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Metroglyph Analysis in Two Species of *Hordeum*

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Abstract: Patterns of morphological variation in *Hordeum* species were determined by metroglyph analysis which revealed apparently four clusters comprising more than one line out of 15 studied. Cluster I was comprised of Centinella and Conquest of *H. vulgare*. Cluster II was comprised of single line of *H. nudum* and four lines (API-19, BEL-34, BEL-72 and BTON-10) of *H. vulgare*. Cluster III and IV were consisted of BEL-4, BTYN-8 and BTYN-37 and BEL-16, BHV-1, BHV-91, BHV-95 and BHV-105 of *H. vulgare* respectively. These clusters showed distinct graduation for breadth of flag leaves i.e., low (cluster I), relatively low (cluster III), intermediate (cluster II) and high (cluster IV). The ray's pattern for 11 morphological characters on the glyph among the clusters revealed a marked variation for the presence or absence of rays.

Key words: Metroglyph, morphology, cluster, ray, *Hordeum* species

Introduction

The genus *Hordeum* belongs to the family Graminae and includes three cultivated species namely *H. vulgare, H. distichum* and *H. irregulare* which are either summer or winter annuals. The *Hordeum* species present much variation morphologically, but there is not yet unanimity about the status of some species. Two species of barley are *H. spontaneum* and *H. agriocrithon* and they are readily crossed with cultivated species. However, probably more than 250 varieties of barley have been released till today. They yield more than the older varieties and often have other advantages such as resistance to disease, insects and drought, greater winter hardness, stiff straw and smooth awns (Wiebe, 1947). Winter barleys are grown for soil cover, but primarily to obtain higher production associated with earlier maturity. About 50 winter or semi-winter varieties, all six-rowed types are grown commercially. Spring barleys are much more widely grown than winter varieties over most of the world. Two-rowed spring barley is the most prevalent than the six-rowed. Thus a metroglyphic analysis is needed to observe the pattern of morphological variation in *Hordeum* species. Metroglyph is a semi-graphic method of studying variability in a large number of germplasm lines taken at a time. The variation is studied within a group as well as among the groups. The analysis of variation is based on the mean values for different traits. Anderson (1957) proposed metroglyph and index score method to study the pattern of morphological variation in crop species. This technique has been used by several workers (Ramanujam and Kumar, 1964; Mukherjee *et al*., 1971; Venkatarao *et al*., 1973; Singh and Chowdhury, 1974) in various crops. This effort has not yet been carried out in *Hordeum* species, which may also be of help in predicting their relationships for classification problems. Thus a metroglyph analysis was made in different species of *Hordeum* to draw a conclusion for the aforesaid problems.

Materials and Methods

The experiment was conducted in the University Farm of Rajshahi University, Bangladesh in the year 2000. Fifteen species of *Hordeum* (Table 1) were grown following complete block design with three replications. Observations were made on 10 plants randomly selected for 11 morphological characters.

Metroglyph and index score method (Anderson, 1957; Mehra and Anderson, 1969) were used. From the data, a mean table was prepared where each value was the mean over replication. A particular line or species was represented by a glyph, the X-axis being the number of seeds per ear and the Y-axis being the plant height. Nine other characters were represented by rays on the glyph, the ray for same character having the same position in each glyph. The range of variation in each character was represented by varying length of rays i.e. a line having low value with no ray, medium value with short ray and high value with long ray. The index values were considered on the basis on range of variability and were divided into three classes i.e., 1-no ray, 2-short ray and 3-long ray. The total index values were recorded by summing up the index scores of all the 11 characters studied.

Table 1: Sources of different varieties/ lines of two species of *Hordeum*

Sl No.	Species	Varieties/lines
1	*Hordeum nudum*	-
2	*Hordeum vulgare*	API-19
3	*Hordeum vulgare*	BEL-4
4	*Hordeum vulgare*	BEL-34
5	*Hordeum vulgare*	BEL-36
6	*Hordeum vulgare*	BEL-72
7	*Hordeum vulgare*	BHV-1
8	*Hordeum vulgare*	BHV-91
9	*Hordeum vulgare*	BHV-95
10	*Hordeum vulgare*	BHV-105
11	*Hordeum vulgare*	BTON-10
12	*Hordeum vulgare*	BTYN-8
13	*Hordeum vulgare*	BTYN-37
14	*Hordeum vulgare*	Centinella
15	*Hordeum vulgare*	Conquest

Results and Discussion

The way of analyzing the morphological variations among 15 species of *Hordeum* appeared to follow variation of pattern as revealed by assigning score to the variabilities and then compared with the pattern or score. The results of such metroglyph analysis (Fig. 1) were considered to study the pattern of morphological variation. The minimum and maximum scores were nx1 and nx3, respectively where n was the total number of characters included in the study. The performance of a genotype was denoted by the index score of that genotype and depending upon the score represented by the varying length of rays. Two most variable characters, the number of seeds per ear and plant height were used for determining the X-axis and Y-axis to plot a graph and thus for construction of metroglyph pattern (Singh and Chaudhary, 1979). Placement of glyph on the graph indicated that these two characters were related to each other; there was a definite increase in seeds per ear for every unit increase in plant height and the placement of glyphs substantiated the relationship. Besides a few characters were found to increase with respect to the variable characters and in such cases the placement of the glyphs would be different, if other pair of characters are

Table 2: Class intervals, index values and distribution of scores of Hordeum species under different character intensities

Characters	Range of mean	Index values 1 Range	1 Sign	2 Range	2 Sign	3 Range	3 Sign
Plant height (cm)	67.23-99.88	78.14 (4)		78.15-89.01 (4)		89.02 (7)	
No. of tillers/plant	6.50-14.23	9.08 (4)	0	9.09-11.67 (7)		11.68 (4)	
Internode lenght (cm)	21.19-34.11	25.50 (6)	0	25.51-29.82 (3)		29.83 (6)	
Lenght of flag leaf (cm)	10.79-14.59	12.06 (4)	0	12.07-13.34 (6)		13.35 (5)	
Breadth of flag leaf (cm)	0.66-1.04	0.79 (3)	0	0.08-0.93 (5)		94.00 (7)	
Ear lenght (cm)	6.60-11.09	8.10 (4)	0	8.11-9.61 (8)		9.62 (3)	
Days to heading	54.00-60.30	56.10 (6)	0	56.11-58.21 (5)		58.22 (4)	
No. of spikelets/ear	16.40-25.53	19.44 (7)	0	19.45-22.49 (6)		22.50 (4)	
No. of seeds/ear	31.16-50.13	37.48 (3)		37.49-43.81 (7)		43.82 (5)	
Seed wt. (mg)/ear	1.25-1.97	1.49 (6)	0	1.50-1.74 (6)		1.75 (3)	
100 seed wt. (mg)	2.81-4.51	3.38 (6)	0	3.39-3.96 (5)		3.97 (4)	

(Number of score shown in parentheses), Index values: 1= no ray, 2= short ray and 3= long ray; 0= glyph or circle

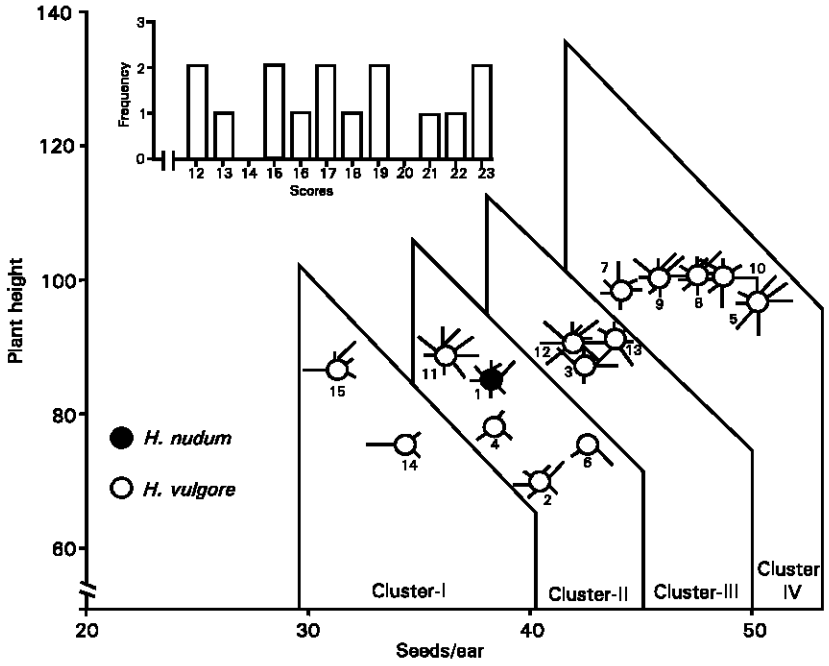

Fig. 1: Metroglyph diagram of various characters in two species of *Hordeum*. The different lines of two species can be identified by the Nos. which are same as in Table 1

considered for X and Y axis. Thus, metroglyph analysis has some limitations. However, it may be speculated from the present study that variation for a number of characters among the lines of *Hordeum* species may be less due to conservation of genes. However, maximum variability observed between these two characters e.g. plant height and number of seeds per ear could be due to high genetic correlation. Presence or absence of ray and also the length of rays on the glyph among the clusters and within a cluster showed marked variations.

Cluster-I was represented by two lines found to be distinguishable by their ray patterns. This cluster showed high values for no. of tillers per plant, medium values for breadth of flag leaf and 100 seeds weight. Similar results were obtained in three *Cicer* species namely *C. arietinum*, *C. cuneatum* and *C. judaicum* (Kabir *et al.*, 1993). Cluster-II consisted of 4 lines and they were also distinguishable by the pattern of rays. High value for the breadth of flag leaf, no. of tillers and 100 seeds weight and low value for internode length were observed in this cluster. Three lines consisted cluster-III and two of them showed high values for the length of flag leaf, no of tillers per plant, seed weight per ear and 100 seeds weight and low values for no. of spikelets. BEL-4 revealed low values for no. of tillers per plant, breadth of flag leaf, days to heading, seed weight per ear and 100 seeds weight. Cluster-IV was represented by 5 lines. This cluster showed low values for 100 seeds weight and high values for internode length, breadth of flag leaf, length of flag leaf, ear length, days to heading, no. of spikelets and seed weight per ear. Jaiswal (1984) also reported high values for 100 seeds weight in *Cicer* species. Using suitable class intervals, the range of variability with regard to a character was classified into three groups (Table 2). The sum of index values based on all characters allotted to an individual is the indication of individual's worth. The range of variability for plant height was from 67.28 to 99.88 cm. Out of 15 lines, 7 lines were under long ray, 4 lines were under short ray and other 4 lines had no ray.

Findings of Ladizinsky (1975) suggested that the two species of *Cicer arietinum* and *Cicer reticulatum* have morphologically close resemblance. In present study the two species of *Hordeum* were found to form different clusters associated with different ray patterns. However, there was resemblance in the rays for different characters among the lines of these two species of *Hordeum*. The score for a given character was same between most of the lines of *Hordeum*. Results indicated that lines of 2 and 11 of *H. vulgare* and *H. nudum* have resemblance for most of the

characters namely breadth of flag leaf and no. of tillers. Moreover, hybridization between these two species could be a possibility to account for the observed resemblance. Jaiswal *et al*. (1984) suggested that some of the diversity of common type chickpea might have originated through introgression of genes from *Cicer reticulum* into *Cicer arietinum*.

Findings discussed above suggested that despite the formation of different clusters among 15 lines of *Hordeum* species they showed more resemblance for many characters and a few diversity among them might have originated through introgression of genes. It may also be mentioned that the method of analysis despite its limited application helped to ascertain the diversity among 15 genotypes of *Hordeum* species.

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