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GENETIC DIVERGENCE IN RAINFED BARLEY (*Hordeum vulgare* L.)

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ABSTRACT

Thirty two genotypes of barley were collected from different centres of India including some exotic strains. These were planted in rainfed condition and clustering of genotypes was done by means of Mahalanobis' D^2 analysis and Anderson's metroglyph clustering. In the first case the cultures grouped themselves into 6 clusters. No relation was found between geographical and genetic diversity. From the *per se* performance, intercluster distance and cluster composition, it was inferred that Karan-15 may be crossed with LHDP-238, (a), Karan-19 (b), Karan-521 (c), BCB (Hyl)-7 (d), Karan-201 (e) LLK-224 (f), or BON (MRA)-13 (g) for overall yield improvement on the basis of D^2 - analysis. In case of metroglyph analysis, the genotypes were grouped into 7 clusters. The prospective cross on the basis of later one predicted, such as 'a', 'd', 'e', 'f' and 'g' were common for both analysis. Therefore, it can be concluded that Anderson's metroglyph analysis although not comparable to D^2-analysis, could be a meaningful support to D^2 and in the absence of systematic clustering, could be a good indicator at field level.

KEY WORDS: Barley, Divergence, D^2-analysis, Metroglyph

Among the succeeding crops in rice based cropping system 'barley' possesses immense potentiality, to grow under moisture stress situation. Hence crop improvement leading to higher productivity under this problematic situation could be a good alternative. Study of diversity of parents is a pre requisite for any hybridization programme. More heterotic F_1's and broad sprectum variability could be obtained in the segregating generation by crossing diverse parents (Arunachalam, 1981). Therefore the present study was undertaken to identify the diversity among the collection of 32 genotypes grown under rainfed situation in the field previously occupied with rice.

MATERIALS AND METHODS

Thirty two barley genotypes were collected from diverse sources like barley coordinated cell, Karnal, Indian Agricultural Research Institute (I.A.R.I.), New Delhi; International Centre for Agricultural Research in Dry Areas (I.C.A.R.D.A.), Aleppo, Syria; Jaipur, (Rajasthan) ; Kanpur etc. These were sown at Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during November 1992 with a spacing of 20 x 10 cm in a plot consisting of three lines of thirty single plant hill rows each in randomised block design with 3 replications.

All the recommended package of practices were adopted for rainfed situation. Five competitive plants were tagged from the middle row and observations were recorded for seven quantitative characters.

Data were analysed for Genotypic Coefficient of variation (G.C.V.) and Phenotypic Coefficient of variation (P.C.V.) as per Burton (1952). Estimates of genetic divergence were based on multivariate analysis using Mahalanobis' D^2 Statistic or described by Rao (1952). The genotypes were grouped into clusters by Tocher's method (Rao, 1952). The criterion used was that any two parents belonging to the same cluster at least on an average shows a smaller D^2 value than those belonging to two different clusters.

The mean observations of all the characters were taken into account to draw the metroglyph scattered diagram again (Fig. 1). Here the character 'seed yield' was presented in 'X axis'. From the remaining traits the most variable character, i.e., weight of ear, was taken in 'Y axis' and graphical representation of genotypes was done. The range and index score of each character was presented by different length of rays and the different parameters by position of the rays on the glyph. (Table-4).

RESULTS AND DISCUSSION

The analysis of variance revealed that there was highly significant difference among the genotypes for all the seven characters indicating the presence of sufficient variations for all the characters. Phenotypic coefficient of variation was higher than the genotypic coefficient of variation. Weight of ear, No. of fertile grains/ear, 1000-grain weight and yield/plant exibited higher P.C.V. as well as G.C.V. indicating higher variation of these traits in comparison to others (Table - 4).

The D^2 value among the genotypes ranged from 1.75 between cultures, PL-157 and DL-3 (both of them collected from I.A.R.I., New Delhi) to 131.74 between collections LLK-224 and Karan-4, which were collected from I.C.A.R.D.A., Syria and Barley Coordinated Cell, Karnal respectively, indicating the diversity of the genotypes. Based on the genetic distance the 32 genotypes were grouped into six clusters (Table-1). The cluster-1 constituted 11 genotypes where as cluster-II was the largest cluster comprising 16 genotypes. Cluster-III had got 2 cultures whereas clusters-IV, V and VI were mono-genotypic each.

There was no correspondance between genetic diversity and geographical origin as was found in present study. The genotypes from I.A.R.I., New Delhi, viz. DL-3, DL-100, DL-157, DL-349, BCB (EL)-43 ; Barley coordinated cell, Karnal viz. Karan-3, Karan-4 ; Kanpur viz. K-226, Jyoti ; I.C.A.R.D.A., Syria viz. Karan-3, Karan-4 ; Kanpur viz. K-226, Jyoti ; I.C.A.R.D.A., Syria viz. Bon (MRA)-52, BCB (EL)-43 and RS-6 from Rajasthan were found to constitute the same cluster (Table-1). Similar reports by Engels (1994) supported the

Table-1 : Clusters formed on the basis of Mahalanobis's D^2-analysis

Clusters	No.of strains	Name of strains
I	11	DL-157(3), DL-3(1), DL-100(2), K-226(16), Jyoti(15), Karan-4(5), DL-349(30), RS-6(14), Bon (MRA)-52(18), BCB (EL)-43(32), Karan-3(4)
II	16	Karan-280(12), BCB(HyL)-8(21), BCB(EL)-33(20), BON(MRA)-13(25), LHDP-246(26), LLK-224(31), Karan-16(7), BCB(EL)-42(19), LHDP-236(23), LLK-25(22), BCB(HyL)-5(29), Karan-19(08), strain BCB (HyL)-1(27), Bon (MRA)-24(17), Karan-521(13), BCB (HyL)-7(28),
III	2	Karan-163(10), Karan-201(11)
IV	1	Karan-92(9)
V	1	Karan-15(6)
VI	1	LHDP-238(24)

No. in the parenthesis indicates the serial Nos. of genotypes.

Table-2 : Average intercluster and intracluster distance - D^2 and D values (in parenthesis) in barley genotypes.

Clusters	I	II	III	IV	V	VI
I	13.99 (3.74)	45.83 (6.77)	73.62 (8.58)	26.73 (5.17)	65.77 (8.11)	39.69 (6.30)
II		15.37 (3.92)	25.70 (5.07)	60.99 (7.81)	98.80 (9.94)	19.62 (4.43)
III			7.02 (2.65)	81.54 (9.03)	102.21 (10.11)	39.56 (6.29)
IV				0.00 (0.00)	25.00 (5.00)	69.22 (8.32)
V					0.00 (0.00)	110.46 (10.51)
VI						0.00 (0.00)

Table-3. Mean values of different clusters in respect of 7 traits of barley

Traits	I	II	III	IV	V	VI
Plant height (cm.,)	48.87	50.91	38.87	54.17	50.68	55.13
No. of tillers/ plant	3.30	3.03	3.06	3.20	3.67	4.07
Ear length (cm.)	13.75	13.23	13.10	13.14	13.51	15.04
Mean weight of ear (g)	2.34	2.02	1.57	2.59	2.60	1.28
Number of grain /ear	49.46	43.07	40.50	73.93	60.13	44.93
Test weight (g.)	41.54	42.99	33.70	37.84	39.85	47.75
Grain yield/ plant	5.44	3.10	2.84	6.38	6.67	2.98

Table-4 : Range of variability, G.C.V., P.C.V., index score and sign for different characters in 32 Barley genotypes.

Characters	Range of Variability	G.C.V.	P.C.V.	Index Range	Score I Sign	Index Range	Score II Sign	Index Range	Score III Sign
Plant Height	38.13 - 63.54	13.02	14.40	38.13 - 46.60	⊙	46.60 - 55.07	⊙	55.07 - 63.54	⊙
Eff. Tiller No.	2.33 - 4.07	9.91	18.88	2.33 - 02.95	⊙	2.95 - 03.57	⊙	3.57 - 04.20	⊙
Ear Length	12.79 - 16.23	5.51	9.09	12.79 - 13.93	⊙	13.93 - 15.08	⊙	15.08 - 16.23	⊙
Wt. of Ear	1.27 - 02.77	20.59	25.16	1.27 - 01.77	⊙	1.77 - 02.27	⊙	2.27 - 02.77	⊙
No. of fertile grains/Ear	34.20 - 73.73	14.15	21.52	34.20 - 47.37	⊙	47.37 - 60.54	⊙	60.54 - 73.73	⊙
1000 grain wt.	30.95 - 49.77	14.02	19.02	30.05 - 37.22	⊙	37.22 - 43.49	⊙	43.49 - 49.77	⊙
Yield/Plant	2.62 - 06.67	31.29	35.72	2.62 - 03.97	⊙	3.97 - 05.32	⊙	5.32 - 06.67	⊙

above findings. Murty and Arunachalam (1966) explained that genetic drift and selection pressure could cause greater diversity than geographic origin alone.

The average intracluster distance (D-Value) ranged from 0.0 (cluster-IV, V and VI having single genotypes) to 3.92 in cluster-II (Table-2). While the closest proximity was observed between cluster-III and VI (average D value-4.43), maximum distance was found between V and VI (10.51) followed by III and V (10.11) and II and V (09.94). Promising hybrid derivatives might result from complementary interaction of divergent genes in crossing those parents. There is also possibility of wide ranging variability in segregating generation. Based on intercluster distance, crossing of genotypes of cluster V and VI or cluster III and V might be useful.

Table-3 depicts the comparison of mean values of seven characters. Semidwarf plant types have been clustered themselves in cluster III, whereas cluster VI contained single genotype

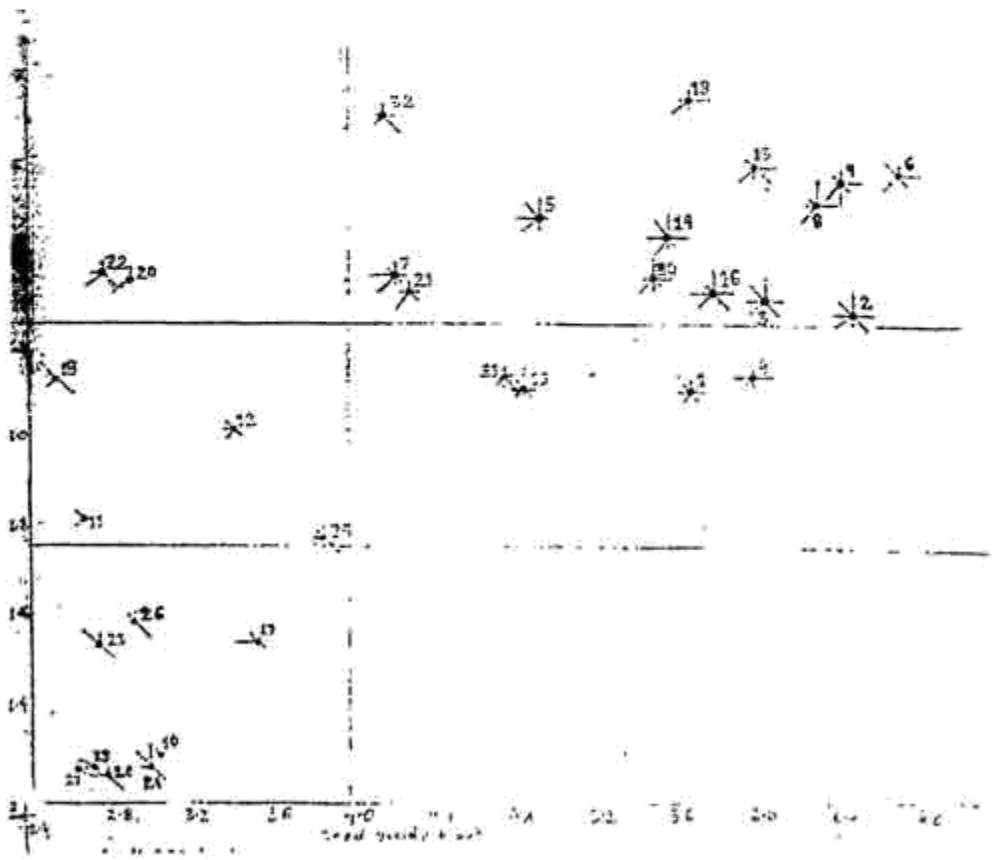

Fig.1. Metroglyph scattered diagram of 32 genotypes of barley.

Table 5. Distribution of 32 genotypes in different groups (as per metroglyph pictorial representation)

Group	Number of genotypes	Genotypes
I	10	DL-100(2), DL-157(3), Karan-15(6), Karan-19(8),Karan-92(9), Karan-521(13), RS-6(14), K-226(16), Bon (MRA)-52(18), DL-349(30)
II	4	Karan-4(5), Karan-16(7), BCB(HyL) -8(21), BCB(EL)-43(32)
III	2	DL-3(1), Karan-3(4)
IV	2	Jyoti (15), LLK-224(31)
V	2	BCB(EL)-33(20), LLK-225(22)
VI	4	Karan-201(11), Karan-280(12), BCB(EL)-42(19), Bon (MRA)-13(25),
VII	8	Karan-163(10), Bon (MRA)-24(17), LHDP-236(23), LHDP-238(24), LHDP-246(26), BCB (HyL)-7(28), BCB(HyL)-5(29), BCB(HyL)-1(27)

Number in parenthesis represent glyph of genotypes in scatter diagram (Fig.1)

having highest plant height, tiller number, ear length and test weight. Cluster V contained a variety having highest weight of panicle whereas cluster IV having Karan 92 had maximum number of fertile grains.

On the basis of cluster composition, intercluster distance in D^2 analysis and *per-se* performance, Karan-15(6) may be crossed with Karan-20(11), Karan-19(08), Karan-521(13), BON (MRA)-13(25), BCB (Hyl)-7(28), LLK-224(31) or BCB (HyL)-8(21) for overall yield improvement.

On the basis of metroglyph analysis and scattered diagram (Fig.1) the entries were classified into 7 groups (Table-5).

Genotypes Karan-15(6), Karan-92(9) and DL-100(2) appeared to be promising parents for rainfed situation, considering high yield and panicle weight. These could be crossed with low to medium yielding, but showing medium to high mean performance for other quantitative traits, from distant groups such as BCB (HyL)-5(29), BCB(HyL)-7(28), LHDP-238(24), BON(MRA)-13(25), Karan-20(11) or LLK-224(31).

The groups based on two most variable character (pictorial representation) although did not match exactly to the D^2-analysis, its predictions about prospective parents largely matched the former one. The parental pairs 6~24, 6~28, 6~11, 6~31 and 6~31 and 6~25 (numbers are previously indicated in parentheses in table-1 and table-5) might be chosen because of their sufficient distance for useful cross as per both D^2 and metroglyph analysis.

Therefore, Anderson's metroglyph pictorial representation and subsequent conclusion may be a meaningful indicator of support in the field level. Because of quick assessment and simplicity its help could be taken in the absence of systematic clustering like D^2 analysis.

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