GENETIC ANALYSIS OF YIELD AND ITS COMPONENTS IN WHEAT.

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F_1 data from a diallel cross of six wheat varieties were analysed for yield per plant, number of spikes per plant number of kennels per spike, and 1000-kernal weight. The Vr/Wr graphic representations showed that yield and its main component, spikes per plant, were under the control of over-dominance type of gene action. The number of kernesl per spike and kernel weight were governed by additive type of genetic control with partial dominance. The analysis of genetic components confirmed the graphic interpretation.

INTRODUCTION

The diallel cross technique as advocated by Hayman (1954) and Jinks (1954) holds a great promise for plant breeders especially in self-fertilized crops like wheat, barley and cotton. It provides information on the genetic mechanism of the control of characters in F_1. Its advantages and disadvantages have been fully discussed by Johnson (1963) and Khan (1963).

In order to improve the genetic potential for yield, quality and resistance to diseases and insect pests much information on the inheritance pattern of desirable characters is needed. Whitehouse *et al.* (1957) reported that yield per plant was governed by overdominance type of gene action and yield components such as number of spikes, number of kernels and kernel weight were additively controlled. Sharif and Shah (1968) observed additive control with partial dominance for yield in crosses of semi-dwarf x tall varieties of wheat. Johnson (1963) reported overdominance for yield per unit area in barley. He obtained a strong positive correlation between number of kernels per head and yield.

Studies on combining ability in wheat by Kronstad and Foote (1964) McNeal *et al.* (1965) and Brown *et al.* (1966) have shown greater importance for general combining ability, The results of Davis *et al.* (1961) and Gandhi *et al.* (1962) show higher values for interaction component of variance, They indicated the need for testing the varieties for more than one season at more than one location.

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This paper deals with the results of an experiment consisting of 6-parent diallel set of crosses between local and exotic varieties of wheat carried out at University Farm Lyallpur.

MATERIALS AND METHODS.

A 6 x 6 diallel set of crosses (F_1) of four local wheat cultivars (C271, C 228, C5667, and Dirk) and two exotic selections AU 45 (C.I.11596) and AU 46 (C.I. 11597) were tested in randomized complete blocks with four repeats in the field in 1965. A uniform distance of 12 inches was kept between rows and between plants within a row. Each row had five plants with one non-experimental plant on each side. The blocks were separated by two non-experimental rows. All cultural operations were carried out according to standard practice followed at the University Farm. Eighty lbs. N. in the form of Ammonium sulphate was applied in two split doses. One half was mixed with soil at the time of preparation of land and the second half was applied with the first irrigation (after 3 weeks).

The data in respect of yield per plant, number of spikes per plant, number of kernels per spike, and 1000 kernel weight was analysed statistically to determine the significance of mean differences. Wherever the differences were significant, the data was further analysed according to Hayman (1954) and as applied by the white-house *et al.* (1958). The components of genetic variance used have the following meaning :-

(a) Variation between the mean effects of each parental line. This is a measure of additive effects.

(b) Deviations of progeny from their parental means. It is measure of dominance.

(c) Average maternal effects of each line. Used as a measure of error for (a) and (b).

(d) It was used as an error against which to test (c).

RESULTS.

Yield per plant.

The data presented in Table 1 reveals that C228 was the highest yielding parent followed by Dirk, AU 45, C271, C5667, and AU 46. The crosses of AU45 showed the best and those of AU 46 the lowest mean yields per plant. Within the arrays, the cross between C228 and and AU 45 was the top yielder, followed by C271 x Dirk and C 5667 x AU 45. This means that AU 45 had the best general as well as specific combining ability of the local varieties.

TABLE 1 : *Mean values of parents and F_1 districts for various characters*

Parents and crosses.	Yield/plant (gm.)	Spikes plant	Kernels/ spike	Kernel Weight (gm)	Spikelet/ Spike.
C271	35.0	23.0	53.0	47.0	19.0
C228	53.0	30.0	56.0	52.0	19.0
C5667	32.0	20.0	60.0	42.0	19.0
Dirk	43.0	30,0	44.0	52.0	19.0
AU45	39.0	21.0	67.0	47.0	24.0
AU46	31.0	23.0	63.0	38.0	22.0
C271 x C228	48.0	28.0	59.0	49.0	20.0
C271 x C5667	31.5	23.0	46.5	43.0	20.0
C271 x Dirk	61.0	38.0	48.0	53.5	19.4
C271xAU45	47.5	22.0	62.0	49.5	22.0
C271xAU46	45.5	24.0	62.5	47.0	20.0
C228xC5667	41.5	23.0	63.0	45.5	20.0
C228xDirk	40.0	28.0	47.0	49.0	20.0
C228xAU45	67.0	30.5	60.5	50.5	20.0
C228xAU46	44.0	24.0	59.5	49.0	21.5
C5667xDirk	51.0	35.0	50.5	52.0	20.5
C5667xAU45	58.5	24.0	65.5	47.0	21.5
C5667xAU46	52.5	27.0	63.5	48.5	22.0
DirkxAU 45	54.5	32.5	52.0	52.0	21.5
DirkxAU 46	42.0	28.5	45.0	48.5	21.0
AU45xAU46	47.0	26.5	68.0	39.5	23.0

TABLE 2 *Components analysi of yield and its components.*

Component	D.F.	S.S.	M.S.	F.
		(i) Yield (g)		
(a)	5	678.83	135.77	0.95 N.S.
(b)	15	66757.85	4450.52	157.59**
(c)	5	6999.69	139.94	4.95*
(d)	10	282.42	28.24	—
		(ii) Spikes per plant.		
(a)	5	349.11	135.77	0.95 N.S.
(b)	15	80070.11	1614.04	142.20**
(c)	5	192.67	38.53	2 01 N.S.
(d)	10	191.83	19.18	—
		(iii) Kernels per spike		
(a)	5	401.45	80.29	2.08 N.S.
(b)	15	80070.11	5338.01	278.31**
(c)	5	192.67	38.53	2.01 N.S.
(d)	10	191.73	19.18	—
		(iv) 1000-kernel-weight (g)		
(a)	5	417.11	83.42	3.13N.S.
(b)	15	56212.86	3747.52	1574 58**
(c)	5	133.17	26.63	11.18**
(d)	10	23.83	2.38	—

N.S. Nonsignificant
* Significant at 5% level.
** Significant at 1% level.

A reference to Fig 1 reveals that the regression line intercepted the covariance (Wr) axis on the negative side indicating over-dominance type of genetic mechanism controlling yielding ability. The significant deviation of regression from a unit slope ($b = .5553 \pm .4454$) implies some kind of gene interaction. The position of array points on the regression line shows dominance of AU 46, which is situated nearest the origin, and recessiveness of C271, having distant position. The scatter of the points on the graph further confirms the presence of some kind of interaction.

The analysis of variance components in Table 2 shows that 'a' was non significant and 'b' (dominance) was highly significant. This also confirms the situation shown by Vr/Wr graph.

Number of Spikes per Plant.

The data in Table I shows the superiority of parent varieties, C228 and Dirk and inferiority of AU 45 and C271. The array of Dirk was the best followed by those of AU 45 and C271. The crosses of C271 x Dirk and C5667 x Dirk were the two top scorers, and those of C271 x AU 45 and C5667 x AU 45 were the lowest scorers.

Fig. 2 depicts overdominance type of gene action controlling the expression of tillering capacity. The deviation of regression coefficient from a unit slope was significant which reveals presence of interaction. The array of AU 46 was nearest to the origin, and had most of the dominant genes and C271, being away from the base, had maximum number of recessive alleles. The component analysis confirmed the graphic representation.

Number of Kernels per Spike.

Table I shows that the exotic selections, AU45, AU46, had the greater number of kernels as compared to the local varieties. The array of AU 45 was the best, followed by those of AU 46 and C5667. The dirk array had the lowest number of kernels per spike. The crosses of AU45xAU46, showed better specific combining ability than all other crosses. The Vr/Wr graph in Fig 3 reveals partial dominance for kernels per spike. The significant deviation of 'b' value shows some type of interaction. The proximity of Dirk and remoteness of AU 46 from the origin of the graph shows dominance and recessiveness of these arrays respectively.

The analysis of genetic component (Table 2) confirms the situation on the graph as 'a' and 'c' were non significant and 'b', the dominance component, was highly significant.

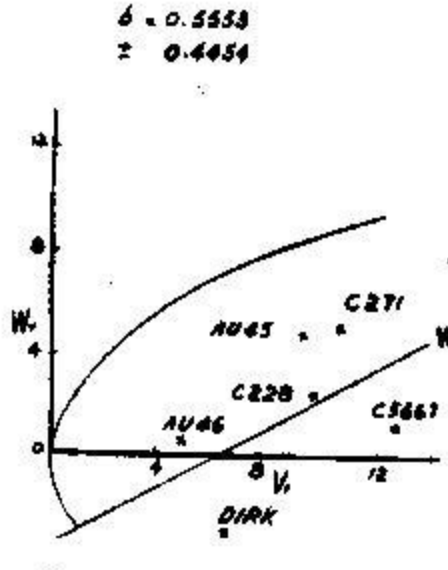

FIG. 1. V_r/W_r GRAPH = YIELD PER PLANT (G).

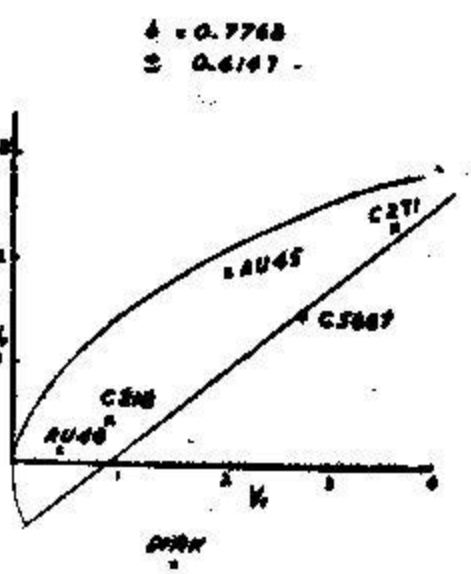

FIG. 2. V_r/W_r GRAPH = SPIKE PER PLANT.

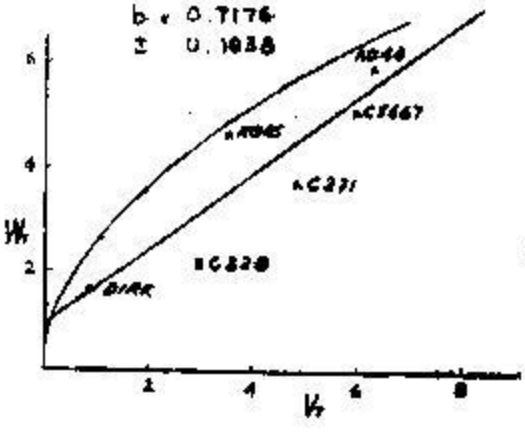

FIG. 3. V_r/W_r GRAPH = KERNELS PER SPIKE.

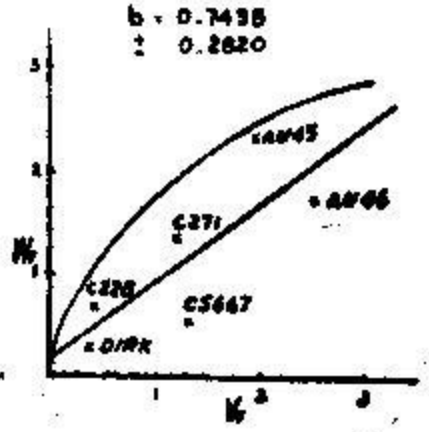

FIG. 4. V_r/W_r GRAPH = 1000-KERNEL WEIGHT (G)

1000 - KERNEL WEIGHT.

Table 1 shows that the local varieties, C228 and Dirk had the heaviest kernels and the exotic selection, AU 46, had the lightest kernel weight. The Dirk array was the best, followed by those of C228 and C271. The of AU 46 had the lowest value. The crosses of C271, C5667 and Au45 with Dirk were better than all other combinations.

The Vr/Wr graph in Fig 4 shows that kernel weight was controlled by addittive gene action with partial dominance. The arrays of Dirk and C228 with higher values for kernel weight were situated near the origin and those of AU 45 and AU 46 with lower values were placed far away from the origin. It suggested that higher kernel weight was dominant over lower kernel weight. The significant deviation of the slope of regression line from unity shows the presence of some kind of interaction. This is confirmed by analysis of variance of genetic components, where (b) is highly significant as also the (c) which measures the maternal effects.

DISSCUSSION.

From the foregoing account it is quite clear that quantitative characters like yield and its components in wheat may show overdominance type of gene action, as also shown by Whitehouse *et al.* (1958) in respect of yield. But it is not true of the yield components which according to them were governed by additlve gene action.

The analysis of genetic components brings forth the importance of dominance which was many times the additive component. These results are quite in conformity with those of Davis, *et al.* (1961) and Gandhi *et al.* (1962) but do not agree with results of Kronstad and Foote (1964), McNeal *et al.* (1965) and Brown *et al.* (1966) who reported greater importance of general combining ability effects. The over-dominance was found to be accompanied by some kind of gene interaction, which appears to be a universal phenomenon and its importance has been fully discussed by Hayman (1964), Jinks (1954, 1955), Whitehouse *et al.* (1958) and Khan (1963).

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