Pak. J. Agri. Sci., Vol. 21 (1-2), 1984

THE COMPARISON OF GENETIC VARIABILITY BETWEEN THE HIMALAYAN CENTRES OF DIVERSITY FOR BARLEY CHARACTERISTICS

Mansur Mohsin Gilani*

ABSTRACT

The investigations were carried out on 197 populations of barley from Nepal and Pakistan for various qualitative and quantitative characters. The variability exhibited by barley from these two regions was similar for quantitative characters like length and breadth of flag leaf, height, number of infertile and fertile tillers, number and weight of grains per plant. This was related to the environmental heterogeneity since the altitudes of these two areas vary two the same extent. Thus the results are not in conformity with the exepted theory that Nepal is a primary centre of diversity for barley as for as quantitative characters are concerned. Awn length, the only quantitative character recorded, showed variation which is related to the crop plants' centre of deversity.

INTRODUCTION

The population of world is consistently increasing; the need for higher production per hectare must necessarily respond in discarding a number of crops with low yield which helped to furnish protection in ancient times. It seems necessary to know about all the germplasm within genetic access in food plants. The germplasm that could be utilised when required has not so far been comprehensively searched.

Takahashi (1955, 1963) examined world distribution of barley. He stated that barley genotypes are regularly distributed and the frequency of the naked character of the caryopsis changes over large geographical areas. Ward (1962) described the variation within eighteen regions of the world while examining the U.S.D.A. world collection of barley. Qualset (1975) examined 413 populations of barley collected over a large area of Ethiopia and grouped into

*Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad.

approximately twenty independent areas of collection. He investigated variation for resistance to barley yellow dwarf virus.

In recent years due importance has been given, in general, to genetic exploration and conservation work on major crops, while some of the regions have attracted more attention in this regard. The above in view, two genetic conservation expeditions were organised, one to Eastern Nepal and the other to Northern Pakistan. These expeditions collected primitive barley (*Hordeum vulgare* L.) from these centres of diversity. In the present study the genetic variability of barley between the two centres of diversity was compared.

MATERIALS AND METHODS

The seed for these investigations was taken from material collected by the genetic conservation expeditions (Witcombe, 1975a, 1975b). The experiments were conducted at the University College of North Wales, Bangor, Great Britain.

The experiments consisted of the following :

	Nep.* Barley			Pak.** Barley		
	Covered	Naked	Total	Covered	Naken	Total
Accessions	73	35	108	21	68	89
Plants	283	129	412	83	271	354
Sites of origin	68	32	100	21	66	87

*Nep. = Nepalese. **Pak. = Pakistani.

The Nepalese barley seed was randomly procured from each accession from seed obtained by growing the barley accessions in Bangor, while the seed for Pakistani barley accessions was obtained from the original seed collected by the expedition. The naked and covered barleys were sown with randomisation between the Nepalese and Pakistani accessions. The plants were grown in pots with four plants per accession in a cold greenhouse. Seven pre-harvest and two post-harvest observations were recorded.

RESULTS

The variability exhibited by barley from Nepal and Pakistan was compared on the basis of coefficients of variation (Table 1). The variability displayed

Table 1. *Variability of characters recorded in Nepalese and Pakistani barley accessions*

Character	Covered and naked				Covered				Naked			
	Mean		Coefficient of variation		Mean		Coefficient of variation		Mean		Coefficient of variation	
	Nep.*	Pak.**	Nep.	Pak.	Nep.	Pak.	Nep.	Pak.	Nep.	Pak.	Nep.	Pak.
Length of flag leaf (cm)	15.5	18.7	28.7	21.7	14.9	20.4	31.5	24.4	16.8	18.1	20.7	19.7
Breadth of flag leaf (cm)	1.3	1.4	24.0	24.3	1.2	1.4	24.6	23.3	1.3	1.3	22.6	23.8
Height (cm)	96.1	82.2	14.8	13.8	96.3	82.0	15.4	15.4	95.5	83.1	13.5	13.3
Length of middle awn central row (cm)	7.8	13.4	46.5	16.0	7.1	12.1	46.2	14.8	10.5	13.9	34.6	15.0
Length of middle awn lateral row (cm)	3.8	10.3	72.5	18.6	4.5	9.5	56.7	15.9	1.2	10.6	152.1	18.6
Number of infertile tillers per plant	0.4	0.5	153.3	138.1	0.5	0.7	147.5	130.8	0.3	0.5	165.1	137.2
Number of fertile tillers per plant	3.1	4.1	33.5	25.5	3.3	4.2	32.6	30.2	2.7	4.1	32.0	23.8
Number of grains per plant	97.4	133.0	42.9	29.5	104.0	116 5	42.6	32.5	82.9	138.0	37.7	27.7
Weight of grains per plant (gm)	3.9	5.9	39.8	27.0	4.2	5.6	38.3	32.4	3.2	6.0	36.1	25.2

*Nep. = Nepalese. **Pak. = Pakistani

by different quantitatively varying characters under observation was remarkably similar. However, in the case of the two awn characters the Nepalese barley showed a much greater variability than Pakistani barley. These differences were reflected in the means of characters where there were great similarities for the quantitative characters but in the case of awns the Pakistani barley had a much longer mean awn length than the Nepalese barley. The data were examined further by comparing the Nepalese and Pakistani covered and naked barleys separately (Table 1). The same trends were shown in both these analyses as were shown when the data for the covered and naked barleys were combined. The greatest difference between the Nepalese and Pakistani barley is in the middle awn of the lateral row in naked barley (Table 1) in which there are very large differences for both mean and coefficient of variation.

Distribution of variability between and within accessions.

To observe the variation between and within accessions of Nepales ande Pakistani barley, the variance ratios for different characters were calculated. Table 2 shows that variation between various accessions for many of the characters was not significantly higher than that of within accessions. The variance ratios do not vary in a striking manner. The flag leaf and awn characters have some large variance ratios but infertile tiller number always has small variance ratios. There are very slight differences between the cereals whether comparisons are made between covered and naked or between Nepalese and Pakistani barley.

DISCUSSION

Comparison of variability in two centres of diversity

The Nepalese and Pakistani barleys show the most remarkable similarity for coefficients of variation for all the quantitative characters examined. Awn length is a quantitative character and here the Nepalese barley is strikingly more variable than the Pakistani barley.

These results can be explained by assuming that the quantitative characters are fitness characters which are under influence of strong natural selection pressures, whilst qualitative characters such as glume pigmentation, awn length etc., are less affected by natural selection pressures. This difference between quantitative and qualitative characters in relation to fitness is probably valid.

Table 2. *Variance ratios for the between and within accession variances of the characters recorded in Nepalese and Pakistani barley accessions*

Character	Covered and naked				Covered				Naked			
	Nep.		Pak.		Nep.		Pak.		Nep.		Pak.	
	V.R.[1]	Sig.[2]	V.R.[1]	Sig.$_2$	V.R.[1]	Sig.[2]	V.R.[1]	Sig.[2]	V.R.[1]	Sig.[2]	V.R.	Sig.[2]
Length of flag leaf (cm)	1.6	N.S	1.7	*	1.5	N.S	2.2	*	1.7	*	1.4	N.S
Breadth of flag leaf (cm)	1.8	*	1.8	*	1.6	N.S	1.8	N.S	2.2	**	1.8	*
Height (cm)	1.5	N.S	1.7	*	1.7	N.S	1.8	N.S	1.2	N.S	1.8	*
Length of middle awn central row (cm)	2.2	**	1.6	N.S	2.1	**	1.3	N S	1.7	*	1.5	N.S
Length of middle awn lateral row (cm)	2.1	*	1.8	*	2.1	*	1.4	N.S	1.4	N.S	1.8	*
Number of infertile tillers per plant	1.1	N.S	1.1	N.S	1.1	N.S	0.9	N.S	1.1	N.S	1.2	N.S
Number of fertile tillers per plant	1.4	N.S	1.4	N S	1.4	N.S	1 4	N.S	1.2	N.S	1.5	N.S
Number of grains per plant	1 5	N.S	1.6	N.S	1.4	N.S	1.8	N.S	1.6	N.S	1.6	N.S
Weight of grains per plant (gm)	1.5	N.S	1.7	*	1.4	N.S	2.0	*	1.6	N.S	1.6	N.S

V.R.[1] = between accession mean square/within accession mean square.

Sig[2]. = significance.

* = $P \leqslant 0.05$

** = $P \leqslant 0.01$

N.S = Non-significant.

These indications of significance levels are used throughout.

the rumen for 24 hours through the fistula. After removing from rumen, the samples were dried and analysed for crude protein and crude fibre. The digestibility of dry matter, crude protein and crude fibre was calculated on the basis of loss in nutrients in rumen during suspension (Anwar, 1970).

RESULTS AND DISCUSSION

Chemical Analysis of Grasses

The proximate composition of the grasses under test has been shown in Table 1. Dry matter was observed to be generally higher in local varieties than that of exotic. However, *Pennisetum orientale*, an exotic variety, showed the highest crude protein (15.9 per cent). The crude protein content of exotic varieties was higher than that of local varieties. All the varieties had almost similar ether extract values. The local varieties had higher crude fibre and NFE contents than those of exotic varieties. The exotic varieties had higher total mineral content than that of local varieties.

Digestibility

In-vitro digestibility : The dry matter, crude protein and crude fibre digestibi-

Table 1. *Percentage proximate composition of exotic and local varieties of range grasses*

Names of grass species	Dry matter	Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Total ash
Exotic						
Pennisetum purpureum	23.2	14.5	2.9	26.2	39.1	17.3
Pennisetum orientale	26.2	15.9	2.6	27.4	39.4	15.1
Panicum maximum	31.4	13.1	3.1	27.4	45.3	13.0
Chloris gayana	34 0	14.2	2.3	27.9	42.3	13.2
Local						
Cenchrus ciliaris	29.4	13.8	2.7	28.0	42.4	13.7
Panicum antidotale	32.0	11.7	3.4	30.6	43.0	11.7
Cynodon dactylon	53.0	10.2	2.0	26.1	48.1	10.0
Heteropogon contortus	36.4	13.1	2.7	29.5	36.9	13.1

lity coefficients have been shown in Table 2. The dry matter digestibility ranged from 44.0 to 67.5 per cent in exotic varieties, being higher than in local varieties. However, crude protein and crude fibre digestibilities were higher in local varieties.

Table 2. *Percentage digestibility of different nutrients by in-vitro and in-vivo-vitro techniques*

Name of grass species	Digestibility coefficients					
	Dry matter		Crude fibre		Crude protein	
	In-vitro	*In-vivo-vitro*	*In-vitro*	*In-vivo-vitro*	*In-vitro*	*In-vivo-vitro*
Exotic						
Pennisetum purpureum	67.0	77.3	8.0	20.3	69 8	72.2
Pennisetum orientale	67.5	72.9	18.2	27.8	60.0	76.4
Panicum maximum	44.0	70.1	17.7	22.0	65.5	66.5
Chloris gayana	54.4	66.9	20.7	24.1	66.1	69.6
Local						
Cenchrus ciliaris	66.5	75.9	21.5	27.5	71.7	75.0
Panicum antidotale	60.5	72.3	31.8	36.7	71.7	77.0
Cynodon dactylon	36.0	60.6	10.2	14.7	61.2	64.9
Heteropogon contortus	45.0	66.9	26.0	32.5	65.2	72.9

In-vivo-vitro digestibility : Dry matter, crude protein and crude fibre digestibility coefficients have also been presented in Table 2. The dry matter digestibility was higher in case of exotic varieties than that of locals, the values being 66.9 to 77.3 and 60.6 to 75.9 per cent, respectively. These were similar to *in-vitro* digestibility results. Crude fibre digestibility by *in-vivo-vitro* technique was higher in local varieties than in exotic varieties, showing similarity with *in-vitro* results. Crude protein digestibility, however, did not differ much between local and exotic varieties. The digestibility of crude protein in all the varieties ranged from 64.9 to 77.0 per cent.

The exotic varieties *Pennisetum purpureum* and *Pennisetum orientale* showed higher dry matter digestibility. Gill and Gill (1974) and Burns *et al*

(1978) also reported similar findings. *Cynodon dactylon* showed the lowest dry matter digestibility which supported the results of Olubajo *et al.* (1974). The crude fibre digestibility observed during this study showed lower values as compared to those reported by Hamid (1972) and Binnie *et al.* (1974). This might be due to the effect of stage of growth, varieties and variations in the techniques employed. Differences in the values by *in-vitro* and *in-vivo-vitro* techniques ranged from 5 to 10 per cent. The results were higher in case of *in-vivo-vitro* techniques (Velloso *et al.*, 1978). On the basis of the results of this study, it may be concluded that the exotic varieties *Pannisetum orientale* and *Pennisetum purpureum* and local varieties *Cenchrus ciliaris* and *Panicum antidotale* had higher merit on the basis of chemical composition and digestibility values.

The exotic varieties *Panicum maximum* and *Chloris gayana* and the local variety *Heteropogon contortus*, however, may be considered as grasses having moderate value In contrast, the local variety *Cynodon dactylon* although is high yielding but contains less nutrients with low digestibility when compared with other varieties.

REFERENCES

AOAC. 1980. Official Methods of Analysis of the Association of Official Analytical Chemists, 13th ed. Washington D.C., USA.

Anwar, M. 1970. Studies on the comparative digestibility of different fodders in cows and buffaloes. M.Sc. Thesis, Univ. of Punjab, Lahore.

Binnie, R.C., F.J. Harringtan and J.C. Murdoch. 1974. The effect of cutting height andn nitrogen level on the yield, *in-vitro* digestibility and chemical composition of Italian ryegrass swards. J. Brit. Grassland Soc. 29 (1) : 57-62.

Burns, J.C., D.H. Timothy, R.D. Mochrie, D.S. Chamblee and L.A. Nelson. 1978. Animal preference, nutritive attributes and yield of *Pennisetum flaccidum* and *Pennisetum orientale*. Agron. J. 70 (3) : 451-456.

Gill, S.S. and R.S. Gill, 1974. Effect of stage of maturity on the nutritive value of Hybrid Napier, Indian J. Animal Sci. 44 (9) : 615 617.

Hamid, M H. 1972. *In-vivo-vitro* evaluation of *Cenchrus ciliaris* (Linn) at different stages of growth with special reference to cellulose digestion in rumen. M.Sc. Thesis, Univ. of Agriculture, Faisalabad.

Johnson, W.L., J. Guerreno and D. Rozo. 1973. Cell wall constituents and *in-vitro* digestibility of napier grass (*Pennisetum purpureum*). J. Animal Sci. 37 (5) : 1255-1261.

Olubajo, F.D., P.J. Van Soest and V.A. Oyenuga. 1974. Comparison and digestibility of four tropical grasses grown in Nigeria. J. Animal Sci. 38 (1) : 149-153.

Velloso, L., M. Prachnov and W. Steasza Cappa. 1978. Forage production and nutritive value of pasture of guinae grass (*Panicum maximum*). Boletin de Industrial Animal, 35 (2) : 235-245 (Nutr. Abst. Rev., 51 : 686, 1980.).