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Inheritance of Earliness, Dry Matter and Shelling in Pea

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ABSTRACT

A full diallel crosses of six-parents was evaluated in peas for earliness, dry matter and shelling percentage. From the study, there were highly significant differences among the genotypes, days to flowering and shelling percentage were under the control of both additive and non-additive gene actions, while dry matter was under the control of additive gene actions. Days to flowering was controlled by partial dominance, also, dry matter and shelling percentage were controlled by over dominance. The Vr/Wr graphs confirm the previous analysis only in shelling percentage. Broad and narrow sense heritability were ranged from moderate to low for all the studied characters.

Key words: Pea plant, Shelling,genetic variations.

Introduction

Garden pea (*Pisum sativum* L.) is one of the popular vegetable crops in Egypt. It is grown primarily for its edible green seeds. Genetic investigations into the inheritance of days to flowering, green seed dry matter and shelling percentage are basic to the production of the required pea cultivars.

Surinder *et al*. (1980) studied the genetic components of variance and combining ability for number of days to flowering in the parental, F_1 and F_2 generations of a 6x6 half-diallel in garden peas. Additive genetic control was important in the expression of flowering time.

Dhillon and Chahal (1981) in a diallel cross involving sex pea cvs and reciprocals, additive genetic variance was predominant for number of days to flowering.

Gupta and Dahiya (1986) studied the genetic variance for height of pea plant in a 12x12 half diallel analysis. Additive gene effects predominated for plant height and days to first flowering. Recessive genes controlled plant height, while days to flowering showed partial dominance.

Kumar and Agrowal (1986) studied the genetic components of variance for number of days to 50% flowering in the parental and F_1 generations of the diallels in garden pea. Flowering was predominatly controlled by additive genetic effects. The data suggested the presence of two systems of genetic control of flowering. In one system, earliness and latness were due to accumulation of dominant and recessive genes, respectively, while in the other system the reverse was observed.

Srivastava *et al*. (1986) in their work on the a 8-pea parents half diallel cross concluded that partial dominance were predominant for days to flowering.

Waly and Abdel-Aal (1986) using a diallel cross among four varieties of peas found that plant height was under the control of both additive and non-additive gene actions. Days to flowering was additive and the over-dominance was expressed for earliness.

Singh *et al*. (1987) studied the combining ability of yield, its components and protein content from F_1 and F_2 generations of a diallel cross involving ten parents of pea. It showed significant additive and non-additive genetic effects for days to flowering in both F_1 and F_2 generations.

Tewatia *et al*. (1988) reported that twelve varieties of *Pisum sativum* were crossed in a partial diallel fashion and the parents, plus 30 F_1 hybrids, were grown to maturity, various yield and quality characters were evaluated and all showed highly significant differences between genotypes.

The objective of this work was to study the inheritance of earliness, dry matter contents and shelling percentage in pea.

Materials and Methods

The present study was carried out at the Experimental farm of Faculty of Agriculture, Assiut University, Assiut during the seasons of 2007/2008 and 2008/2009.

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Six cultivars of pea i.e. Progress No. 9 (P_1); Freezer (P_2), No. 40 (P_3), Pigeon (P_4), First & Best (P_5) and Burpeena Early (P_6) were used in this study. The cultivars were crossed according to diallel. Pattern with reciprocals to obtain all the possible hybrids. The 30 F_1 hybrids seeds were produced by hand pollination during the 2007/2008 season.

In season 2008/2009, seeds of 6 parents and the resulting 30 F_1 hybrids together were planted in the field for genetical evaluation on 1st October. The genetical materials were arranged in a randomized complete block design with three replicates. The normal practices of cultivation, irrigation, fertilization and pest control of peas were followed.

Data were obtained for: No. of days to first flower, dry matter content and shelling percentage.

A diallel analysis as developed by Hyman (1954 and 1958) and Mather and Jinkes (1971) was performed in the collecting data.

Results and Discussion

a. No. of days to first flower:

Analysis of variance for the No. of days to first flower of parents and their F_1 hybrids are presented in Table 1. The results showed that there were highly significant difference among the genotypes. The significance of both parents vi and heterosis hii indicating important effects for both additive (vi) and non-additive (hii) genetic variations controlling days to flowering. Also, the break down of heterosis (hii) showed significant average heterosis (h) of F_1 versus parents, significant heterosis due to each cultivar contribution (hi) and significant specific heterosis effects (Sii).

The analysis of variance of Wr + Vr and Wr – Vr was shown in Table (2), Wr + Vr was significant confirming the presence of non-additive gene action. Wr – Vr was not significant confirming the absence of deviation from the basic diallel model.

The ratio $(H_1/D)^{½}$ was 0.89, which less than one indicating partial dominance (Table 7).

Broad-sense and narrow-sense heritability values are presented in Table 7. h^2_{bs} was 68.37% and h^2_{ns} was 42.00% (Table 7).

The Vr/Wr graph for days to flowering shown in Fig. 1. The regression in line cut the Wr axis in a negative position, showing the presence of over dominance. Positions of arrays indicate that parent 1, the early cultivar, possess most recessive alleles and parents 2, 3 and 4, the late types, having most dominant alleles. The remaining parents be in order of increasing earliness starting from the origin.

Table 1: Analysis of variance of No. of days to first flower in the 6x6 diallel crosses.

Source of variation	D.F.	Mean square	Variance ratio
Blocks	2	0.531	0.067
Genotypes	35	74.39	9.48**
Cultivars (vi)	5	214.95	27.40**
Heterosis (hii)	15	62.129	7.919**
(h)	1	236.626	30.163**
(hi)	5	42.99	5.48**
(Sii)	9	53.37	6.80**
Error	70	7.844	

** Significance at P = 0.01.

Table 2: Analysis of variance of (Wr + Vr) and (Wr – Vr) of No. of days to first flower in the 6x6 diallel crosses.

Item	D.F.	M.S.	V.R.
Wr + Vr	5	2163.554	4.165*
Error	10	519.371	
Wr – Vr	5	33.052	0.587
Error	10	56.306	

* Significance at P = 0.05.

b- Dry matter content:

The analysis of variance for the dry matter showed that there were highly significant differences among the genotypes (Table 3). Item vi was highly significant indicating important effects for additive genetic variations controlling this character, while item hii was not significant indicating the absence of non-additive effects for dry matter. The break down of heterosis (hii) showed only significant heterosis due to each cultivar contribution (hi). The other two items (h) and (Sii) were not significant.

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The analysis of variance of Wr + Vr was not significant confirming the absence of non-additive gene action (Table 4). Also, Wr – Vr was not significant confirming the absence of deviation from the basic diallel model.

The average degree of dominance was 1.60 for dry mater which more than one indicating over dominance (Table 7).

Table 3: Analysis of variance of dry matter in the 6x6 diallel crosses.

Source of variation	D.F.	Mean square	Variance ratio
Blocks	2	42.144	1.939
Genotypes	35	72.102	3.318**
Cultivars (vi)	5	180.084	8.287**
Heterosis (hii)	15	36.781	1.692
(h)	1	50.026	2.302
(hi)	5	58.761	2.704*
(Sii)	9	23.098	1.063
Error	70	21.72	

** Significance at P = 0.01.

Table 4: Analysis of variance of (Wr + Vr) and (Wr – Vr) of dry matter in the 6x6 diallel crosses.

Item	D.F.	M.S.	V.R.
Wr + Vr	5	2441.89	0.972
Error	10	2512.16	
Wr – Vr	5	49.709	0.716
Error	10	69.422	

Broad-sense heritability was 25.04% and narrow-sense heritability was 5.83% (Table 7).

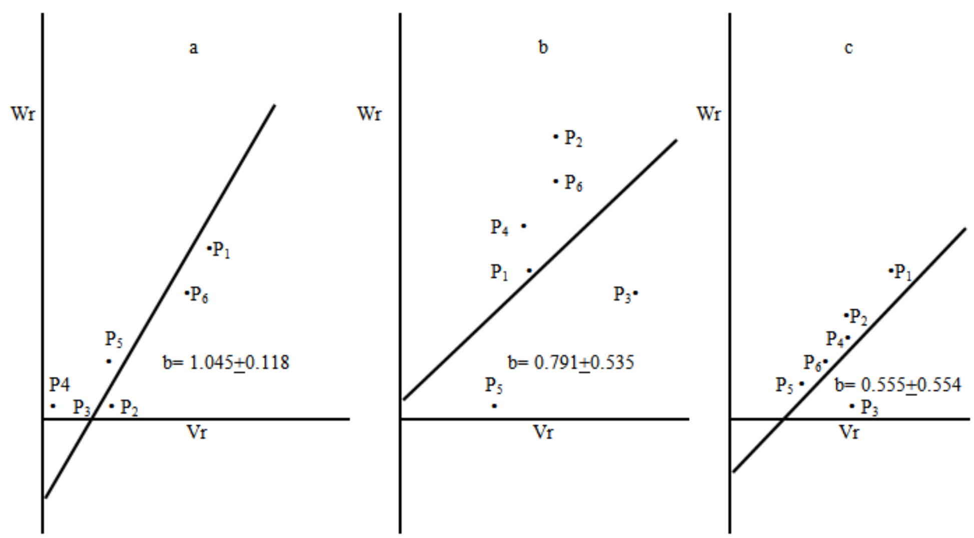

Fig. 1: Vr/Wr graphs for (a) days to flowering, (b) dry matter and (c) shelling percentage.

The Vr/Wr graph for dry matter show in Fig. 1. The regression line cut the Wr axis above the origin showing the presence of partial dominance. Position of arrays indicate that parent 5 possess dominant alleles and parents 3 and 6 possess recessive alleles.

c- Shelling percentage:

Analysis of variance for shelling percentage of parents and their F_1 hybrids are presented in Table 5. The results showed that here were highly significant differences among the genotypes. The parents vi was significant confirming the absence of additive effects, also, heterosis hii was significant indicating important effects for non-additive genetic variations controlling shelling percentage. The break down of heterosis (hii) showed significant average heterosis due to each cultivar contribution (hi) and specific heterosis effects (Sii) was not significant.

The analysis of variance of Wr + Vr and Wr – Vr was shown in Table (6), both of them was not significant confirming the absence of non-additive gene action and the absence of deviation from the basic diallel model.

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The ratio $(H_1/D)^{½}$ was 12.57, which more than one indicating over dominance. Also, h^2_{bs} was 16.13% and h^2_{ns} was 6.28% (Table 7).

The Vr/Wr graph for shelling percentage shown in Fig. 1. The regression line cut the Wr axis in a negative position, showing the presence of over dominance. Position of arrays indicate that parent 5 possess most dominant alleles and parent 1 possess most recessive alleles.

From the study, the analysis of variance showed that there were highly significant differences among the genotypes for all the studied characters. The variation among cultivars due to additive effects was significant for all the studied characters, however, great variation shown by non-additive effects for days to flowering and shelling percentage.

Table 5: Analysis of variance of shelling percentage in the 6x6 diallel crosses.

Source of variation	D.F.	Mean square	Variance ratio
Blocks	2	302.62	5.92
Genotypes	35	149.42	2.92**
Cultivars (vi)	5	336.80	6.59**
Heterosis (hii)	15	116.71	2.286
(h)	1	258.53	5.057
(hi)	5	125.53	2.459*
(Sii)	9	96.09	1.282
Error	70	51.04	

** Significance at P = 0.01.
* Significance at P = 0.05.

Table 6: Analysis of variance of (Wr + Vr) and (Wr – Vr) of shelling percentage in the 6x6 diallel crosses.

Item	D.F.	M.S.	V.R.
Wr + Vr	5	3255.43	1.194
Error	10	2726.36	
Wr – Vr	5	373.92	0.633
Error	10	590.13	

Table 7: Average degree of dominance $(H_1/D)^{½}$, broad sense heritability (h^2_{bs}) and narrow sense heritability (h^2_{ns}) for the studied characters of 6x6 diallel cross.

Item	No. of days to first flower	Dry matter	Shelling percentage
$(H_1/D)^{½}$	0.89	1.60	2.57
h^2_{bs}	58.37%	25.04%	16.13%
h^2_{ns}	42.00%	5.83%	6.28%

Partial dominance effects controlling days to flowering while, over dominance effects controlling dry matter and shelling percentage. The Vr/Wr graphs confirm the previous analysis only in shelling percentage.

Broad and narrow sense heritability were ranged from moderate to low for all the studied characters.

Present results are in general agreement with the findings of Surinder *et al*. (1980), Dhillon and Chahal (1981), Gupta (1982), Floyd and Murfet (1986), Srivastava *et al*. (1986), Singh *et al*. (1987), Arumingtyas and Murfet (1992) and Sarawat *et al*. (1994).

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