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Multivariate Analysis of Genetic Divergence in Wheat[1]

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ABSTRACT

Fourteen bread wheat varieties representing conditions varying from irrigated high fertility to rainfed low fertility were examined for the nature of genetic divergence estimated by multivariate analysis using Mahalanobis's D^2 statistic. The analysis of variance revealed considerable variation among the populations, for all the 10 characters studied. It was possible to group the fourteen populations into eight well-separated clusters. The varieties Kayansona, Timgalín and EC 57191 constituted single clusters and were considered to be the most divergent material included in the study. The primary factors that contributed to genetic diversity in the present study were days to flower, flag leaf area, panicle length and 1000 grain weight. The genotypes with greater genetic diversity were suggested for breeding better varieties in wheat.

COMPENDIO

Catorce variedades de trigo harinero representativas de condiciones irrigadas de alta fertilidad y de condiciones de temporal de baja fertilidad, fueron estudiadas por la naturaleza de divergencia genética estimada mediante análisis multivariado usando el estadístico Mahalanobis D^2. El análisis de varianza reveló una considerable variación entre las poblaciones para todos los 10 caracteres estudiados. Fue posible agrupar las catorce poblaciones dentro de ocho grupos bien separados. Las variedades Kalyansona, Timgalin y EC 57191 constituyeron simples grupos y pueden llegar a ser considerados como los más divergentes incluidos en el estudio. Los factores primarios que contribuyeron para la diversidad genética en el presente estudio fueron días a floración, área de la hoja bandera, longitud de la espiga y peso de 1000 gramos. Los genotipos con la más grande diversidad genética fueron recomendados en el programa de hibridación para producción de mejores variedades en trigo.

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INTRODUCTION

The success of any plant breeding program depends on the choice of the parental material Generally parents from diverse sources express more heterosis in their hybrids for yield and its components than the related ones, and their progeny exhibit a broad spectrum of variability for selection of superior genotypes. In the hybrid vigour breeding program, the diversity of parental material is always emphasised. Rational selection of parents depends on a knowledge of the genetic diversity The detection of potential parents for crossing programs can be accomplished through the estimation of genetic diversity

Mahalanobis's D^2 statistic seems to be a powerful tool in detecting divergence among groups based on multivariate analysis, and identifies highly divergent material for breeding better varieties in several crop plants Genetic diversity studies have been carried out by several researchers (1, 3, 4, 6 and 8) in crop plants and have suggested excellent parental material in the crossing program The present study aims at understanding the pattern of genetic diversity in a group of cultivars in bread wheat for suggesting potential parents for effecting hybridization

REVIEW OF LITERATURE

Somayajulu *et al* (8) studied genetic diversity among a set of 67 wheat straims under three different environments representing different levels of fertility Sixty-seven varieties have been classfied into different clusters The widely divergent clusters remained distintc in all the environments The association between genetic diversity and heterosis over superior parents was found to be significant when all the available 46 crosses were considered At the individual cross level, there was also a fair agreement between heterosis and genetic diversity, even through there was no one-to-one correspondence

In durum wheat, genetic diversity studies have been made (3) through Mahalanobis's generalised distance for days to flower, days to physiological maturity, height, lodging and grain yield in ten varieties The studies suggested divergent material for crossing and obtaining heterosis in the F_1 generation. No association was found between genetic divergence and geographical origin of the varieties included in the study

The primary factors contributing to genetic diversity were reported to vary from crop to crop (2, 5 and 8) In general, days to 50% flowering, plant height and tiller number were considered to be very important to the genetic divergence in crop plants

MATERIALS AND METHODS

Fourteen high-yielding bread wheat (*Triticum aestivum* L.) varieties with a broad spectrum of variability were included in this study Seven varieties (Shera, Raj 821, HP 916, Hira, Moti, Sharbati Sonora and HD 2009) were selected based on their higher performance for grain yield under irrigated and fertilized conditions. All were the derivatives developed from Indian and Mexican germplasm and the three varieties (Raj 857, HP1739 and Hy65) recorded higher yields under low fertility, rainfed conditions, while the two varieties Sonalika and Kalyansona were better under both the environments The two Australian varieties Timgalin and EC 57191 contained a higher percentage of protein These genotypes were seeded in a randomized block design with four replications at the Division of Genetics, Indian Agricultural Research Institute, New Delhi, India. The experimental plots received 120 N, 60 P_2O_5 and 30 K_2O kg per hectare Each plot had four rows of 5 m long and spaced at 20 cm between rows and 10 cm between plants within a row, maint-taining a single seedling per hill. A five-plant random sample was taken in the middle two rows in each plot and observations were recorded on individual plants for ten characters, namely grain yield per plant, grains per main ear, grain weight per main ear, 100 grain weight, ears per plant, trillers per plant, plant height, flag leaf area, days to flower and ear length

The means of the characters were utilized for calculating the analysis of variance and the genetic diversity among 14 populations using the Mahalanobis D^2 statistic as described in detail by Rao (7). The pivotal condensation method was followed to compute relationship between mean values of the characters and standardised uncorrelated variables. The grouping of the populations was done in Tocher's method, described by Rao (7)

RESULTS AND DISCUSSION

The mean values of the characters studied are presented in Table 1 The analysis of variance revealed significant differences for all the ten characters (Table 2), indicating substantial variability for all the traits between 14 populations

The grain yield per individual plant varied from 10.14 g to 17.29 g with a mean of 12.54 grams The variety HD 1739 recorded maximum grain yield per

Table 1. Mean values of different characters in wheat.

Variety	Grain yield/ plant (g)	Grains /main ear	Grain weight /main ear (g)	1000- grain weight (g)	Ears/ plant	Trillers per plant	Plant height (cm)	Flag leaf area/ (cm²)	Days to flower	Ear length (cm)
Shera	12.48	49.48	1.81	31.65	10.05	10.75	81.73	32.75	97.80	10.95
Raj 821	12.47	47.68	1.73	35.25	9.30	9.72	89.45	30.75	98.90	12.80
Raj 857	13.21	58.43	1.51	28.58	10.55	11.30	76.35	33.52	99.90	11.30
HP 916	12.25	47.70	1.45	26.93	9.80	10.33	90.35	37.25	100.23	11.83
Sonalika	12.50	46.37	1.61	34.25	11.45	11.55	92.05	31.30	96.40	13.00
Kalyansona	11.69	76.08	1.87	20.18	10.00	10.53	88.13	40.70	107.50	12.73
Hira	11.46	56.97	1.73	27.35	9.00	9.75	67.87	27.70	97.60	11.40
Moti	13.28	48.37	1.56	28.85	12.30	12.87	61.05	17.12	98.80	11.68
S. sonara	11.03	46.32	1.37	28.00	10.99	11.14	82.15	23.38	99.83	10.48
HD 1739	17.29	55.28	1.92	44.08	13.25	13.35	107.55	26.28	101.25	10.28
HD 2009	12.66	57.70	1.45	24.10	10.70	10.89	84.38	22.00	101.18	12.35
Hy 65	14.18	49.80	1.42	37.43	13.93	14.30	107.87	24.30	101.57	10.20
Timgalín	10.14	42.13	1.29	28.03	11.45	11.73	89.50	16.50	107.68	9.18
EC 57191	10.94	40.80	0.85	19.80	11.25	11.48	119.43	27.75	120.00	14.83
SE (M)	1.10	2.23	0.10	1.32	0.95	1.16	5.52	1.21	0.47	0.29
CD at 5%	3.01	6.11	0.28	3.62	2.60	2.79	15.13	3.34	1.28	0.79
Mean	12.54	51.58	1.54	29.61	11.00	11.41	88.43	27.95	101.62	11.64

plant and was superior to the rest of the varieties. The variety Hy 65 registered second position for grain yield and was followed by Moti, Raj 857 and HD 2009. The grain number per main ear ranged from 40.8 to 76.08, with a mean of 51.85, and the varieties Kalyansona, Raj 857, HD 2009, Hira and HD 1739 recorded a superior number of grains per main ear compared to other varieties. The number of ears per plant varied from 9.3 to 13.93 and the mean was 11.0; the varieties HD 1739, Hy 65 and Moti were the best for this character. The two varieties HD 1739 and Hy 65 produced higher values for all three yield components and developmental characters.

It was interesting to note that fourteen populations showed considerable diversity and formed eight well-separated clusters on the basis of D^2 values. The D^2 values ranged widely from 13.59 to 987.24, indicating the diversity in the genetic material. The intracluster distance for the eight clusters are given in Table 3 and diagramatically in Fig. 1. The highest inter-cluster distance was between V and VIII (D = 29.73), while the lowest was recorded between I and V (D = 6.50). The varieties included in each of the eight clusters are given below in Table 3.

Interestingly, the rainfed wheat varieties Hy 65 and HD 1739, the former of which is a parent of the latter, were found included in the same cluster and were distinct from the rest of the lines. This showed that the hybrid HD 1739 was not divergent from one of its parents, HY 65.

The characters contributing to divergence were reported to vary from crop to crop (1, 2, 5). In general, days to flower, plant height and tiller number were considered to contribute to divergence in cereals

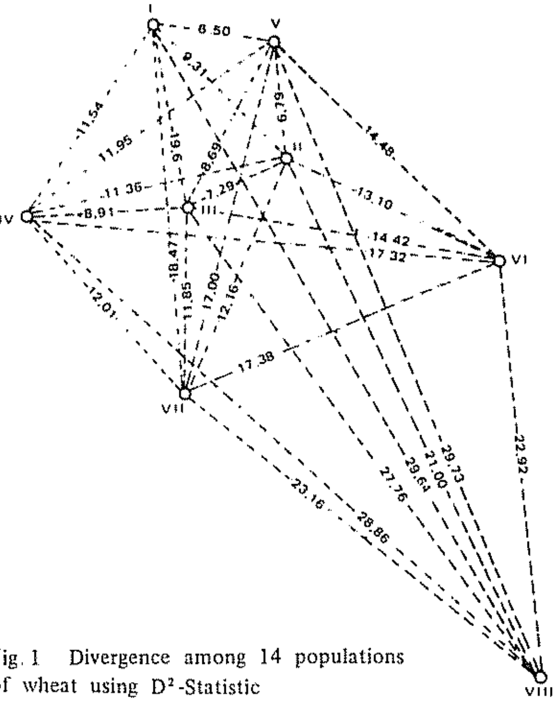

Fig. 1 Divergence among 14 populations of wheat using D^2-Statistic

(2, 5). On the other hand, in the present study, days to flower, flag leaf area and panicle length were found to be important, followed by 1000 grain weight and grain number per ear. The characters, grain yield per plant, plant height and number of ears per plant, however, had only limited influence on genetic diversity.

The three strains Kalyansona (Cluster VI), Timgalín (Cluster VII) and EC 57191 (Cluster VIII) formed distinct, highly divergent and single strain clusters. These three varieties differed substantially with regard to a number of developmental and yield-contributing characters, thus justifying the delination of these varieties in three widely scattered clusters.

Based on these studied the varieties EC 57191, Timgalín, HD 1739, Hy 65, Sonalika and Moti are suggested for hybridization program for breeding better varieties under irrigated and rainfed conditions simultaneously. The crosses involving these varieties manifested higher heterotic performance for yield and its components in both the environments over superior parents (data not presented) in the combining ability studies made using the same 14 varieties.

Table 2. Analysis of variance for different characters in wheat.

Source of variation	d.f.	Mean sum of squares									
		Grain yield/ plant	Grains /main ear	Grain weight /main ear	1000-grain weight	Ears per plant	Tillers per plant	Plant height	Flag leaf area	Days to flower	Ear length
Replications	3	16 283	12 520	0 021	6 150	10 881	10 110	124 196	9 995	1 846	0 058
Genotypes	13	15 246**	320 133**	0.306	173 320**	7 271**	5 957**	1 067 375**	197 031**	148 546**	8 331**
Error	39	4 827	19 882	0 043	6 970	3 597	4 135	121 665	5 938	0 868	0 327

** Significant at 1 percent level

Table 3. Average inter-and intracluster distance among 14 wheat varieties.

Cluster number	I	II	III	IV	V	VI	VII	VIII
I	3.61	9.31	9.61	11.54	6.50	16.97	18.47	29.64
II		4.35	7.29	11.36	6.79	13.10	12.16	21.00
III			5.48	8.91	8.69	14.42	11.85	27.76
IV				5.71	11.95	17.32	12.01	28.86
V					5.83	14.48	17.00	29.73
VI							17.38	22.92
VII								23.16

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Efecto Alelopático del Madero Negro (*Gliricidia sepium*) en la Germinación y Crecimiento Inicial de Algunas Malezas Tropicales[1]

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ABSTRACT

This study presents the allelopathic effects of the vegetative parts of madero negro (*Gliricidia sepium* Jacq) on the seed germination and the radicle-hypocotyle axis growth of *Hyptis capitata*, *Asclepias curassavica* and *Ipomea* sp. in vitro. Also included is an analysis of the allelopathic effects of madero negro on the germination of *Momordica charantia* and on the germination and initial growth of *Asclepias curassavica* in soil samples under laboratory conditions. All of the weeds tested are common in the region of San Carlos, Costa Rica. The magnitude of the effects varied according to the vegetative part from which the extracts were obtained, the extract concentration and the weed species. The most effective extracts were those from leaves, followed by those from roots. The tendency was toward an inverse relationship between the extract concentrations and the response variable. The resulting allelopathic effects were more evident in *Hyptis capitata* and *Ipomea* sp. than in *Asclepias curassavica*. Furthermore, the stem extracts did not produce any significant effects in the germination of the growth of *Asclepias curassavica*. A significant response was obtained in the germination of *Momordica charantia* with leaf extracts and in the germination and the growth of *Asclepias curassavica* with leaf and root extracts in the soil sample trials.

COMPENDIO

Se presenta un estudio sobre el efecto alelopático de partes vegetativas del madero negro sobre la germinación de semillas y el crecimiento del eje radículo-hipocotilar de *Hyptis capitata*, *Asclepias curassavica* e *Ipomoea* sp., en cajas de Petri. Se incluye un análisis del efecto alelopático del madero negro sobre la germinación de *Momordica charantia* y sobre la germinación y crecimiento inicial de *Asclepias curassavica*, en muestras de suelo bajo condiciones de laboratorio. Todas son especies de malezas comunes en la región de San Carlos, Costa Rica. La magnitud del efecto varió según la parte vegetal de la que se obtuvo el extracto, la concentración del extracto y la especie de maleza. Los extractos más efectivos fueron lo de hoja seguidos por los de raíz, encontrándose tendencia hacia una relación inversa entre la concentración de extractos y las variables de respuesta. El efecto alelopático resultó más evidente en *Hyptis capitata* y en *Ipomoea* sp. que en *Asclepias curassavica* y los extractos de tallo no produjeron ningún efecto significativo en la germinación ni en el crecimiento de esta última especie. Se obtuvo respuesta significativa en la germinación de *Momordica charantia* con extractos de hoja y en la germinación y crecimiento de *Asclepias curassavica* con extractos de hoja y raíz, en las pruebas realizadas en muestras de suelo.

INTRODUCCION

Ante la agricultura basada en subsidios energéticos, ha surgido una corriente que visualiza la producción agrícola como una actividad en la que no se puede seguir ignorando o sustituyendo los principios biológicos elementales y que debe dirigir los esfuerzos hacia áreas importantes de la investigación agrícola, en busca de formas de producción menos dispendiosas (8)

La alelopatía es un proceso biológico presente tanto en los ecosistemas naturales como en los agroecosistemas; ha sido propuesta como una alternativa potencial en el manejo de los componentes del agroecosistema, entre ellos, las malezas (1, 8)

El alto costo del control de malezas y el deterioro ambiental que a veces se produce con los métodos

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