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GENETIC DIVERGENCE IN LATE SOWN WHEAT (*Triticum aestivum* L. em Thell)

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Forty nine genotypes of wheat (*Triticum aestivum* L. em Thell) suited for late sown irrigated conditions were studied for their genetic divergence for a set of seven characters using Mahalanobis D^2 statistic. The genotypes could be grouped into seven clusters. The genetic diversity among genotypes did not show any relation to geographical diversity. Based on genetic divergence and superior cluster means, it is predicted that crosses between genotypes from clusters II, IV, VI and VII may result in superior types.

Key words : Wheat, genotypes, genetic divergence, hybridization

Choosing genetically diverse parents is a pre-requisite for any plant breeding programme because it enables the expansion of genetic base and there from development of superior types. The use of Mahalanobis' D^2 statistic based on quantitative traits to estimate genetic divergence has been emphasized by many workers (Bhatt, 1973; Jatasara and Paroda, 1983; Dasgupta and Das, 1984; Kuruvadi, 1988) to formulate the hybridization programme before effecting the actual crosses. Besides, the present status of wheat cultivation in North Indian wheat belt includes very few number of wheat cultivars like HD 2285, UP 2338, PBW 373, UP 2425, Raj 3765 and Raj 3077 (Tondon and Sethi, 1998). Of these, many are going to be obsolete. Hence, the genetic diversity of cultivars for late sowings is going to be very narrow. This situation demands diversification of genotypes at cultivar level which needs the availability of the genetic diversity in wheat germplasm which is going to contribute towards the development of late sown wheat.

MATERIALS AND METHODS

The experimental material consisted of 49 elite genotypes of wheat suited for late sowing and contributed by different wheat breeders of IARI, New Delhi and its regional stations located in different mega-environments of wheat cultivation. The experiment was laid out in a randomized block design with three replications during rabi season of 1997-98 under late sown irrigated conditions. Each genotype was planted in a plot having a gross area of 6 m × 1.08 m, with 6 rows at 18 cm apart. The recommended cultural and agronomical practices for late sown irrigated conditions were followed to raise the crop with respect to seed rate, fertilizer and irrigation requirement. Observations were recorded for seven yield contributing characters viz. plant height (cm), relative leaf water content (%), total chlorophyll content (mg/g of flag leaf sample), days to physiological maturity, number of seeds/spike, 1000-grain weight and grain yield/100 tillers. The mean values were subjected to Mahalanobis D^2 statistic to measure genetic divergence as suggested by Rao (1952) and the clusters were formed by Tocher's method (Rao, 1952).

RESULTS AND DISCUSSION

The analysis of variance exhibited highly significant differences among the genotypes for all the seven characters. On the basis of D^2 values, all the 49 genotypes were grouped into seven clusters (Table 1). The maximum number of genotypes were in cluster II (10 genotypes) while cluster V included the minimum number of genotypes (5 genotypes). It was interesting to note that the genotypes belonging to different eco-geographical areas were included in the same cluster. This indicated that there is no association between clustering pattern and eco-geographical distribution of genotypes. Hence, it seems that geographical diversity is not necessarily related to genetic diversity. These findings are on consonance with Bhatt (1970), Thete *et al.* (1987) and Garg and Gautam (1988). The clustering of genotypes from different eco-geographical locations into one cluster could be attributed to possible free exchange of breeding materials or even varieties from one place to another (Sharma and Hore, 1997). This may also be due to the fact that the unidirectional selection practised for a particular trait in several places produced similar phenotypes which were aggregated in one cluster irrespective of their geographic origin (Somayajulu *et al.*, 1970). On the other hand, many genotypes originating from one place were scattered over different clusters. Such genetic diversity among the genotypes of common geographic origin could be due to factors like heterogeneity, genetic architecture of the populations, past history of selection, developmental traits and degree of general combining ability (Murty and Arunachalam, 1966).

Table 1. Group constellation of the genotypes

Cluster	No. of genotypes	Genotypes included
I	6	PS 458, DL97-11, PS 463, GW 173, PS 460, Ind 98-34
II	10	DW 1093, PS 465, DW 1092, DW 1104, DL 97-8, PBW 373, DL 97-12, DW 1119, DW 1111, DW 1118
III	6	DW 1105, PS 456, PS 469, DW 1118, PS 466, Ind 98-32
IV	8	DL 97-9, DW 1120, PS 467, Ind 98-36, DL 97-10, DW 1097, WR 821, PS 464
V	5	Ind 98-35, Ind 98-33, DW 1123, DW 1106, DW 1115
VI	6	PS 461, DW 1114, HW 2045, DW 1102, PS 462, DW 1117
VII	8	PS 470, NIAW 34, PS 468, PS 459, HP 1744, PS 457, PS 455, DW 1122

Sources of genotypes:
IARI, Regional Station, Pusa (Bihar) : PS series
IARI, Regional Station, Indore (MP) : Ind Series
Rust Genetics Group, IARI, N. Delhi : DL series
High Fertility Irrigated Group, IARI, N. Delhi : DW series
Interspecific Programme, IARI, N. Delhi : WR series
Miscellaneous and Standard Checks : GW,HP,NIAW,HW series

The intra- and inter-cluster divergence among the genotypes was of varying magnitude (Table 2). It can be seen that intra-cluster distance was maximum for cluster II while cluster I showed minimum intra-cluster distance. The highest inter-cluster distance was noted between cluster I and II. The distance between cluster III and VII was minimum indicating close relationship between these clusters. The greater the genetic distance between clusters, wider is the genetic diversity between genotypes. The cluster means for each character are presented in Table 3. Cluster VI showed the highest mean for plant height, relative leaf water content, days to physiological maturity and grain yield/100 tillers. The highest mean for total chlorophyll content was observed for cluster II. Cluster IV exhibited the highest mean number of seeds/spike. The maximum mean for 1000-grain weight was observed for cluster III. The lowest mean for plant height, total chlorophyll content, number of seeds/spike and grain yield/100 tillers was observed for cluster I. Cluster VII showed minimum mean for relative leaf water content.

Table 2. Inter and intra cluster distances (D^2 and $\sqrt{D^2}$ values) for 7 characters

Cluster		I	II	III	IV	V	VI	VII
I	D^2 $\sqrt{D^2}$	236.49 (15.38)	674.95 (25.98)	427.32 (20.67)	609.17 (24.68)	299.90 (17.32)	644.48 (25.39)	435.28 (20.86)
II	D^2 $\sqrt{D^2}$		369.61 (19.22)	576.67 (24.01)	461.32 (21.48)	583.79 (24.16)	469.77 (21.67)	510.40 (22.59)
III	D^2 $\sqrt{D^2}$			2567.90 (16.06)	379.24 (19.47)	373.41 (19.32)	437.13 (20.91)	281.64 (16.78)
IV	D^2 $\sqrt{D^2}$				336.06 (18.33)	671.98 (25.92)	373.56 (19.33)	501.46 (22.39)
V	D^2 $\sqrt{D^2}$					244.98 (15.65)	618.37 (24.87)	530.73 (23.89)
VI	D^2 $\sqrt{D^2}$						296.27 (17.21)	367.36 (19.17)
VII	D^2 $\sqrt{D^2}$							270.70 (16.45)

Table 3. Cluster means of 49 genotypes for 7 characters

Cluster	Plant height (cm)	Relative leaf water content (%)	Total chlorophyll content (mg/g)	Days to physiological maturity	Number of seeds/spike	1000-grain weight (g)	Grain yield/100 tillers (g)
I	81.19	56.13	1.74	116.50	37.72	40.67	155.60
II	83.13	57.57	2.96	120.17	45.67	39.78	189.27
III	85.07	58.27	2.35	114.94	38.22	45.66	183.96
IV	84.02	64.49	2.01	117.67	49.92	40.01	196.88
V	87.66	55.20	1.96	120.73	41.40	37.50	155.83
VI	89.80	70.02	2.17	121.06	45.78	42.53	198.78
VII	87.82	51.56	2.09	119.03	40.83	44.13	189.49

Cluster III had the lowest mean for days to physiological maturity. Cluster V exhibited the lowest mean for 1000-grain weight.

On the basis of divergence and grain yield and components of grain yield, it is suggested that maximum heterosis and good recombinants could be obtained in crosses between genotypes of clusters II, IV, VI and VII. This information may be useful to the breeders engaged in varietal improvement programmes of late sown irrigated wheat.

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