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PHENOTYPIC MANIFESTATION OF PRIMITIVE BARLEYS

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The phenotypic performance of 14 accessions of Chitralean naked barleys collected from altitudes ranging from 2290 3500 metres was compared with a hulled variety T5. Flag leaf area biomass weight, number of ears per plant were significantly higher than T5, both at accession level as well as plant level. Accession 707 out-yielded all other accessions with a grain weight recorded at 73.0 gm. per plant which is unusual of a primitive to excel the standard. However, acc. 488 combines higher grain weight per plant with high protein content, which combination warrants future exploitation. Potential of some strains as new introduction in plants is also high.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is one of the oldest and dependable cereals, domesticated by man since before the recorded history. It shows a wide ranging adaptability to various climates. However, it is generally cultivated in the temperate regions of the world. On higher altitudes, barley is still the major grain crop as wheat does not thrive well there.

Hawkes (1976) remarked that there exists a very wide gene pool in wild species for our mostly cultivated crops. Furthermore, wild germplasm is usually disease free so the breeders must resort to wild germplasm in order to induce desiarble characters in the cultigens.

Witcombe and Rao (1976) and Rao and Witcombe (1977) concluded that naked barleys are predominantly grown on higher elevations of the mountain systems of the sub-continent and possess a range of useful genetic variability. This confirmed the earlier finding of Brucher and Aberg (1968) who stated that in the Chitral Region barley is the only crop grown at the upper limits of the agriculture.

Dixit (1973) reported that grain yield of barley was genotypically and phenotypically associated with number of tillers and leaf width. He further added that days taken to earing showed a negative correlation with culm height.

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Pomeranz *et al.* (1976) reported that protein content was highest in six rowed hulless spring and lowest in six rowed covered winter cultivars.

In plains barley is not relished much and has been competed out by wheat to a great extent. To effect improvement in this historically dependable cereal it's grain quality and quantity can be improved by utilizing the desirable traits available in its gene pool. The use of its primitive cultivars as either parent or as new introductions may be an answer to it and the diminishing credibility of this crop may be re-established.

MATERIALS AND METHODS

Fourteen hulless (naked) accessions of primitive Chitralean barley cultivars, made available by the Netherlands-Pakistan Germplasm Expedition, 1976 were sown at the experimental area of the Botany Department, University of Agriculture, Faisalabad, during 1977, alongwith control, hulled variety T5. Forty eight seeds of each accession were planted with the help of a dibbler maintaining plant to plant and row to row distances of 30.0 cm and 60.0 cm respectively. First ten plants of each accession were earmarked to record the data for the characteristic listed below. It was presumed that the seed stock used was heterogeneous, therefore the experiment was not replicated. However, every effort was made to keep other environmental factors uniform to a possible extent.

1. Stem height, 2. Days taken to earing, 3. Number of mature ears per plant, 4. Biomass weight, 5. Flag leaf area, 6. Total grain weight per plant, 7. Total protein content of single plants.

Final stem height was measured in centimeters from ground level to base of main ear. The date of earing was recorded when half of the ear had emerged out of the leaf sheath. The number of ears per plant was recorded just after harvesting and their total biomass weight and total grain weight per plant were taken in grams. Flag leaf area was calculated with the help of a formula: Length × Breadth × 0.75. Total protein content was determined through Macro Kjeldahl method of analysis.

RESULTS AND DISCUSSION

Variability is a fundamental characteristic of living things and these primitive barleys were not exception to this principle. The variations exhibited

Tabe 1. *Comparison of cardinal limits of various characteristics of naked barley with T5*

Characteristics	Among Accessions (Cardinal limit/Accession)				Among Plants (Cardinal limit/Accession)				Among Plants of T5 (Cardinal limits)	
	Max.	Acc.**	Min.	Acc.	Max	Acc.	Min.	Acc.	Max.	Min.
1. Plant Height	98.7 (3.6)*	488	67.1 (3.3)	726	115 P_2*** (3.6)	488	32 (3.6)	P_1 338	85 P_6	42 P_1
2. Days taken to heading	130.6 (4.1)	639	80.1 (6.1)	337	142.00 P_5 (7.9)	338	61.00 (3.2)	P_{10} 379	128 P_8	117 P_7
3. Mature ears plant	22.1 (3.4)	379	7.8 (4.1)	338	46.00 P_3 (3.9)	707	2.00 (4.1)	P_7 338	19.00 P_{13}	4.00 P_5
4. Biomass Weight	167.07 (26.86)	707	27.82 (6.36)	338	183.00 P_3 (6.5)	337	9.3 (13.3)	P_8 329	85.7 P_8	20.7 P_6
5. Flag leaf area	46.5 (3.8)	488	16.4 (1.1)	190	63.9 P_4 (3.8)	379	5.41 (4.3)	P_{10} 492	23.00 P_8	16.5 P_3
6. Total grain per plant	60.32 (8.36)	707	18.7 (3.7)	190	73.00 P_8 (8.36)	707	11.4 (7.28)	P_4 488	43.7 P_{10}	18.7 P_6
7. Total protein content	—	—	—	—	14.6 P_7	726	9.5	P_{10} 488	12.0	—

*Standard Error

**accession

***P denote plant and the figure preceding it is the number of plant of that accession.

by them (Table 1) is much more pronounced and is in line with the findings of Hawkes (1977), who stated that primitive and wild stocks possess enormous variability for adaptation and a wide gene pool exists among them.

Regarding individual characters the magnitude of the variation is even higher. Pertaining to stem height, the tallest and the shortest accessions measured 98.7 cm and 67.1 cm collected from Bandak (acc. 488 alt. 3500 m) and Mogh (acc. 726 alt. 3070m), respectively. At plant level even greater amount of variability was recorded, the tallest (488 P_2) measured 115.00 cm endemic to Bandok while the shortest being 32.0 cm of (acc. 338 P1 alt. 2850m). Fig. 2 is an indirect indication that stem height is not influenced by the altitude; on the whole no correlation was found between stem height and grain yield, a fact contradicting Dixit (1973) who reported positive correlation between these two characters. Generally these barley stocks are tall stemmed as compared with T5 (max. 85.0 cm).

Days taken to heading is another character showing enormous amount of variation. Among accessions, 639 (alt. 3000m) from Dobargar is the latest earing population taking 130.6 days, while acc. 338 P5 (alt. 2850m) took 142.0 days for earing. However, acc. 337 (alt. 2850m) was found early heading and took 80.1 days for flowering whereas 379 P10 (alt. 2920m) took only 61.0 days to flower. T5 headed after 120 days. A haphazard behaviour of heading time with regard to altitude is seen in fig. 2, therefore this phenomenon of flowering is generally controlled by photoperiod and prevailing temperature. Regarding mature ears and biomass weight per plant these barleys are much superior to T5.

The maximum number of mature ears were 29.1 in acc. 379 (alt. 2920m). Among plants still greater number of ears (46.0) was counted in acc. 707 P3 (alt. 2550m). T5 presented 19 ears per plant on the whole. It was observed that high yielding accessions were endemic to relatively higher altitude. It appears as if altitude favours ear development positively in the naked barleys (fig. 2). Flag leaf area among accessions ranged from 16.4 cm to 46.5 cm. Among single plants the range of variation is 5.3 to 63.9 cm. It is interesting that neither width nor the length of flag leaf showed any significant correlation with grain yield, a fact contradicting Dixit (1973) and Chowdry *et al.* (1ep976) who rorted positive and significant correlation of length and width of flag leaf with grain yield. This seems to be a good criterion to adjudge the primitiveness of such genetic stocks.

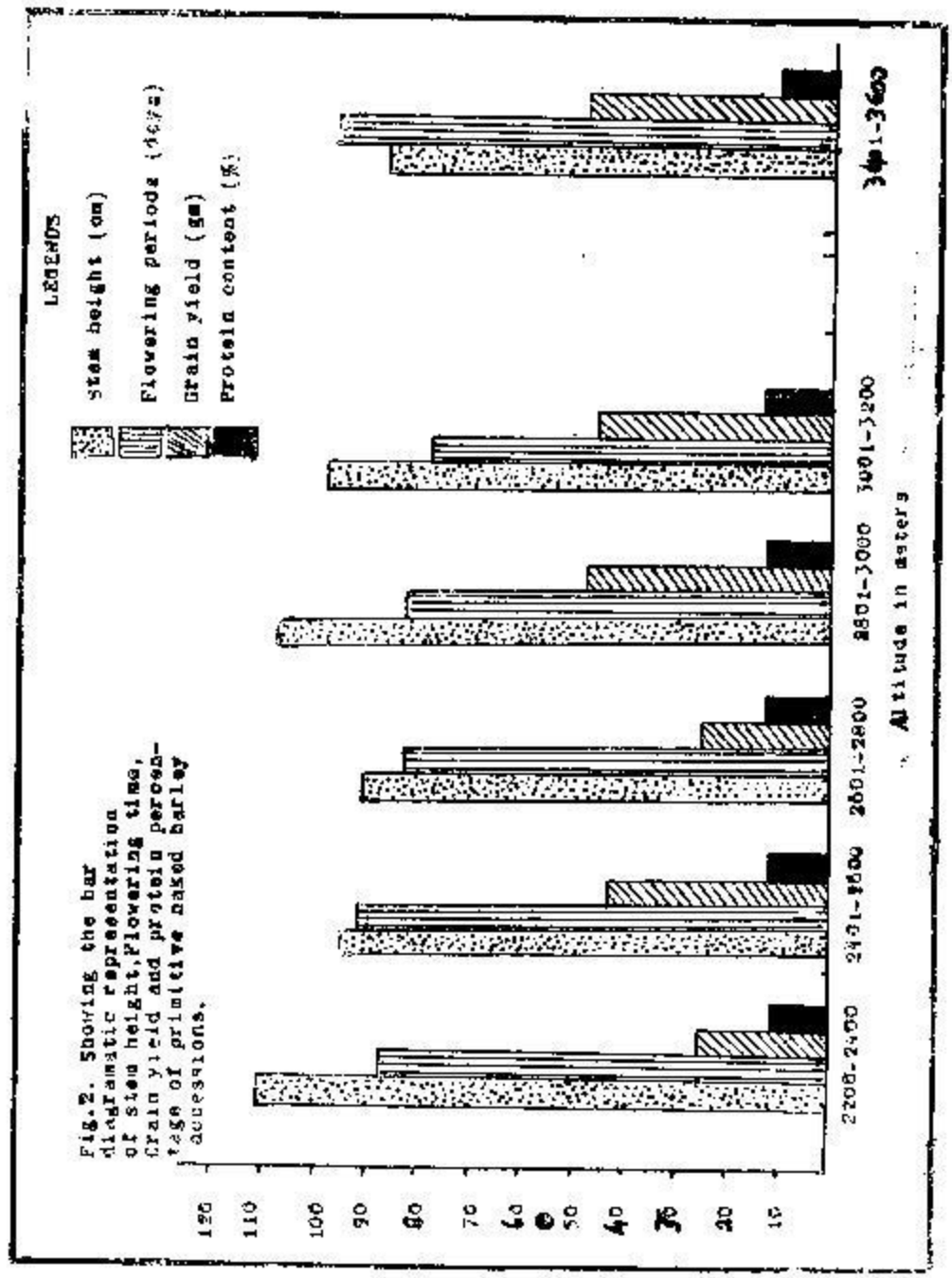

Fig.2. Showing the bar diagramatic representation of stem height, Flowering time, Grain yield and protein percentage of primitive naked barley accessions.

With regard to total grain weight acc. 707 endemic to Ourshik (alt. 3070m) yielded 60.12 gm, the highest per plant. Among plants P8 of the same accession yielded 77.00 gm. being the maximum. Fig. 2 reveals that in general the grain yield increases with altitude, however, third category (3800–3000m) is an exception to this reduction. Since the yield is a very complex and quantitative character, therefore, its phenotypic expression depends upon functioning and interaction of many physiological components in a particular environment. It seems that these spring barleys got adapted to the climate of Faisalabad. On the basis of grain yield performance of a number of accessions and individual plants excelling the check variety it undoubtedly speaks of their genetic superiority. The promising nature of some of them necessitates further trails. Their use as elite parent is yet another important possibility of utilization. Grain yield and fertile tillers showed a positive correlation which is in confirmity with Solanki and Bukhshi (1973) and Sharma *et al.* (1973).

Protein being a basic component of human and animal bodies, like other research workers attracted our attention too. The analysis of total protein content of these primitive barleys proved rewarding in the sense that not only these naked barleys excelled the covered check variety T5, but also proved heavy yielding than the control, therefore T5 does not seem to be matching them in any way. There are indications to get some positive correlation between yield and protein content. These results confirm the earlier finding of Pomeranz *et al.* (1976), who concluded that six rowed hulless spring barleys yield higher proteins.

Witcombe and Rao (1976) and Rao and Witcombe (1977) established the naked group of barley as a separate entity than that of husked group. The magnitude of genetic diversity, its adaptability and performance is superior than that of husked group (husked barley being published elsewhere). Hence this gene pool of naked barley offers a unique opportunity of directly introducing some accession/plant as 'New crop' of the plains of Punjab coupled with enhanced yield and protein content.

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