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Evaluation of variability parameters, character associations and genetic distance in *Triticum durum* genetic stocks

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Abstract : Genetic diversity was assessed in 42 genetic stocks of *Triticum durum* on the basis of 10 quantitative characters. High magnitude of variation was reflected by a wide range values for all the characters. Six characters i.e., days to heading, plant height, productive tillers per plant, 1000 grain weight, protein content and sedimentation value showed high heritability value which means that these characters are likely to respond to direct selection. Low correlation between 1000 grain weight and yield indicated that the role of 1000 grain weight in enhancing yield appeared to be limited in case of durum wheat and the two traits were behaving independently. Low negative correlation of yield with protein (-0.18) and no correlation with sedimentation value indicate the possibility of evolving varieties with high yield along with high protein content and strong gluten strength. Clusters formed revealed the absence of relationship between geographical distances and genetic divergence. Crossing between cultivars belonging to clusters I, V, VI and VII is expected to give mazimum extent of heterosis for yield. *(Key words : Wheat, Triticum durum, Genetic stocks, Variability and Genetic divergence)*

Triticum durum is the second most important wheat species grown in our country. Thus, with an area of nearly 2.4 million hectares, India is one of the biggest durum growing countries in the world. A clear understanding of the degree of divergence for economic characters in the species will be an added advantage in this regard, as intermating of divergent groups would increase variability and range of frequency distribution. But, no precise information exists on genetic divergence in genetic stocks of *T.durum*. This study was aimed at estimating the degree of genetic divergence and association of economic characters in some genetic stocks of *T. durum* and identifying diverse genotypes to be used in future hybridization programmes to evolve superior varieties.

Materials and Methods

The experimental material comprised of 42 genotypes of wild germplasm of *T. durum* maintained at Genetics Division, I.A.R.I, New Delhi. The materials were grown in randomized block design with three replications for two years (1994 and 1995). All the recommended package of practices were followed to raise a good crop. Observations were recorded on five randomly selected plants on 10 quantitative characters. To study the genetic diversity, the data were analyzed using Mahalonobis D^2 statistic and standard statisticals methods for association and other analysis.

Results and Discussion

Analysis of variance indicated highly significant differences among genetic stocks for all the characters. High magnitude of variation in the experimental material was also reflected by values of range for almost all the characters (Table 1). A close resemblance between the corresponding estimates of PCV and GCV (Table 1) suggests that the environment has little role in the expression of different characters. Highest PCV and GCV were recorded for plant height (17.6 and 15.6) followed by harvest index (17.0 and 15.0), sedimentation value (16.5 and 14.6), grain yield per plant (16.2 and 14.3) and 1000 grain weight (14.6 and 13.8). High co-efficient of variation for these characters is indicative of high magnitude of variability present in the experimental material.

Estimates of heritability varied from 24 per cent (grain yield/plant) to 99 percent (plant height). Six characters, i.e., days to heading, plant height, productive tillers per plant, 1000 grain weight, protein content and sedimentation value showed more than 75 per cent heritability (Table 1). High heritability of these characters might be due to additive gene effects and hence these characters are likely to respond to direct selection (Gandhi et al., 1964).

Correlation studies (Table 2) revealed that heading days has significant positive correlation with plant height and biomass per plant, while negative with productive tillers per plant and harvest index. Plant height has significant negative association with grain per ear, grain yield per plant, sedimentation value and harvest index and positive with 1000 grain weight, protein content and biomass/plant. Grain yield per plant had a significant positive correlation with grains per ear, 1000 grain weight and biomass per plant, whereas a high positive association (0.81) with harvest index. Productive tillers per plant showed positive association with biomass per plant and negative with grains per ear, 1000 grain weight and protein content. Grains per ear showed positive association with grain yield per plant, sedimentation value and harvest index. Thousand grain weight showed a significant positive correlation with protein content and negative with sedimentation value. Protein content showed significant positive association with sedimentation value and biomass per plant and negative with harvest index. Sedimentation value showed no association with biomass per plant and harvest index, while biomass/plant showed significant negative association with harvest index.

Absence of association or low association of days to heading with all the traits revealed that flowering period had the least role in determining grain yield in existing genotypes (Table 2). Tillers per plant made significant contribution to yield even though having negative association with grains per ear (-0.25) and 1000 grain weight (-0.27). Role of 1000 grain weight in enhancing yield appeared to be limited in case of durum wheat as most of the genotypes in this species, in general, had high 1000 grain weight. Low correlation between 1000 grain weight and yield (0.15) indicated that the two traits behaved independently in case of durum wheat. Smocek (1978) also reported a weak positive association between grain yield and 1000 grain weight. Low negative association between grain yield with protein (-018) and no correlation with sedimentation value indicated the possibility of evolving varieties with high yield along with high protein and strong gluten strength as reported by Levy and Feldman (1987).

Positive response between protein content and 1000 grain weight revealed that it could be easy to breed high weight and high protein in case of durum wheat. Positive response between protein and sedimentation value indicated that there is a greater possibility that high protein strains will also possess a strong gluten (Lin et al., 1989).

The forty two genotypes were grouped into eight clusters on the basis of D^2 values (Tables 3). The distribution pattern of genotypes into clusters indicated that cluster V was the largest containing 11 genotypes. Cluster IV had a single genotype. The genotypes included in the largest cluster V originated from different ecological regions of the world. The intra and inter cluster D^2 values (Table 4) showed that the maximum divergence was present between cluster III and IV (73.1) followed by cluster IV and VII (61.8) and cluster II and IV (58.1). Minimum divergence was observed between cluster V and VII (8.6). Cluster II (8.2), cluster VIII (8.0), Cluster III (7.6) and cluster VI (7.5) had the highest intra cluster D^2 values.

Cluster means of ten characters for forty two genotypes are given in Table 5. Mean values of different clusters indicated that maximum variation is there for days to heading, plant height, grains number per ear, 1000 grain weight, grain yield per plant, biomass/plant and harvest index as observed by Sethi et al., (1992). Cluster formed revealed the absence of relationship between geographical distance and genetic divergence as Gulab from India and CPAN 6019 from Afghanistan remained in the same cluster, while Trinakaria from Italy and Yavaros 79 from Mexica were in one cluster and CPAN 6018 and CPAN 6019 both from Afghanisthan were in two different clusters (Raut et al., 1985).

It was observed that harvest index, biomass and grains per ear can be used as important selection traits in the order of merit to improve yield and productivity in durum wheat under high input conditions. It can be concluded that the high yielding genotypes could be selected from clusters I, V, VI and VII. However, only one or two genotypes from each cluster could be used in a diallel crossing programme to determine the combining ability of these genotypes for yield and its components.

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Table 1. Estimates of variability and heritability in *Triticum durum* genotypes

Charcters	Mean	Range		PCV%	GCV%	Heritability
		Min	Max			
Heading days	84.3	70.7	103.0	9.2	9.1	0.97
Plant height (cm)	98.9	75.7	133.8	17.6	15.6	0.99
Prod. Tillers/plant	5.8	4.3	8.6	13.8	13.1	0.90
Grain/ear	47.8	34.9	58.4	12.1	11.7	0.41
Grain yield/plant (g)	14.6	10.6	18.6	16.2	14.3	0.24
1000 grain weight (g)	52.5	37.9	78.3	14.6	13.8	0.86
Protein content (%)	12.7	11.0	14.5	7.3	6.5	0.80
Sedimentation value (ml)	30.3	21.3	37.3	16.5	14.6	0.78
Biomass/plant (g)	35.5	31.8	43.2	10.8	9.1	0.54
Harvest index	41.5	25.4	52.2	17.0	15.0	0.59

Table 2. Correlation coefficients between different characters in durum wheat

Characters	Plant height	Prod. Tillers/ plant	Grains / ear	Grain yield / plant	1000 grain weight	Protein content	Sedimentation value	Biomass / plant	Harvest index
Heading days	0.14*	-0.13*	0.02	-0.01	-0.08	0.07	-0.06	0.24**	-0.13*
Plant height		0.07	-0.60**	-0.14*	0.36**	0.17*	-0.22**	0.37**	-0.35**
Prod. Tillers /plant			-0.25**	0.13*	-0.27**	-0.23**	0.17*	0.25**	-0.05
Grains /ear				0.26**	-0.19**	-0.04	0.18**	0.02	0.24**
Grain yield/ plant					0.15*	-0.18**	0.02	0.27**	0.81**
1000 grain weight						0.18**	-0.25**	0.29**	-0.01
Protein content							0.21**	0.14*	-0.27**
Sedimen tation value								0.02	0.01
Biomass /plant									-0.34**

Table 3. Distribution of *Triticum durum* genotypes into different cluster

Cluster numer	Numer of genotypes	Name of genotypes
I	7	HD 4530, A 9-30-1(T), GW 1021, WH 868, Raj 6392, CC 422 and PDW 215
II	4	NI 5749 (T), Bijaga Red (T), N 56 (T) and A 206 (T)
III	3	HD 4502, Altar 84 and J 957
IV	1	CPAN 6018 (T)
V	11	PSW 34, DWL 5023, CPAN 6117, CPAN 6127, DDC 80, HD 4519, CPAN 1311, CPAN 1469, CPAN 1471, CPAN 1480 and CPAN 1548
VI	8	Bijaga Yellw (T), Jairaj, MACS 9 (T), IP 1 (T), Raj 1555, MACS 1927 (T), MACS 1967 and Ni 146 (T)
VII	4	Raj 911, Trinakaria (T), Yavaros 79 and DDC 96
VIII	4	IP 2(T), NP 400(T), Gulab(T) and CPAN 6019(T)

Note : T = Tall types and rest are semi-dwarf types.

Table 4. Intra and inter cluster D^2 values for the cluster comprising genetic stocks

Clusters	I	II	III	IV	V	VI	VII	VIII
I	3.9							
II	18.2	8.2						
III	11.2	41.3	7.6					
IV	46.9	58.1	73.1	0.0				
V	9.8	24.6	11.0	47.0	5.0			
VI	13.0	17.0	20.3	50.9	9.3	7.5		
VII	13.7	32.7	9.2	61.8	8.6	14.6	4.6	
VIII	25.9	30.7	47.8	37.8	31.4	29.6	25.6	8.0

Table 5. Mean values of the clusters for durum genetic stocks

Characters	I	II	III	IV	V	VI	VII	VIII
Heading days	85.0	81.2	81.9	102.7	86.0	76.4	85.5	95.1
Pant height (cm)	91.5	111.2	86.5	122.1	85.8	110.1	94.8	125.4
Prod. Tillers/plant	5.9	7.7	5.4	4.3	5.6	5.4	5.8	5.7
Grains/ear	48.2	38.0	55.4	34.9	50.9	45.3	52.24	45.3
Grain yield/plant(g)	12.1	14.4	14.6	11.9	15.4	15.9	16.3	12.9
1000 grain Wt. (g)	47.6	48.8	46.3	46.8	52.6	58.6	55.9	58.3
Protein content (%)	13.2	112.4	12.8	14.2	12.1	12.8	113.3	13.2
Sedi. value (ml)	33.6	29.9	30.3	26.3	29.1	28.9	31.2	28.5
Biomass/plant (g)	34.4	36.0	34.8	28.2	34.0	34.8	39.2	41.7
Harvest index	35.2	39.6	42.3	42.2	45.4	45.7	42.5	31.0

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Surge irrigation studies in maize (i) crop response for geometry and on-off timings

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Abstract : Field experiments were carried out from December 1994 to March 1995 at Tamil Nadu Agricultural University to study the impact of maize planting geometry and on – off timings under cost free surge irrigation as compared to continuous flow and basin furrow method of farmers. The quantum of flow was 1.5 lps per furrow and the length of furrow was 150m. The single row planting geometry with higher volume of water consumption influenced the plant height, root volume in surge and continuous flow under two on – off timings of 10 and 15 minutes but not for 20 minutes. Farmers' method recorded increased plant height among the irrigation methods. There is reduction in plant height in sector 5 irrespective of planting geometry, irrigation methods and on – off timings. Single row planting geometry recorded increased cob length as compared to double row planting except on – off timings of 20 minutes. Single row recorded lower yield. Among the sectors, there was a progressive decrease from sector one to four and significant decrease in Sector 5 due to penultimate depression and increase in the last sector due to stagnation. Water saving under single row geometry was ranging from 15-22 per cent.
(Key words : Surge irrigation, Crop response, Geometry)

Among surface irrigation methods, basinfurrow layout with a length of 5-10 m is common for many crops including maize in Tamil Nadu. The area under each basin-furrow accounts for 20-40m. Basin-furrow of short length result in a land loss of 17 to 20 per cent for cultivation.