873 (2)	2726 (3)
NE-1102-12	110	174	2	2	1	101	18207 (7)	2711 (4)
NE-1001-1	113	171	3	2	2	115	20533 (6)	2594 .(5)
NE-1001-12	105	173	3	4	2	116	31367 (1)	2535 (6)
NE-1305-46	86	128	3	4	3	97	17200 (11)	2481 (7)
NE-1305-55	84	137	2	3	3	84	18160 (8)	2473 (8)
NE-6401-21	86	146	7	3	1	91	17707 (9)	2395 (9)
NE-2101-21	105	171	5	4	4	114	24707 (4)	2331 (10)
NE-20	84	139	13	2	5	73	16460 (13)	2282 (11)
NE-109	84	131	7	2	3	79	16773 (12)	2250 (12)
NE-50	105	157	3	3	5	88	17533 (10)	2167 (13)
NE-52	81	128	2	2	3	77	14533 (14)	2067 (14)
NE-1704-2	85	134	3	3	2	71	13573 (16)	1867 (15)
NE-86	88	139	4	4	3	83	14220 (15)	1790 (16)
				Significance			HS	HS
				CV =			25.13%	16.13%
				LSD =			8920kg/ha	665kg/ha

Table No. 44: DETAILS OF IET AT PAKHRIBAS (PAC)

Trial Number	: 10
Design	: Balanced Lattice (4 X 4)
Plot Size	: 1.5 X 2m
Net Harvested Area	: 3 M^2
Spacing	: Local Method 100 seedlings/m^2 1,000,000 plants/ha
Replications	: 5
Seeding Date	: 16/5/1984
Transplanting Date	: 21/6/1984
Seedlings Age	: 36 days
Fertilizer	: 10 t/ha FYM
Fertilizer to Previous	: 60:30:0 N: P_2O_5:K_2O (kg/ha)
Elevation	: 1350 m.a.s.l. south farm
Soil Treatment	: BHC dust 5% @ 20 kg/ha incorporated
Conditions of Soil at Planting	: Wet
Land Type	: Upland Medium Production Potential High population gave high yields.

XII. ADVANCED VARIETAL TRIAL (RELAY)

Objectives :

The objectives of this experiment were to test 4 varieties of finger millet that have performed well in the past by relaying them into the canopies of two maize varieties in order to, not only isolate the varieties that perform the best under these conditions, but also to test finger millet X cropping systems interactions. In addition the purpose of these experiments was to identify yield components of finger millet which were consistently related to both seed and forage yields over the 4 varieties and two environments. Khumaltar and Lumle were the two environments.

Varieties Under Study :

Maize : Arun-2 and Local, Khumaltar
Arun-2 and Kakani Yellow, Lumle

Finger Millet :

Site 1: Khumaltar	Site 2: Lumle
1. Oakhale-1	1. Oakhale-1
2. NE-6401-26	2. NE-1104-13
3. IE-143	3. IE-143
4. Local	4. Local

XIII. AVT (RELAY), KHUMALTAR

Discussion :

Results and details of trials of the AVT (R) conducted at Khumaltar are presented in tables 45 and 46. Analysis of variance split-plot (5,14) were performed on 12 agronomic traits (each trait was sampled from each treatment and repetition and analyzed). In the main-plot analysis only the length of main rachis/panicle differed significantly at 0.05 p. Under the Arun-2 canopy, the length of the main rachis was slightly reduced. In the sub-plot (finger millet varieties) analysis more traits differed significantly: 1) number of rachi/panicle, 2) number of productive tillers/plant, 3) number of inflorescence harvested/plot, and 4) harvest index. All traits except harvest index were reduced in magnitude under Arun-2's canopy. Maize X finger millet interaction was significant probably due to IE-143's poor competitive ability and earliness. There was high C.V. for grain yield and varieties did not differ significantly at the (0.05 p.).

XIV. AVT RELAY, LUMLE

Results for the AVT relay conducted at Lumle are presented in tables 47 and 48. Analysis of variance, split-plot, (5, 14) were performed on 8 plant traits for Lumle. In the main-plot, maize varieties, (Kakani Yellow and Arun-2) forage yield and plant height were significant (0.01 p. and 0.05 p. respectively). Both of these traits were reduced

under Kakani Yellow. The reduction of those traits under Kakani Yellow canopy may due to its leafy characteristics, taller plant height and later maturity. In addition, at the time of panicle initiation of finger millet the growth of Arun-2 is declining while Kakani Yellow's is still vigorous.

In the sub-plot (finger millet varieties), all characteristics differed significantly. Under both Kakani Yellow and Arun-2, Bhuka Local and Dakhale-1 recorded the highest mean yields. These varieties also recorded the highest mean number of productive tillers/plant, mean number of rachi/panicle, mean number of inflorescences harvested/plot, mean forage yield and mean harvest index. Maize X finger millet (observed plant populations) interaction was significant (0.05) p. There was an overall non-significant higher plant population of finger millet under Arun-2, however, the interaction came from IE-143's low mean plant stand under Arun-2.

XV. COMPONENTS OF YIELD AVT RELAY, KHUMALTAR

Discussion :

Correlation coefficients (10) were obtained between 8 morphological traits and seed yield and also forage yield. Results are summarized in table 49 for grain and table 52 for forage. Multiple correlation among these attributes were obtained and the best fitting regression models and other models are summarized in table 50 for grain and table 52 for forage. The one attribute most strongly correlated with seed yield at Khumaltar was number of inflorescences harvested/plot (HH). Mean weight of ten inflorescences (XW) was also strongly correlated with seed yield. All plant attributes accounted for 95% of the variability. When plant population was included 97% of the variability in seed yield was accounted for. Harvest index was strongly correlated with seed yield, but this can be expected since seed yield is a component of harvest index (HI). It is also not surprising that forage yield and harvest index accounted for 93% of the variability in seed yield. The number of productive tillers/plant had the lowest correlation with seed yield. This may be due to the unexplainable increase in number productive tillers/plant under relay conditions (in relation to monoculture conditions), without necessarily an increase in the seed yield (see plant population trial, page 61 and tables 55-60). The increase in productive tillers/plant under relay conditions was only observed at Khumaltar.

Intercorrelations (10) among the traits were obtained as well. While few consistent results were found, there were slightly negative correlations found between length of main rachis and number of productive tillers/plant, and mean weight of ten inflorescences. Mean weight of ten inflorescences was positively correlated with all other traits except for

length of main rachis and productive tillers/plant, (r's ranged from 0.59 for seed yield, 0.47 for number of spikes/ panicles to 0.06 and -0.28 for length of main rachis and number of productive tillers/plant respectively in relation to length for main rachis).

Components of Forage Yield, Khumaltar :

Tables 52 and 53 summarize regression coefficients and best fitting regression (10) models (including and excluding harvest index since forage yield is a component of harvest index). The one attribute most strongly correlated with forage yield at Khumaltar was seed yield followed by plant height, and mean weight of ten inflorescences. Harvest index was negatively correlated with forage yield. All attributes accounted for 93% of the variability and when plant population was included this rose to 96%. Much of the remaining unexplained variability was probably due to the uneven sundrying of the forage. It is fortunate that forage yield is closely correlated with seed yield for forage yield is a very important component of livestock feed in the hills of Nepal.

XVI. COMPONENTS OF GRAIN YIELD AVT (RELAY), LUMLE

Discussion :

Correlation coefficients (10) were obtained between 8 morphological traits and seed and forage yield. Results are summarized in table 49 for grain and table 52 for forage. Multiple correlations (10) among these attributes were obtained and the best fitting models and other models are summarized in table 51 and table 54 for grain and forage respectively. The one attribute most strongly correlated with seed yield at Lumle was harvest index (HI) followed by number of rachi/ inflorescence (only rounded numbers with no s.d. were available for analysis for this trait (sp.). Number of productive tillers/plant and number of inflorescences harvested/ plot almost equally correlated with seed yield (r= 0.52 and 0.48 respectively). All plant attributes accounted for 93% of the variability in seed yield (see table 51). When plant population was included in the model this rose to 96% of the variability. The best fitting (4 variable) model excluding harvest index was straw yield, number of productive tillers/ plant, inflorescences harvested and plant height. Harvest index, number of rachi/inflorescence and forage yield taken together in a three variable regression model were shown to account for most of the variability in seed yield at Lumle (R-Square= 0.894).

Components of Forage Yield, Lumle :

Tables 52 and 54 summari e correlation coefficients and best fitting regression models including and excluding harvest index. The one attribute most strongly correlated with forage

yield at Lumle was seed yield followed by number of rachi/ inflorescence. Plant height was found to only slightly correlate (R= 0.35) with forage yield. Harvest index, plant height and seed yield taken together in a three variable regression model were shown to account for 89% of the variability in forage yield. All attributes taken together accounted for 93% of the variability in forage yield. When plant population was taken into account this rose to 95% of the variability. In both locations, forage was sundried and grain mositure content was approximately 11%.

Comparison of Seed Yield Components for Lumle and Khumaltar :

Harvest index, forage yield, and number of inflorescences harvested/plot were the most common yield components common to both locations. Mean weight of ten inflorescence and length of main rachis/inflorescence data was not available from Lumle so a more thorough comparison can not be done. There was high variation in seed yield in both locations and there was probably undetected interaction between maize and finger millet which may have induced low overall correlations. Also, Lumle and Khumaltar vary widely in temperature and rainfall patterns (1, 15). Since yield components are sensitive to relay or monoculture condition, the components of yield should be tested under more uniform conditions and more representative environments where finger millet is grown. This is being planned for the 1985 cropping season (17).

Table No. 45 :

SUMMARY OF AGRONOMIC CHARACTERISTICS AVT RELAY, KHUMALTAR (MEANS)

Variety	P.P.X 1000 Finger Millet	P.P. X 1000 Maize	No.of Spikes/ Panicle	No.of P.T.* Per Plant	Wt.of 10 Heads Plant (g)	Length of Main Finger/Pan. (cm)	No.of Heads Harvested/ Plot	Plant Height (cm)	Maize Grain Yield (kg/ha)	F.M.** Straw Yield (kg/ha)	Harvest Index (HI)	F.M.** Grain Yield (kg/ha)
A.Main Plot												
Local Maize												
Sub-Plots												
1. Oakhale-1	665	34	4.30	2.25	2.30	6.75	314	56	2002	2415-	0.16	483
2. NE6401-26	765	40	4.65	2.75	2.63	6.65	330	53	1806	1615	0.26	596
3. IE-143	725	36	4.15	2.25	1.80	6.88	190	58	1576	1807	0.18	437
4. Local Check	750	46	4.13	3.15	1.95	6.55	293	53	2151	1402	0.26	479
B.Main Plot												
Arun-2												
Sub-Plots												
1. Oakhale-1	702	42	4.30	2.38	2.28	6.55	293	54	1687	1899	0.25	613
2. NE6401-26	765	43	4.63	2.73	2.88	6.58	299	56	2089	1322	0.26	638
3. IE-143	710	38	4.15	2.35	2.05	6.40	176	58	2972	2642	0.14	433
4. Local Check	495	42	4.15	3.25	2.40	6.38	312	53	2572	1659	0.22	504
GRAND MEAN	718	40.13	4.32	2.575	2.25	6.59	276	53.09	2108	1908	0.22	523
CV% Main Plot (a)	10.10	12.67	3.56	18.73	38.16	4.56	80.32	20.15	10.47	24.72	40.87	87.41
Sub-Plot (b)	15.65	18.44	8.45	20.13	23.20	3.33	24.31	31.60	22.08	23.10	22.63	42.13
LSD Main P. (a)	NS	NS	NS	NS	NS	0.676	NS	NS	NS	NS	NS	NS
Sub-Plot (b)	NS	NS	0.54	1.05	NS	NS	132	NS	NS	NS	0.10	NS
Interaction M-S (a X b)	NS	NS	NS	NS	NS	NS	NS	NS	691	NS	NS	NS
Probability (a)	-	-	-	-	-	0.05	-	-	-	-	-	-
(b)	-	-	0.05	0.01	-	-	0.01	-	-	-	0.01	-
Interaction (axb)	-	-	-	-	-	-	-	-	0.01	-	-	-

* - P.T. = Productive Tillers

** - F.M. = Finger Millet

a X b = Maize var. X F.M. var.

HS = Highly Significant (0.01) p.; S = Significant (0.05) p.

NS = Not Significant.

Table No. 46 : DETAILS OF ADVANCED VARIETAL TRIAL RELAY, KHUMALTAR

Trial Number	: 11
Design	: Split Plot
Plot Size	: Maize - 9 X 2.5m; Finger Millet - 2 X 2.5m
Spacing	: Maize - 1 X 0.20m; Finger Millet - 10 X 10cm
Replications	: 4
Seeding Dates	: Maize - 24/5/1984 Finger Millet - 2/7/1984
Transplanting Date	: 3/8/1984
Fertilizer	: Maize - 60:30:0 (N, P_2O_5 and K_2O, kg/ha) F.M. - 20: 0:0 Maize - 30:30:0 Basal; Finger Millet - None Maize - 30: 0:0 top-dress; Finger Millet - 20:0:0
Previous Crop	: Wheat
Elevation	: 1145 m.a.s.l.
Soil Texture	: Silt Loam
Fertilizer Application to Previous Crop	: 90:60:40 (N, P_2O_5 and K_2O, kg/ha

F.M. = Finger Millet

Table No. 47: SUMMARY OF AGRONOMIC CHARACTERISTICS AVT RELAY, LUMLE (MEANS OF CHARACTERISTICS)

Variety	Days to P.E. x	Days to A.E. ++	Days to Mat.	F.M. P.P. + X1000	Plant Ht.	#Spikes/ Panicle	Prod. #T.*/ Plant	#Heads Harvested Plot	Straw Yield kg/ha	Harvest Index (HI)	Grain Yield (kg/ha)
A.Main Plot Kakani Yellow											
1.Oakhalo-1	134	144	193	166	61	4.00	2.25	53	4400	0.11	540
2.NE1104-13	108	118	179	158	82	3.25	1.00	21	1427	0.10	133
3.IE-143	86	96	148	163	54	2.75	1.75	81	1180	0.05	53
4.Bhuka Local	130	140	193	169	76	4.75	2.25	80	3187	0.18	747
B.Main Plot Arun-2											
1.Oakhale-1	134	144	193	175	67	5.25	2.50	54	4007	0.08	433
2.NE1104-13	108	118	179	168	83	3.25	1.25	27	2560	0.06	93
3.IE-143	86	96	149	124	48	2.50	1.50	56	803	0.06	47
4.Bhuka Local	130	140	189	162	80	6.00	2.50	79	4787	0.09	427
GRAND MEAN:				159	69	4.03	1.84	56	2911	0.09	309.09
CV %(Main Plot(a)	NA	NA	NA	12.13	5.05	14.98	24.13	47.33	9.11	69.13	55.45
Sub-Plot(b)	NA	NA	NA	10.11	11.97	27.46	29.47	42.29	61.11	40.55	60.79
LSD Main Plot(a)				NS	9.10	NS	NS	NS	1094	NS	NS
Sub-Plot (b)	NA	NA	NA	24	16.83	2.25	1.11	48	3621	0.08	433
Interaction (a X b)				24	NS	NS	NS	NS	NS	NS	NS
Probability (a)				-	0.05	-	-	-	0.01	-	-
(b)	NA	NA	NA	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01
(a X b)				0.05	-	-	-	-		-	-

x - P.E. = Panicle Emergence
* - T = Tillers
+ - P.P. = Plant Population
++ - A.E. = Anther Exertion

a X b = Maize var. X F.M. var.
H.S. = Highly Significant 0.01 p
S = Significant (0.05) p.
NA = Not Applicable

Table No. 48 : DETAILS OF ADVANCED VARIETAL TRIAL (RELAY), LUMLE

Trial Number	:
Design	: Split Plot
Plot Size	: Maize - 9 X 2.5m; F.M. - 1.5 X 2.5m
Spacing	: Maize - 75 X 25cm; F.M.- 10 X 10cm
Replications	: 4
Seeding Dates	: Maize - 30/4/1984
	F.M. - 30/4/1984
Transplanting Date	: 28/6/1984
Seedlings Age	: 58 days
Fertilizer	: Maize - 60:30:0 (N, P_2O_5, K_2O, kg/ha)
	F.M. - 20: 0:0
	Maize - 40:30:0 Basal 30/4/1984
	Maize - 20: 0:0 Top-dress 12/8/1984
Elevation	: 1675 m.a.s.l.
Previous Crop	: Wheat

Table No.49: CORRELATION COEFFICIENT (r) FOR 8 VARIABLE PLANT ATTRIBUTES WITH SEED YIELD/HA - N = 32

Sl. No.	Abbreviation	Variable	Khumaltar r	Khumaltar PROB	Khumaltar Sign.	Lumle r	Lumle PROB	Lumle Sign.
01.	TP	No. of prod. tillers/plant	-0.03	0.66	NS	0.52	0.001	HS
02.	LM	Length of main rachis	0.04	0.68	NS	Data Not Available		
03.	SP	No. of rachis/pan.*	0.13	0.48	NS	0.69	0.001	HS
04.	PH	Plant height	0.41	0.11	NS	0.22	0.209	NS
05.	SY	Straw yield	0.56	0.001	HS	0.64	0.001	HS
06.	$\bar{X}W$	Mean wt. of 10 heads	0.60	0.001	HS	Data Not Avai'ble		
07.	HI	Harvest index	0.62	0.001	HS	0.72	0.001	HS
08.	HH	No. of heads harvested/plot	0.75	0.001	HS	0.48	0.005	HS

*Pan.= Panicle.

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Table No.50: REGRESSION MODELS FOR DEPENDENT VARIABLE SEED YIELD/HA, KHUMALTAR. THE BEST FITTING MODELS (AND OTHERS) ARE SHOWN FOR A GIVEN NUMBER OF VARIABLES BEYOND ONE (SEE TABLE 47 FOR EXPLANATION OF ABBREVIATIONS)

No. of X's in model	R-Square	Variable(s) in Model
1	0.0009	TP
1	0.016	SP
1	0.168	PH
1	0.314	SY
1	0.563	HH
2	0.369	SY, PH
2	0.569	HH, PH
2	0.931	SY, HI
3	0.669	HH, HI, WT
4	0.942	HH, HI, WT, SY
5	0.950	HH, HI, WT, SY, SP
6	0.951	HH, HI, WT, SY, SP, PH
7	0.792	All except HI
7	0.946	All except HH
7	0.951	All except TP
8	0.954	All variable

Table No. 51:

Regression Models for dependent variable seed yield/ha, Lumle. The best fitting model is shown for a given number of variables beyond one. See Table 47 for explanation of abbreviations

No. of X's in Model	R-Sqaure	Variables in Model
1	0.048	PH
1	0.230	HH
1	0.270	TP
1	0.410	SY
1	0.476	SP
1	0.518	HI
2	0.339	TP, PH
2	0.521	SP, HH
2	0.528	HI, PH
3	0.439	TP, HH, PH
3	0.894	HI, SP, SY
4	0.523	SY, TP, HH, PH
4	0.895	HI, SP, SY, TP
5	0.931	SY, HH, PH, HI, SP
6	0.934	All variables in model

****

Table No.52:

Correlation coefficient (r) for variable plant attributes with straw yield/ha N=32. See Table 47 for explanation of abbreviations

Abbreviation	Khumaltar r	Khumaltar PROB.	Khumaltar Signi.	Lumle r	Lumle PROB.	Lumle Signi.
HI	-0.24	0.05	S	-0.06	0.69	NS
TP	-0.14	0.47	NS	0.45	0.01	HS
LM	0.05	0.69	NS	Data Not Available---------		
SP	0.07	0.68	NS	0.59	0.001	HS
HH	0.32	0.07	NS	0.41	0.02	HS
WT	0.34	0.05	S	Data Not Available---------		
PH	0.50	0.003	HS	0.35	0.05	S
MY (Grain Yield)	0.55	0.001	HS	0.64	0.001	HS

Table No. 53:

Regression models for dependent variable straw yield/ha, Khumaltar. The best fitting model plus the best model excluding harvest index (HI) is shown for a given number of variables beyond one. See Table 47 for explanation of abbreviations.

No. of X's in Model	R-Square	Variables in Model
1	0.050	HI
1	0.020	TP
1	0.104	HH
1	0.250	PH
1	0.303	MY
2	0.525	PH, MY*
2	0.893	HI, MY
3	0.633	PH, HH, TP*
3	0.894	HI, PH, MY
4	0.733	MY, PH, WT, TP*
4	0.949	HI, WT, PH, MY
5	0.541	TP, MY, PH, WT, HH
5	0.904	HI, WT, PH, HH, MY
6	0.542	TP, MY, PH, WT, HH, SP*
6	0.927	HI, MY, PH, WT, HH, SP
7	0.695	All variables except HI*
7	0.928	All variables except TP
8	0.928	All variable in model

* - indicates harvest index (HI) removed from the model.

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Table No. 54:

Regression models for dependent variable straw yield/ha, Lumle. The best fitting model plus the best model excluding harvest index is shown for a given number of variables beyond one. See Table 47 for explanation of abbreviations.

No. of X's in model	R-Square	Variables in Model
1	0.003	HI
1	0.119	PH
1	0.351	SP
1	0.410	MY
2	0.423	MY, SP*
2	0.756	HI, MY
3	0.493	MY, HH, PH*
3	0.813	MY, HI, PH
4	0.516	MY, HH, PH, SP*
4	0.822	HI, MY, HH, PH
5	0.523	MY, HH, PH, TP, SP*
5	0.838	MY, HI, HH, PH, TP
6	0.838	TP, SP, PH, MY, HI, HH

* - indicates Harvest Index (HI) removed from the model.

PLANT POPULATION TRIAL

The objectives of this trial were to test the released variety of finger millet recommended for the mid-to-high hills, Oakhale-1, at 5 plant populations under both sole and relay conditions. The treatments tested were the following:

250,000 plants/ha
500,000 plants/ha
750,000 plants/ha
1,000,000 plants/ha
1,250,000 plants/ha

Also, the secondary objectives of this experiment were to observe the quantitative agronomic characteristics of main millet, and how these are affected by both relay and monoculture conditions.

LOCATIONS

1. Khumaltar
2. Pakhribas Agricultural Centre
3. Lumle Agricultural Centre

VARIETIES UNDER STUDY

Maize : Arun-2
F.Millet : Oakhale-1

XVII. PLANT POPULATION TRIAL, KHUMALTAR

Discussion :

At Khumaltar, analysis of variance split-plot (5, 14) were performed on 12 characteristics. Details of trial and summary of agronomic traits and their significance are presented in tables 53 and 54. In the main-plot (plant populations) analysis, number of productive tillers/plant, number of inflorescences harvested/plot, harvest index, forage and grain yields differed significantly at 0.01 p. Observed plant populations were actually lower than the treatments specified due to high mortality of seedlings; nonetheless, observed plant populations differed significantly (0.01 p.) as should be expected.

In the sub-plot (sole or relay crop conditions) all traits except length of main rachis/inflorescence, forage yields and maize yields (maize yields analyzed as R.B.D.)

differed significantly (0.01 p.). Also, there was interaction (plant population X sole or relay crop conditions) in the number of productive tillers/plant.

At Khumaltar, mean grain performances increased with increasing plant population; however, with the highest plant population there was no dropping off of yields indicating the treatments perhaps should have been higher to ascertain the maximum yield at optimum plant populations. Populations of 670,000 and 860,000 plants/ha yielded 669 and 1178 kg/ha of grain under sole and relay conditions respectively. Low yields of Okhale-1 can be attributed to it's non-adaptability in Khumaltar conditions (see AVT discussion). At higher plant populations overall mean number of tillers/plant and number of rachi/inflorescence were reduced significantly (0.05 p.)

In the sole and relay (sub-plot) analysis, relay grain yields were significantly higher (0.01 p.). Under relay conditions, the major components of yield were significantly higher than values obtained under sole conditions (mean weight of ten inflorescences, number of inflorescences harvested/plot, and number of productive tillers/plant). It is not fully understood why relay conditions resulted in higher mean grain yields. This is in contradiction to results obtained at both Lumle and Pakhribas. Since relay conditions significantly and positively affected both grain, number of productive tillers/plant and other traits there is probably some yet unknown physiological shading effects of the maize on the finger millet at Khumaltar. There was interaction between plant population and sole/relay conditions (0.05 p.). The higher mean number of productive tillers/plant under relay condition directly translated into higher mean grain yields especially at higher plant populations.

In the sole crop conditions, there was little compensation observed in the number of productive tillers/plant at lower plant populations. For example, there was 1.33 and 1.14 productive tillers/plant at populations 1 and 5 respectively (sole crop).

Correlation coefficients (9, 10) and graphs (13) were obtained for grain and observed plant populations for both sole and relay conditions at the three sites the trial was conducted (figures 11-16). Correlation coefficients were significantly lower under sole crops conditions compared to these relay conditions indicating the relative importance of maintaining high plant populations especially under relay conditions (R= 0.85, 0.87 and 0.94 Khumaltar, Lumle and Pakhribas relay crop conditions respectively). For example, under relay conditions at the three sites 72%, 76% and 88% of the variability of seed yield is explained by observed plant

population alone. (There was no plot to plot plant population data available from Pakhribas, therefore, means were employed, N= 5.)

XVIII. PLANT POPULATION TRIAL, LUMLE

Discussion :

Analysis of variance split-plot (5, 14) were performed on seven characteristics at Lumle. Details and results of trial are summarized in tables 55 and 57. In the main plot (plant populations) analysis, five traits differed significantly at the 0.01 p. (Number of inflorescences harvested/ha, plant height, forage yield, harvest index and seed yield). In the sub-plot (sole/relay crop conditions) analysis, all plot to plot measured traits differed significantly (0.01 p.). No interaction (population X sole/relay crop) was observed for any traits at Lumle. The mean grain performance of Dakhale-1 increased with increasing plant population. For example, 1,141,000 and 1,137,000 plants/ha yield 3,520 and 2,673 kg/ha of grain under sole and relay crops conditions respectively. Maintaining higher plant populations was more important under relay conditions due to the maize competition and the resulting negative effects in the yields components of the finger millet (see figures 13 and 14).

In the sole and realy (sub-plot) analysis, all characteristics were reduced in magnitude under relay conditions except, of course, maize+millet combined yields. Plant populations under sole or relay conditions did not differ significantly. No interaction was observed. Under relay conditions, finger millet 50% panicle emergence was delayed by approximately 4 days at low plant populations and by 15 days at high plant populations. Number of rachi/panicle were reduced under relay conditions.

XIX. PLANT POPULATION TRIAL, PAKHRIBAS

Analysis of variance split-plot (5, 14) were performed on 4 characteristics. In the main-plot (plant populations) analysis, only forage yield differed significantly (0.01 p.). In the sub-plot (sole or relay crop) analysis, forage yield, harvest index and maize+millet combined grain yields differed significantly. Forage yields were reduced under relay condition while harvest index was significantly increased. Harvest index was significantly increased because of the grain yield reduction (due to relay conditions) was greater in magnitude relative to the forage yield reduction in yield. There was interaction (plant population X sole/relay) in forage yield (0.01 p.). Results and details of the trial are summarized in tables 58 and 56.

Plant population treatments were generally lower than specified treatments. No plot to plot plant population data was

available; however, based on five observed plant populations alone, correlation coefficients (10) were obtained for grain yield and observed plant population. Under sole and relay conditions coefficients of 0.67 and 0.93 respectively were obtained showing the relative importance of maintaining high plant populations especially under relay conditions (figures 15 and 16).

XX. GERMPLASM OBSERVATION NURSERY

Objectives :

The objectives of this experiment were to screen introduced and exotic germplasm of finger millet to isolate agronomically promising lines for further testing.

Locations :

1. Khumaltar; 2. Kakani.

Varieties Under Study :

Ninety-three local varieties from eastern and central Nepal.

Experimental Conditions and Execution :

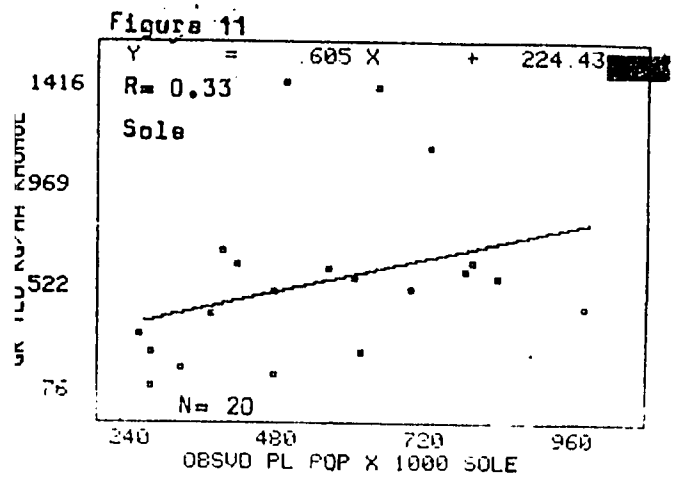
Direct sown 2 rows 3 m long
Date of seeding Khumaltar : 5/25/1984
" " " Kakani : 5/20/1984
Fertilizer: 40:40:20 ½ basal 20:40:20 20:0:0 top-dress

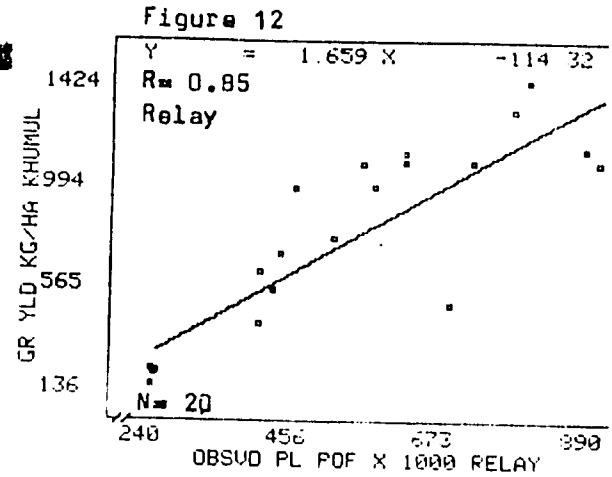
Discussion :

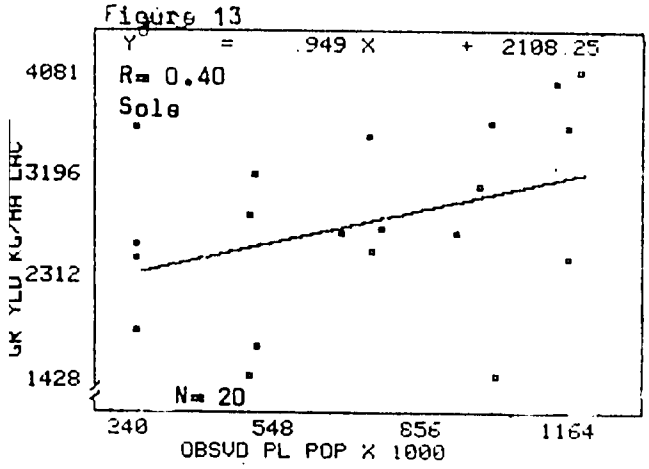
Tables 61 and 62 results from Khumaltar and Kakani are summarized. In table 61 harvest index, grain and forage yields and ranks are summarized. In table 62, results from days to 50% panicle emergence, plant height, number of productive tillers/plant, number of inflorescences harvested/plot harvest index, grain and forage yields are summarized. Mean seed and forage yield at Khumaltar was 1434 and 8834 kg/ha and the mean seed and forage at Kakani was 668 and 699 kg/ha respectively. Overall grain yield at Khumaltar was higher than at Kakani.

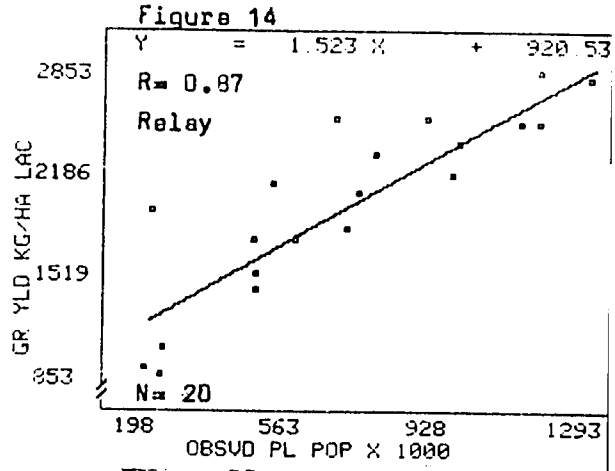
Based on combined analysis of results from Khumaltar and Kakani experimental line numbers 31, 90, 81, 89, 7, 28, 39, 26, 92, and 40 have been advanced to the Initial Evaluation Trial for further testing. (See (16) for origin of varietal numbers.) Line number 7 recorded the earliest date to 50% emergence (72 days).

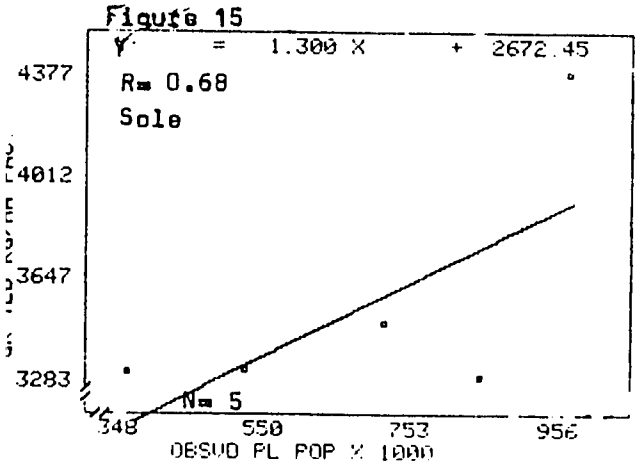
Figures 11-16: Grain Yield and Plant Population Relationships Under Sole and Relay Conditions at Three Sites, Khumaltar, Lumle, and Pakhribas.











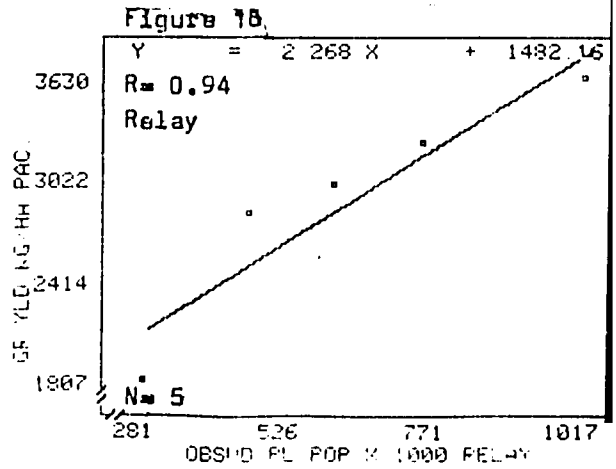


Table No. 55: PLANT POPULATION TRIAL : SUMMARY OF MEAN AGRONOMIC CHARACTERISTICS, KHUMALTAR FARM

Main Plot/Ch.* / Sub-Plot	Obsvd. P.P.** X1000/ ha 0.25m² Sampled Area	Obsvd. P.P.** X1000/ ha 1.0m² Sampled Area	Length of Main Finger/ Pan. (cm)	#/of Finger Panicle	#/Prod. Tillers/ Plt.	#/Heads Harvested Plot	Wt. of 10 Heads Plot (g)	Straw Yield (kg/ha)	Harvest Index (HI)	Maize+ Millet (Relay only) (kg/ha)	Maize Yield (t/h)	Millet Grain Yield (kg/ha)
P1 250,000 P/h												
Conditions Sole	310	268	6.30	5.63	1.33	41.5	2.48	1239.0	0.14	186	-	186
" Relay	355	244	6.25	3.90	4.23	131.3	2.80	1033.3	0.15	3370	3.19	176
P2 500,000 P/h												
Sole	470	400	6.58	5.35	1.33	79.0	2.15	2157.0	0.17	447	-	447
Relay	540	413	6.23	4.08	4.08	170.0	3.05	2106.0	0.22	3733	3.18	554
P3 750,000 P/h												
Sole	570	578	6.50	5.23	1.10	121.8	2.90	3233	0.17	76	-	765
Relay	658	548	6.58	4.10	2.79	146.8	3.10	2074	0.28	3773	2.96	815
P4 1,600,000 P/h												
Sole	750	615	6.10	5.33	1.13	137.5	2.68	2839	0.20	676	-	676
Relay	830	639	6.65	4.13	2.80	187.8	3.33	3030	0.28	3503	2.39	982
P5 1,250,000 P/h												
Sole	670	815	6.43	5.30	1.14	135	2.03	3970	0.15	669	-	669
Relay	860	815	6.85	4.35	2.53	216	3.55	3685	0.25	4161	2.98	1178
GRAND MEAN :	601.25	533.25	6.445	4.688	2.24	136.6	2.81	2541.63	0.20	2128	2.94	644.75
CV% MainPlot (a)	27.94	15.11	5.10	12.23	25.49	27.12	28.78	36.87	14.82	20.84	19.38	39.36
Sub Plot (b)	14.38	15.59	8.32	29.32	25.53	27.93	23.56	46.40	26.17	21.47	NA	30.17
LSD Plt.Pop. (a)	363	174	-	-	1.23	80	-	2024	0.06	-	-	548
Sole/Relay (b)	180	-	-	2.86	1.19	79	1.38	-	0.11	952	NA	405
I.A.+PopXS/R(axb)	NS	-	-	-	1.19	-	-	-	NS	-	NA	NS
Probability (a)	0.01	0.01	NS	NS	0.01	0.01	NS	0.31	0.01	NS	NS	0.01
(b)	0.01	NS	NS	0.01	0.01	0.01	0.01	NS	0.01	0.01	NA	0.01
(a x b)	NS	NS	NS	NS	0.05	NS	NS	NS	NS	NS	NA	NS

* - Ch. = Characteristics
** - P.P. = Plant Populations
\+ - I.A. = Interactions
Obsvd. = Observed
S/R = Sole or Relay

Table No. 56: DETAILS OF PLANT POPULATION TRIAL, KHUMALTAR

Trial Number : 13
Design : Split-plot
Main plot : Plant population
Sub-plot Monoculture: 1 X 2.5m
Or Relay : 3 X 2.5m
Net Harvested Areas : 2.5 m^2
Plant Populations
Plants/ha :

	Plants/ Ha	Observed (Mono)	Plant Pop. (Relay)
1.	250,000	268	044
2.	500,000	400	413
3.	750,000	578	548
4.	1,000,000	615	639
5.	1,250,000	815	815

Replications : 4
Seeding Dates : Maize: 23/5/1985; Mono F.Millet: 23/5/1985
Relay F.Millet 26/6/1985 Transplanting: 28/6/1985
Seedling Age: 43 days Seedlings Age: 32 days
Transplanting: 5/8/1985
Fertilizers : Maize: 60:30:0 (NPK, kg/ha); 30:30:0 Basal
30: 0:0 Top-dress
Relay F.Millet: 20:0:0 (NPK) Top-dress
Mono F. Millet:40:40:20; 20:40:20 Basal
20: 0:0 Top-dress
Previous Crop : Wheat
Fertilizer to Previous Crop : 80:60:40 (NPK)
Elevation : 1372 m.a.s.l.

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Table No. 57: DETAILS OF PLANT POPULATION TRIAL, LUMLE

Trial Number : 14
Design : Split-plot
Main-plot : Plant population
Sub-plots : Monoculture or Relay
Main plot Size : 4 X 2.5m
Sub-plot Size : Monoculture: 1 X 2.5m
Sub-plot Size : Relay : 3 X 2.5m
Plant Populations :

Treatments Plants/ha	Observed Plants/ha(Mono)	Observed Plants/ha(Relay)
250,000	348	281
500,000	512	460
750,000	704	603
1,000,000	836	752
1,250,000	956	1,017

Replications : 4
Seeding Dates : Maize : 5/5/1984
F.Millet : 5/5/1984
Transplanting Date : 20/6/1984

Table No. 57...(Continued)

Seedlings Age : 45 days
Fertilizer : Maize : 60:30:0 N, P_2O_5, K_2O
30:30:0 Basal
30: 0:0 Top-dress
F. Millet (Mono) : 40:40:20 N, P_2O_5, K_2O
20:40:20 Basal
20: 0: 0 Top-dress 6 weeks after transplanting. No fertilizer for relay finger millet employed.
Elevation : 1675 m.a.s.l.

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Table No. 58: DETAILS OF PLANT POPULATION TRIAL, PAKHRIBAS

Trial Number : 15
Design : Split-plot
Main Plot Size : 8.125 m^2
Sub-Plot Size : 2.5 m^2 (Mono); 5.625m^2 (Relay)
Net Harvested Area : 2.5m^2 (Mono); 2.5m^2 (Relay)

Spacings		Observed Plant Pop. Monoculture	Relay
1.	250,000	348,000	281,000
2.	500,000	512,000	460,000
3.	750,000	704,000	603,000
4.	1,000,000	836,000	752,000
5.	1,250,000	956,000	1,017,000

Replications : 4
Seeding Dates : Maize : 5/8/1984
F.Millet : 16/5/1984
Transplanting Dates : 21/6/1984
Seedlings Age : 35 days
Fertilizer : 60:30:0 N, P_2O_5, K_2O
30:30:0 Basal
30: 0:0 Top-dress 20 t/ha FYM
Previous Crop : Wheat
Elevation : South Farm Lotse Block 1350 m.a.s.l.
BHC Dust 5% @ 20 kg/ha

Table No. 59 : PLANT POPULATION TRIAL - SUMMARY OF AGRONOMIC CHARACTERISTICS, LUMLE AGRICULTURE CENTRE

Main Plot/Ch.* Sub-Plot		DAS to 50% P.E.++	DAS to 50% A.E.xx	DAS 95% P.M.@	No.of P.T.@@ /Plot	No.of Rachi/ Panicle	Obsv. Maize P.P.+ X1000	F.M. Obsvd. P.P.+ X1000	#Heads Harvest/ Hectare X1000	Plant Ht. (cm)	Straw Yield (t/ha)	Harvest Index (HI)	Mz** Only Yld. (kg/h)	Mz & Millet Yld. (kg/h)	F.M.x Grain (kg/ha)
P1 250,000 P/h															
Sole	(S)	118	128	183	2.5	6.3	-	241	547	93.3	18.8	0.14	-	2595	2595
Relay	(R)	122	132	187	1.0	4.0	50.3	227	238	78.8		0.04	3160	4333	1173
P2 500,000 P/h															
	(S)	118	128	185	1.75	5.8	-	487	585	88.8	19.8	0.11	-	2270	2270
	(R)	125	134	187	1.00	4.0	52.7	486	462	76.7		0.05	3333	5023	1690
P3 750,000 P/h															
	(S)	118	128	184	1.50	5.5	-	722	816	102.5	22.8	0.13	-	2838	2838
	(R)	132	142	187	1.00	4.0	52.3	670	609	88.3		0.05	3467	5480	2033
P4 1,000,000 P/h															
	(S)	118	128	185	1.25	5.3	-	960	986	44.0	29.5	0.09	-	2691	2691
	(R)	134	144	186	1.00	4.0	52.0	960	876	83.0		0.05	3073	4997	1923
P5 1,250,000 P/h															
	(S)	118	128	183	1.00	5.3	-	1141	1105	103.0	34.9	0.10	-	3520	3520
	(R)	132	142	186	1.00	4.0	51.7	1137	944	87.0		0.06	2558	5231	2673
GRAND MEAN:		Plot to Plot Data Not					51.79	702.9	717	89.5		0.08	3114	3893	2340
CV% Mn.Plot	(a)						10.53	10.24	20.47	11.04		33.12	21.42	20.09	29.06
Sub-Plot	(b)	Available.					-	10.63	11.38	9.55		38.33	-	20.79	26.80
LSD Mn. Plot	(a)						-	155	317	-		-	-	-	1048
Sub-Plot	(b)						NA	-	177	17.82		0.06	NA	1689	1307
Interaction(axb)							NA	-	-	-	-	-	NA	-	-
Probability	(a)						NS	0.01	0.01	NS		NS	NS	NS	0.05
	(b)						NA	NS	0.01	0.01		0.01	NA	0.01	0.01
	(axb)							NS	NS	NS	NS	NS	NA	NS	NS

Maize: Days to Maturity = 140
Days to 50% Silking = 78

* Ch. = Characteristics; ** - Mz = Maize; + - P.P. = Plant Population; ++ - P.E. = Panicle Emergence;
xx A.E.= Anther Exertion; xx - F.M. = Finger Millet; @@= P.T. = Production Tillers; @@ = P.M. = Panicle Maturity
Obsvd. = Observed
P/h = Plants/ha.

Table No. 60: PLANT POPULATION TRIAL : SUMMARY OF MEAN AGRONOMIC CHARACTERISTICS, PAKHRIBAS AG. CENTRE

Main Plot/Ch.* Sub-Plot	DAS 50% P.E.+	DAS 50% Mat.	Obsvd. P.P.** 1000/ha	# of Heads Harvested Ha X 1000	Lodging 1-5	Plant Height (cm)	Straw Yield (t/ha)	Harvest Index (HI)	Maize+ Millet (t/ha)	Millet Yield (kg/ha)	Maize Yield (kg/ha)
P1 250,000 P/ha											
Sole	124	197	348	460	2	93	12.99	0.20	3.30	3295	-
Relay	138	198	281	352	2	81	8.67	0.18	4.93	1807	3122
P2 500,000 P/ha											
Sole	127	196	512	572	3	105	23.55	0.12	3.30	3301	-
Relay	139	196	460	471	2	92	12.73	0.19	6.20	2816	3379
P3 750,000 P/ha											
Sole	124	192	704	664	3	112	26.42	0.11	3.47	3470	-
Relay	140	196	603	548	2	96	14.21	0.18	6.01	2986	3020
P4 1,000,000 P/ha											
Sole	131	192	836	728	3	99	24.55	0.12	3.28	3283	-
Relay	141	195	752	718	2	94	13.41	0.20	6.17	3233	2932
P5 1,250,000 P/ha											
Sole	130	190	956	884	3	107	26.68	0.14	4.38	4377	-
Relay	138	193	1017	979	3	92	16.72	0.18	6.46	3630	2833
GRAND MEAN							17.99	0.16	4.75	3219.95	3057
CV% Main Plot (a)	Plot to plot data not available						9.77	32.92	27.02	35.65	15.60
Sub Plot (b)							10.58	18.30	23.41	31.76	-
LSD Plant Pop. (a)	- ditto -						3.80	-	-	-	-
Sole/Relay (b)							3.97	0.06	2.32	-	-
Pop X S/R (a x b)							3.97	-	-	-	-
Probability (a)	- ditto -						0.01	NS	NS	NS	NS
(b)							0.01	0.01	0.01	NS	NA
(a x b)							0.01	NS	NS	NS	NA

* - Ch. = Characteristics
** - P.P. = Plant Populations
\+ - P.E. = Panicle Emergence
Mat. = Maturity
NS = Not Significant
NA = Not Applicable.

Table No. 61 : OBSERVATION NURSERY, KHUMALTAR

SUMMARY OF GRAIN AND STRAW YIELD RANKS HARVEST INDICES

Trial No.: 16

Sl. No.	Plot No.	Grain Yield (kg/ha)	& Rank	Straw Yield (kg/ha)	& Rank	Harvest Index
01.	31	3767	1	5867	73	.39
02.	90	3508	2	9650	33	.27
03.	81	2833	3	9575	36	.23
04.	89	2792	4	9792	32	.23
05.	24	2783	5	18542	2	.13
06.	18	2700	6	12608	15	.18
07.	14	2558	7	7783	55	.25
08.	92	2542	8	12183	17	.17
09.	74	2417	9	3942	86	.38
10.	33	2383	10	10442	26	.19
11.	32	2325	11	10042	27	.19
12.	83	2292	12	13017	14	.15
13.	16	2283	13	17275	4	.12
14.	40	2283	14	8275	49	.22
15.	84	2250	15	10908	23	.17
16.	91	2208	16	17425	3	.11
17.	07	2758	17	20033	1	.10
18.	93	2100	18	8033	63	.21
19.	26	2083	19	9167	39	.19
20.	28	2083	20	10917	22	.16
21.	43	2017	21	10508	25	.16
22.	75	1983	22	8108	50	.20
23.	41	1950	23	14575	25	.12
24.	25	1792	24	11183	19	.14
25.	10	1792	25	9900	30	.15
26.	27	1792	26	6283	71	.22
27.	37	1792	27	8850	42	.17
28.	79	1792	28	9592	34	.16
29.	80	1783	29	9992	29	.15
30.	19	1725	30	14583	9	.11
31.	39	1717	31	10200	28	.14
32.	6	1708	32	11883	18	.13
33.	35	1708	33	6967	67	.20
34.	23	1700	34	13308	12	.11
35.	76	1700	35	7092	65	.19
36.	89	1692	36	9792	29	.17
37.	34	1675	37	9533	37	.15
38.	45	1667	38	7050	66	.19
39.	86	1625	39	8667	47	.16
40.	13	1600	40	9467	38	.14
41.	12	1567	41	12292	16	.11
42.	82	1550	42	11100	20	.12
43.	88	1542	43	8042	52	.16
44.	59	1492	44	7508	58	.17
45.	77	1492	45	4792	79	.24
46.	36	1483	46	15867	7	.09

Contd.../...

Table 61 Continued.

47.	42	1467	47	10658	24	.12
48.	38	1383	48	16967	5	.08
49.	47	1383	49	7467	61	.16
50.	30	1375	50	7942	54	.15
51.	78	1325	51	9583	35	.12
52.	29	1300	52	13742	11	.09
53.	63	1292	53	7458	60	.15
54.	22	1275	54	15408	8	.08
55.	17	1225	55	16525	6	.07
56.	72	1208	56	4675	81	.21
57.	9	1192	57	8775	43	.12
58.	42	1158	58	10658	24	.10
59.	20	1125	59	9775	31	.10
60.	21	1108	60	4017	85	.22
61.	64	1017	61	5042	77	.17
62.	53	1008	62	6350	70	.14
63.	68	958	63	5025	78	.16
64.	62	933	64	5200	75	.15
65.	52	908	65	2792	91	.25
66.	15	908	66	8875	40	.09
67.	71	803	67	7783	56	.10
68.	47	867	68	3942	61	.18
69.	85	867	69	10933	21	.07
70.	69	850	70	2667	92	.24
71.	58	842	71	7508	41	.10
72.	3	808	72	7117	63	.10
73.	50	800	73	7150	64	.10
74.	73	758	74	3792	88	.17
75.	8	725	75	8733	46	.08
76.	2	708	76	7458	60	.09
77.	65	675	77	6967	83	.09
78.	70	650	78	8592	48	.07
79.	46	625	79	7683	57	.08
80.	51	525	80	4567	82	.10
81.	11	458	81	8758	44	.15
82.	54	442	82	4075	84	.10
83.	61	450	83	8592	48	.05
84.	70	425	84	3900	87	.10
85.	57	417	85	2925	90	.12
86.	5	409	86	6560	69	.06
87.	44	350	87	8092	51	.04
88.	60	325	88	5767	74	.05
89.	56	325	89	4850	80	.05
90.	1	300	90	5917	68	.04
91.	67	283	91	8758	45	.03
92.	4	208	92	5917	72	.03
93.	66	158	93	2167	93	.07

$\bar{X}$=1434 $\bar{\bar{X}}$ = 3834

T= HS T = HS

Table No.62 : OBSERVATION NURSERY

Location: Kakani

Trial No.: 17

Sl. No.	Variety No.	Rank	Days to P.F.*	Plant Ht. (cm)	No.of Tillers/ Plant	No.Heads Harvested/ Plot	Straw Yield kg/ha	Grain Yield kg/ha	HIKAK
01.	20	1	100	80.2	5.6	170	750	2125	.74
02.	30	2	106	69.0	4.6	150	1125	1075	.63
03.	26	3	80	52.2	4.8	140	625	1750	.74
04.	92	4	104	71.0	2.9	140	625	1750	.74
05.	40	5	108	72.6	10.2	140	750	1750	.70
06.	39	6	100	67.0	11.3	130	625	1625	.72
07.	41	7	123	71.8	9.1	120	875	1500	.63
08.	13	8	121	72.6	9.0	110	875	1375	.61
09.	38	9	100	69.6	27.0	100	750	1250	.63
10.	35	10	120	80.0	4.2	90	625	1125	.64
11.	71	11	107	45.4	2.5	90	100	1125	.86
12.	31	12	100	83.0	6.7	90	750	1125	.60
13.	25	13	85	86.4	7.5	90	675	1125	.63
14.	17	14	121	69.0	3.6	90	875	1125	.56
15.	28	15	100	80.2	5.6	170	750	1125	.60
16.	19	16	106	61.2	4.7	70	625	875	.53
17.	42	17	117	74.6	10.0	70	1125	875	.44
18.	43	18	115	68.6	12.3	70	625	875	.58
19.	05	19	112	49.0	4.0	70	1250	875	.41
20.	12	20	106	66.2	2.9	70	1375	875	.39
21.	13	21	104	71.0	7.3	70	75	875	.92
22.	16	22	123	61.4	5.4	70	375	875	.70
23.	53	23	122	61.0	4.7	70	500	875	.64
24.	56	24	110	67.4	4.8	70	750	875	.54
25.	55	25	124	84.2	4.6	60	500	750	.60
26.	57	26	107	84.4	6.0	60	675	750	.53
27.	44	27	113	63.2	8.3	60	563	750	.57
28.	84	28	114	66.6	4.7	60	650	750	.54
29.	32	29	107	84.0	3.6	60	1175	750	.39
30.	23	30	105	67.8	3.3	60	875	750	.46
31.	63	31	118	59.2	5.5	50	600	625	.40
32.	54	32	88	73.0	4.2	50	625	625	.50
33.	13	33	104	71.0	4.5	50	600	625	.48
34.	11	34	107	66.0	3.1	50	875	625	.42
35.	88	35	106	49.6	4.0	50	1250	625	.33
36.	34	36	111	61.0	2.8	50	750	625	.45
37.	88	37	108	66.2	4.3	50	700	625	.47
38.	66	38	100	62.2	5.8	50	550	625	.53
39.	67	39	104	76.6	3.4	50	125	625	.83
40.	24	40	102	57.8	4.1	40	500	500	.50
41.	79	41	111	79.4	3.3	40	750	500	.40
42.	76	42	109	66.8	5.4	40	625	500	.44
43.	77	43	99	65.0	4.3	40	750	500	.40
44.	64	44	113	59.8	2.7	40	375	500	.57
45.	82	45	97	63.4	5.2	40	500	500	.50
46.	81	46	107	66.2	2.7	40	725	500	.41
47.	33	47	106	73.2	5.8	40	1625	500	.22

Contd.../...

Table 62 Continued.

48.	37	48	106	61.8	3.0	40	875	500	.36
49.	51	49	120	69.6	4.1	40	250	500	.67
50.	58	50	110	67.6	6.0	40	750	500	.40
51.	20	51	100	71.2	3.6	30	875	375	.30
52.	65	52	92	40.0	2.8	30	625	375	.38
53.	69	53	85	62.8	5.0	30	375	375	.50
54.	83	54	124	60.4	2.1	30	500	375	.43
55.	85	55	107	49.8	3.0	30	875	375	.30
56.	86	56	109	46.8	3.0	30	500	375	.43
57.	91	57	106	63.2	1.4	30	813	395	.32
58.	09	58	107	54.2	1.4	30	625	375	.38
59.	50	59	114	47.4	3.6	30	250	375	.60
60.	52	60	117	50.2	5.7	30	250	375	.60
61.	60	61	105	62.6	3.8	30	375	375	.50
62.	61	62	107	67.2	4.0	30	750	375	.33
63.	49	63	125	63.4	3.2	25	375	313	.45
64.	76	64	102	64.8	3.7	25	875	313	.26
65.	75	65	102	73.6	2.2	20	625	250	.29
66.	74	66	101	73.0	3.1	20	250	250	.50
67.	70	67	85	61.2	4.0	20	250	250	.50
68.	68	68	95	64.0	1.2	20	250	250	.50
69.	90	69	105	57.6	3.0	20	875	250	.22
70.	62	70	106	44.6	5.4	20	250	250	.50
71.	48	71	124	63.0	1.3	20	250	250	.50
72.	15	72	117	63.6	1.5	20	250	250	.50
73.	02	73	129	51.6	1.7	20	1125	250	.18
74.	03	74	122	46.4	1.2	20	875	250	.22
75.	04	75	108	50.6	1.6	20	750	250	.25
76.	07	76	119	50.0	5.1	20	375	250	.40
77.	05	77	116	47.8	1.6	10	750	125	.14
78.	10	78	113	50.4	2.1	10	1375	125	.08
79.	82	79	108	55.6	3.0	10	565	125	.18
80.	93	80	103	50.0	1.7	10	700	125	.15
81.	73	81	100	49.8	4.7	10	500	125	.20
82.	72	82	98	45.8	1.0	5	125	63	.34
83.	94	83	106	70.2	1.3	5	500	63	.11
84.	88	84	107	50.0	1.3	5	375	63	.14
85.	89	85	111	61.2	2.5	5	625	63	.09
86.	01	86	123	50.4	2.1	5	2000	63	.03
87.	29	87	107	72.0	4.7	110	1375	1375	.50
88.	27	88	107	78.3	4.2	80	1250	1000	.44
89.	21	89	96	72.2	4.5	50	1250	625	.33
90.	22	90	103	51.3	4.3	90	750	1125	.60
91.	26	91	88	52.2	4.8	140	625	1750	.74
92.	36	92	101	72.0	3.8	100	1375	1250	.48

$\bar{X}$ = 698.97 $\bar{X}$=667.04
T = HS T= HS

REFERENCES

01. Cropping Systems Program, 1985. Meteorological unpublished data. The Integrated Cereals Project, Department of Agriculture, Nepal.

02. Eberhart, S.A. and Russel, W.A., 1966. Stability Parameters for Comparing Varieties. Crop Science 6 : 36 - 40.

03. Finlay, K.W. and Wilkinson, G.N., 1963. The Analysis of Adaptation in a Plant Breeding Program. Aust. J. Agric. Res. 14 : 732 - 54.

04. Gomez, K.A. and Gomez, A.A., 1983. Multiple Cropping in the Humid Tropics of Asia. International Development Research Centre, Ottawa, Ontario, Canada, pp. 176 - 185.

05. ------ and -----, 1984. Statistical Procedures for Agricultural Research, 2nd edition. International Rice Research Institute Book. John Wiley and Sons, New York, USA, pp 97-107.

06. Hildebrand, Peter E., 1982. Modified Stability Analysis. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida, USA. Journal Series No. 4577. 22 pages.

07. Kang, M.S. and Miller, J.D., 1984. Genotype-Environment Interactions for Cane and Sugar Yield and Their Implications in Sugarcane Breeding. Crop Science 24:435-440.

08. Madigan, S.D. and Lawrence, Virginia, 1983. ANOVA II. Statistical Computer Package for Analysis of Randomized Complete Block and other Designs File Management et . Human Systems Dynamics, Northridge, CA, USA, manual 104 pages.

09. ----- and -----, 1983. Stats Plus. Statistical Computer Package for Simple Linear Regression, File Management etc. Plus Manual. Human Systems Dynamics, Northridge, CA, USA, manual 110 Pages.

10. ----- and -----, 1983. Regress II. Statistical Computer Package for Multiple Regression and Manual. Human Systems Dynamics, Northridge, CA, USA, manual 82 pages.

11. Purseglove, J.W., 1972. Tropical Crops, Monocotyledonous. Longman House, Essex, U.K. pp 147 - 157.

12. Rachie, K.O. and Peter, L.V., 1977. The Eleusine, A World Literature Review. International Crops Research Institute for the Semi-Arid Tropics, Hyderabad, India.

13. Ronnard, R., 1983. Grafpak II. By Smartware Dayton, Ohio, USA. High Resolution Graphics Screen to Printer Dump Utility for Use with ANOVA Regress II and other Programs.

14. Rajbhandari, Rupak Man, 1985. Split-Plot. Data Systems Int'l. Kathmandu, Nepal. Split-Plot Analysis of Variance Computer Program. Mr. K. Rupak Designer. (Based on Analysis of Variance by Gomez and Gomez No. 5.)

15. Sen, C.K., 1984. Summer Crops Annual Report for Lumle Agricultural Center, Kaski District, Nepal. Presented at Summer Crop Annual Workshop held at Rampur, Chitwan, Nepal.

16. Tamulonis, J.P. and Singh, K.M., 1984. Finger Millet Development Program. The National Maize Development Program, The Integrated Cereals Project/DOA, Nepal. pp 1-55.

17. ----- and -----, 1985. Finger Millet Development Program, Work Plan. The National Maize Development Program, the Integrated Cereals Project/DOA, Nepal. pp 1-80.

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