Genetic Divergence in Facultative and Winter Wheat Germplasm

L. Kant, V. P. Mani, and V. S. Chauhan
Vivekananda Parvatiya Krishi Anusandhan Sansthan (ICAR), Almora, U.P., INDIA 263 601

Abstract

The present study was conducted to measure the genetic diversity amongst 199 germplasm of facultative and winter wheat based on four quantitative characters. The genotypes were grouped into 11 clusters. The highest intercluster distance was obtained between I × VII (4.122). Inter-mating desirable genotypes of one cluster with genotypes of another cluster may give rise to recombinants, having high heterotic vigor for yield, earliness and adaptability.

Key words: *Triticum aestivum* L.; wheat germplasm; genetic divergence.

التنوع الوراثي في الأصول الوراثية للقمح الشتوي والاختياري

الملخص

أجريت الدراسة الحالية لقياس التنوع الوراثي بين 199 مدخلاً من الأصول الوراثية للقمح الشتوي والإختياري، بالاعتماد على أربع صفات كمية. حيث تم فرز الطرز الوراثية إلى 11 مجموعة. و تم الحصول على أكبر مسافة بين المجموعتين في التهجين بين I × VII (4.122) وقد يؤدي إجراء التصالب بين الطرز الوراثية المرغوبة من مجموعة ما مع الطرز الوراثية من مجموعة أخرى إلى ظهور توافيق وراثية تمتلك قوة متباينة عالية على مستوى كل من الغلة، والمبكارية، والقدرة على التكيف.

Introduction

Wheat (*Triticum aestivum* L. em Thell.) is one of the most important cereal crops in India. Although varieties have an average yield potential of 5-6 t/ha, the national productivity is only 2.7 t/ha. Exploitation of winter × spring gene pools of wheat holds promise for further enhancement of yield levels. The diverse parents should be used to succeed in any hybridization program to get better yield recombinants. Multivariate analysis (Mahalnobis D^2 statistic) has been used in spring wheat (Bhatt 1970; Singhal and Upadhyay 1977; Jatasra and Paroda 1978; Somayajulu et al. 1970) and in winter wheat (Jag Shoran and Tandon 1995) identifying genetically-diverse parents for hybridization. The present study was undertaken to estimate genetic diversity in a set of facultative and winter wheat germplasm as well as to identify genetic stocks which may serve as potential donors using the non-Hierarchical Euclidean analysis.

Several breeders in different crops have used D^2 statistics, but Arunachalam (1981) has suggested the technique has limitations. Beale (1969) has advocated classificatory approaches, like principal component and clustering of genotypes, to overcome the limitations of D^2.

The non-Hierarchical Euclidean analysis proved quite useful for estimating the genetic divergence using unreplicated data in large germplasm collections (Garg and Gautam 1997).

Material and Methods

A total of 199 accessions were evaluated during *rabi* 1996/97 in an augmented design with one intermittent check, VL Gehun 616, at the experimental farm Hawalbagh, VPKAS, Almora. Each accession was grown in two rows 3 m long and spaced at 20 cm with 5 cm plant-to-plant distance; a recommended package of practices was followed to raise a healthy crop. Four quantitative characters, that is, days to 50% heading, plant height (cm), grain yield (g/plot) and test weight (g) were subjected to statistical analysis. Five plants were randomly selected to record observations on plant height. The rest of the observations were recorded on a plot basis. The Cluster Analysis Programme of SPAR 1 package developed by IASRI, New Delhi, was used to classify the genotypes. Different cluster solutions were compared using a sequential F ratio test. These components were used to group the genotypes as described by Beale (1969) and as elaborated by Spark (1973).

Results and Discussion

The range of various characters showed wide differences (Table 1) present in this set of facultative and winter wheats, which indicates ample scope for genetic manipulation.

The eigen root vectors and their associated variances have been given in Table 2. The first latent vectors showed a maximum variation of 41.8%, followed by the second vector whose variation was 30.69%. The first two vectors explained around 72% of variations and the other two the remainder.

On the basis of four quantitative characters, the 199 genotypes were grouped in eleven clusters (Table 3) as F-test-determined on the basis of the Euclidean distance of the variable with respect to the desired objective. Cluster I is the smallest, containing only two accessions. It had the lowest mean value for days to 50% heading (94). Cluster II consisted of 14 accessions and had the lowest mean values for plant height (88.21) and test weight (32.74). Clusters III, IV, V, VI and VIII consisted of 19, 28, 29, 23, and 26 accessions, respectively having moderate values for the four characters under study. Cluster V, which had a maximum of 29 accessions, also had moderate mean values for all the characters. Cluster VII contained 20 accessions which had the highest mean value for grain yield/plot. Cluster IX consisted only of 13 accessions which had the highest values for grain yield (820 g/plot) and test weight (45.92 g). Cluster X contained 14 accessions with the highest mean values for days to 50% heading (182.07). Cluster XI consisted of 11 accessions and had the lowest mean values for grain yield (87.82 g/plot). All the clusters had exotic strains indicating existence of wide diversity in exotic germplasm.

The average intra- and inter-cluster D value has been presented in Table 4. The generalized intra-cluster distance (D) ranged from 0.841 (cluster X) to 1.400 (cluster XI). Less genetic variability exists in cluster X and the reverse is true for cluster XI. The minimum inter-cluster distance was observed in clusters VI and VIII.

The maximum inter-genetic distance was marked for groups I × VII and I × III. Hybridization between clusters I and VII and clusters I and IX may result in heterotic combinations with desirable recombinants for better yield coupled with earliness. Group I contained germplasm with the lowest days for 50% heading and groups VII and IX contained germplasm with the highest value for grain yield (g/plot) and test weight (g), respectively (Table 4).

Table 1. Character mean, check mean and range for various characters in wheat germplasm.

Character	Mean	check Mean VL 616	CV %	Name	Origin	Value	Group	Name	Origin	Value	Group
Days to 50% heading	163.18	149.00	9.60	DOVE/BUC/PLK 70 Lira	Syria-CIT	949	I	CH75460	Switzer land	191	X
Plant height (cm)	101.68	103.3	11.96	SERI	Mexico, China	80	V, X,	BOLAL	Nebraska	140	IV
				YUMA115,	Bulgaria, Dobrudja		II, VI,		Turkey		
				BUL 1518.4.38	Bulgaria, Dobrudja		II, II				
				BUL 5554.2	Bulgaria, Dobrudja						
				BUL7. BC.P2.11	Hungary, Martonvasar						
				MVMA							
Grain yield (g/plot)	544.37	696.6	30.36	ID131/MTyLT/3/	CIT	100	IX	SXL/VEE//TRK	CIT	1240	VII
				BEZ/NAD//KZM				13			
Test weight (g)	40.2	44.13	11.79	BUL21.BC1.P2.4	Bulgaria, Dobrudja	26.2	IV	LCR/SERI/3/MEX	CIT	51.5	IX
								-DW/BACA//VONA			

Table 2. Eigen root vector, eigen roots and associated variances for different components in wheat germplasm.

Characters	1	2	3	4
Days to 50% heading	0.605	-0.243	-0.571	-0.499
Plant height (cm)	0.290	0.749	0.386	-0.454
Grain yield (g/plot)	0.393	0.467	-0.387	0.691
Test weight (g)	0.629	-0.403	0.613	0.258
Eigen roots	1.675	1.228	0.623	0.475
% variation	41.87	30.69	15.56	11.88

Table 3. Characters in different clusters of wheat.

	I (2)	II (14)	III (19)	IV (28)	V (29)	VI (23)	VII (20)	VIII (26)	IX (13)	X (14)	XI (11)
Days to 50% heading	96.00	172.36	150.05	174.39	147.76	169.78	168.85	174.00	147.08	182.07	154.64
Plant height (cm)	92.50	88.21	108.16	100.54	93.28	90.00	123.75	108.27	103.85	93.93	110.45
Grain yield (g/plot)	445.00	340.71	546.84	551.07	536.55	476.96	615.50	485.00	820.00	367.86	87.82
Test weight (g)	44.45	32.74	40.24	34.33	44.57	43.27	38.50	41.11	45.92	39.45	37.69

Table 4. Average intercluster and intracluster distance D values among 11 clusters in wheat germplasm.

	1	2	3	4	5	6	7	8	9	10	11
1	**1.242**										
2	3.701	**1.344**									
3	3.813	1.980	**1.047**								
4	3.787	1.724	2.104	**0.994**							
5	3.152	2.145	1.405	2.855	**1.067**						
6	2.980	2.452	2.002	2.201	1.613	**0.985**					
7	4.122	3.488	1.674	2.041	2.047	2.164	**1.175**				
8	4.021	2.578	1.685	1.605	2.019	1.389	1.569	**0.874**			
9	3.187	2.529	1.775	2.082	1.866	2.833	2.967	2.877	**1.097**		
10	3.679	1.532	2.636	1.676	2.675	1.453	3.039	1.642	2.149	**0.841**	
11	2.873	2.719	2.131	2.632	2.903	3.228	1.889	2.748	1.800	2.811	**1.400**

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References

Arunachalam, V. 1981. Genetic divergence in plant breeding. *Indian Journal of Genetics* 42(2): 226-236.

Bhatt, G. M. 1970. Multivariate analysis approach to selection of parents for hybridization aiming at yield improvement in self-pollinated crops. *Australian Journal of Agricultural Research* 21: 1-7.

Beale, E.M.L. 1969. Euclidean Cluster Analysis. Contributed paper to the 37th session of the International Statistical Institute, U.K.

Garg, D. K. and P. L. Gautam. 1997. Genetic divergence studies in wheat germplasm using Non-Hierarchical Euclidean cluster analysis. *Indian Journal of Plant Genetic Resources* 10(1): 11-15.

Jag Shoran and J.P. Tandom. 1995. Genetic divergence in winter wheat (*Triticum aestivum* L. em. Thell). *Indian Journal of Genetics* 55(4): 406-409.

Jatasra, D.S. and R. S. Paroda. 1978. Genetic divergence in wheat under different environmental conditions. *Cereal Research Communication* 6: 307-318.

Singhal, N.S. and M.K. Upadhyay. 1977. Genetic divergence in wheat. *Cereal Research Communication* 5: 275-286.

Somayajulu, P.L., A. B. Joshi, and B. R. Murty. 1970. Genetic divergence in wheat. *Indian Journal of Genetics* 30: 47-58.

Spark, D.N. 1973. Euclidean cluster analysis Algorithm. *Applied Statistics* 22: 126-130.