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GENETIC STUDIES ON SOME ECONOMIC CHARACTERS IN PEA (*Pisum sativum* L.)

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ABSTRACT

This study was carried out at El-Kanater El-Khayria Vegetable Rsearch Farm, Kalubia Governorate, Egypt. During the period from 2008 to 2010. Four pea cvs., viz., Master B, Samroula, Waver Top and Kiados were used in this study. Crosses between these cvs were done and F_1, F_1r and F_2 seeds were produced and evaluated to study the inheritance of some economic characters.

Absence of maternal effect was noticed for all characters in all crosses. Different types of dominance were found in different crosses for the studied characters as over dominance which was found for all characters except for the characters pod length and number of seeds/pod, meanwhile, partial dominance were detected in some hybrids for studied characters.

Positive heterosis values estimated were 1.36 % - 28.10 %, 2.75 % - 30.97 %, 0.60 % - 3.26 %, 10.63 % - 22.83 and 2.78 % – 4.84 % for plant height, total green pods yield/plant, pod length, number of pods/plant and number of seeds/pod, respectively. While negative heterosis estimated was from -15.84 % for plant height and -5.48 % for number of seeds/pod.

Minimum number of gene pairs estimated was 1-2, 1-9, 1-12, 1-4 and 1-7 for plant height, total green pods yield/plant, pod length, number of pods/plant and number of seeds/pod, respectively. BSH estimates for previously listed characters were, respectively, 70.66 % - 89.89 %, 32.56 % - 67.60 %, 38.58 % - 77.85 %, 27.39 % - 68.42 % and 50.00 % - 67.88 % for this characters.

In general, some promising F_2 plants could be selected to start a breeding program for producing a new pea cultivar.

INTRODUCTION

Garden peas, (*Pisum sativum* L.) is an important vegetable crop in Egypt. In developing countries, there is an important role for breeding programs to improve the quantity and quality of agricultural production. Over dominance was observed on pea for plant height Panda *et al.*, (1994), Kumar *et al.*, (1997), Nosser (2005) and Bhnan (2008), for total green pods yield/plant (Panda *et al.*, 1994 and Bhnan 2008). Meanwhile, partial dominance for plant height, total green pods yield/plant, number of pods/plant and number of seeds/pod was detected on pea by Nosser (2005), for pod length Kumar *et al.*, (1997) and Salib (2006). Positive heterosis was reported on pea for the characters plant height (Nosser 2005, Salib 2006, Bhnan 2008 and El-Dakkak and Hussein 2009), for total green pods yield/plant and pod length (Sarawat *et al.*, 1994 and Bhnan 2008), for number of pods /plant Sarawat *et al.*, (1994), Sharma *et al.*, (1998) Nosser (2005) and El-Dakkak and Hussein (2009), for number of seeds/pod Sarawat *et al.*, (1994), Sharma *et al.*, (1998) and Nosser (2005). On the contrary negative heterosis for plant height was detected on pea by Nosser (2005) and Salib (2006).

Number of gene was found for plant height character (Ranal and Mari 1993, Nosser 2005, Salib 2006 and Bhnan 2008), for total green pods

yield/plant and pod length (Ranal and Mari 1993 and Nosser 2005), for number of pods/plant (Ranal and Mari 1993, Nosser 2002, 2005 and Bhnan 2008), also for number of seeds/pod was found by Ranal and Mari (1993) and Nosser (2005).

Broad sense heritability was estimated as moderate to high for plant height, Farag and Darwish (2005), Nosser (2005), Salib (2006), Salem (2007), Abd El-Hady and Hussein (2008), Bhnan (2008), El-Dakkak and Hussein (2009) and Nosser (2011). Total green pods yield/plant (Panda *et al.*, 1994, Nosser 2005, Bhnan 2008 and Nosser 2011), for pod length Nosser (2005), Salem (2007) and Abd El-Hady and Hussein (2008), for number of pods/plant (Nosser 2002, Farag and Darwish 2005, Nosser 2005, Salem 2007, Abd El-Hady and Hussein 2008, Bhnan 2008, El-Dakkak *et al.*,2009 and Nosser 2011), for number of seeds/pod (Nosser 2002 and El-Dakkak *et al.*, 2009 and Nosser 2011).

The aim of this study was to study the inheritance of some economic characters in pea and was also to select some promising F_2 plants to start a breeding program for producing a new pea cultivar.

MATERIALS AND METHODS

This study was conducted during the period from 2008 to 2010. production and evaluation of genetic populations was carried out at El-Kanater El-Khayria Horticulture Research Station, Kalubia governorate.

Production of genetic populations

Seeds of four pea cvs., viz., Master B, Samroula, Waver Top and Kiados were sown in the open field on the first week of October of both seasons 2008 and 2009 to produce F_1, F_1r and F_2 seeds. The cultivars Master B and Kiados are early flowering, meanwhile, Samroula and Waver Top cvs are late flowering and high in both green yield and number of pods/plant. Straight and reciprocal crosses between the used four cvs were produced as follows :

Straight crosses	**Reciprocal crosses**
Master B × Samroula	Samroula × Master B
Master B × Waver Top	Waver Top × Master B
Master B × Kiados	Kiados × Master B
Samroula × Waver Top	Waver Top × Samroula
Samroula × Kiados	Kiados × Samroula
Waver Top × Kiados	Kiados × Waver Top

Some seeds of the straight F_1 crosses were sown . Flowers of F_1 plants were left for selfing to produce F_2 seeds.

Evaluation of genetic populations

Seeds of parental, F_1, F_1r, and F_2 populations for each of the six crosses were sown on 5th October 2010 in a randomized complete block design with three replicates. Each replicate consisted of one row for every non-segregating population, i.e., parents, F_1, and F_1r, and three rows for each F_2. Each row was 4.5 m long and 0.6 m wide. Individual seeds were sown at

a distance of 10 cm apart. Data were recorded on individual plants of the different populations in each cross.

Data were recorded on the following characters :

1 . Vegetative characters :

- Plant height

2 . Yield and its components :

- Total green pods yield/plant.
- Pod length.
- Number of pods/plant.
- Number of seeds/pod.

Genetic parameters estimated

Maternal effect

It was estimated by measuring the significance of differences between F_1 means and their reciprocals by using the (t) test.

Potence ratio

The relative potency of gene set (P) was used to determine the direction of dominance according to the formula given by smith (1952).

$$P = \frac{\overline{F_1} - \overline{MP}}{\frac{1}{2}(\overline{P_2} - \overline{P_1})}$$

$\overline{F_1}$: First hybrid generation mean.
$\overline{P_1}$: Mean of the smaller parent.
$\overline{P_2}$: Mean of the larger parent.
$\overline{MP}$: Mid parent value = $\frac{1}{2}(\overline{P_1} + \overline{P_2})$

Heterosis

Heterosis was calculated on the better parent basis using the following formula :

$$\text{Heterosis} = \frac{\overline{F_1} - \overline{HP}}{\overline{HP}} \times 100$$ (Sinha and Khanna, 1975)

$\overline{F_1}$ = Mean of the first hybrid generation.
$\overline{HP}$ = Mean of the high or better parent.

Minimum number of genes

The minimum number of genes controlling the character in each cross was calculated using Wright formula (Burton, 1951)

$$N = \frac{0.25\,(0.75 - h + h^2)\,D^2}{VF_2 - VF_1}$$

Where : $$h = \frac{\overline{F_1} - \overline{P_1}}{\overline{P_2} - \overline{P_1}}$$

N = Minimum number of gene pairs.
D= The difference between the observed mean of female and male parents.
V_{F1} and V_{F2} = Variance of F_1 and F_2 populations, respectively.

Broad sense heritability

(BSH) was calculated using the formula given by (Allard, 1960):

$$BSH = \frac{V_G \times 100}{V_P}$$

Where:

V_G = Genetic variance which was calculated by substracting the environmental variance (V_E)from phenotypic variance (V_p).

V_p = Phenotypic variance = VF_2.

V_E = Environmental variance which was considered as the geometric mean of variance of the non-segregating populations, *i.* e., parents and F_1.

In a given characters, the crosses which their parents showed significant difference among them were used to study this trait.

RESULTS AND DISSCISION

Plant height

Data obtained on plant height of parental, F_1, F_1r, and F_2 populations of the crosses Master B × Samroula, Master B × Waver Top, Master B × Kiados, Samroula×Kiados and Waver Top × kiados are presented in Table1.

Parents were distinctively different in plant height in all studied crosses. In each cross, F_1 mean was taller than the parents except in the crosses Master B × Samroula who observed intermediate between the parents. F_2 means were intermediate between its respective parents with a high tendency towards the high parent. No significant differences were observed between F_1's and their reciprocals for plant height in all studied crosses indicating absence of maternal effect.

Quantitative genetic parameters obtained for plant height are presented in Table 2. Positive values of potence ratio were observed in all crosses except for the cross Waver Top × Kiados. The crosses Master B × Waver Top and Samroula × Kiados showed over dominance and the crosses Master B × Samroula and Master B × Kiados exhibited partial dominance for the tall parent. Meanwhile, the cross Waver Top × Kiados showed partial dominance of the short parent. These results are in agreement with Panda *et al.*, (1994), Kumar *et al.*, (1997), Nosser (2005), and Bhnan (2008). Positive heterosis values were estimated for the crosses Master B × Waver Top, Samroula × Kiados and Waver Top × Kiados as 1.36, 28.10 % and 4.57 %, respectively. Similar results was obtained by Nosser (2005), Salib (2006), Bhnan (2008) and El-Dakkak and Hussein (2009). Negative heterosis values were obtained for other studied crosses ranged from –15.84 % to –13.62 % for the crosses Master B × Samroula and Master B × Kiados. Similar results was obtained by Nosser (2005) and Salib (2006). Plant height was found to be controlled by one pair in the cross Master B × Kiados to two pairs of genes in all the crosses. These results were in agreement with those obtained by Ranal and Mari (1993), Nosser (2005) Salib (2006) and Bhnan (2008).

Table 1: Distribution, mean, and variance of plant height of parental, F_1, F_1r, and F_2 populations of pea crosses.

Population	Frequency of plant height in class [a]											Total No. of plants	Mean ($\bar{X} \pm S_{\bar{X}}$) b	Variance (S^2)
	25	30	35	40	45	50	55	60	65	70	75			
Master B × Samroula														
Master B (P_1)			2	9	14	2						27	42.96 ± 0.72	13.96
Samroula (P_2)							2	10	9	7		28	63.75 ± 0.88 *	21.53
F_1					2	2	11	5	3			23	56.09 ± 1.13 NS	29.44
F_1r					2	9	8	4				23	53.04 ± 0.93	19.86
F_2												79	52.91 ± 0.96	72.83
Master B × Waver Top														
Master B (P_1)			2	9	14	2						27	42.96 ± 0.72	13.96
Waver Top (P_2)							4	9	8	4		25	62.40 ± 0.96 *	23.17
F_1							1	8	11	2		22	63.18 ± 0.78 NS	13.20
F_1r							2	6	12	1		21	62.86 ± 0.81	13.93
F_2			2	5	12	19	8	9	12	2		69	53.04 ± 1.05	76.73
Master B × Kiados														
Master B (P_1)			2	9	14	2						27	42.96 ± 0.72	13.96
Kiados (P_2)	9	10	5	1								25	30.76± 0.52 *	6.96
F_1				2	6	8	3					19	48.16 ± 1.03 NS	20.03
F_1r				2	8	6	2					18	47.22 ± 1.00	18.30
F_2	4	8	14	18	9	12	8					73	41.03 ± 0.99	72.19
Samroula× Kiados														
Samroula (P_1)							2	10	9	7		28	51.25 ± 0.88	7.75
Kiados (P_2)	9	10	5	1								25	30.26 ± 0.86 *	6.69
F_1							2	5	6	8	2	23	65.65 ± 1.19 NS	32.51
F_1r							4	9	8	1		22	61.36 ± 0.88	26.29
F_2	4	8	14	14	9	12	8					69	41.09 ± 1.05	76.38
Waver Top × Kiados														
Waver Top (P_1)							4	9	8	4		25	62.40 ± 0.95	22.49
Kiados (P_2)	9	10	5	1								25	29.60 ± 0.86 *	18.58
F_1								4	11	5		20	65.25 ± 0.77 NS	11.77
F_1r								4	8	6		18	65.56 ± 0.89	14.38
F_2	4	8	15	11	9	6	8		8			71	44.30 ± 1.00	168.15

[a] Each class represents a range of 5 (cm) and class values indicated represent class center.

[b] Pairs of means were either significantly (*) or not significantly (NS) different from each other according to t- test.

Estimates of BSH for this trait ranged from 70.66 % to 89.89 % (Table 2). These results were partially agree with BSH estimates of Farag and Darwish (2005), Nosser (2005), Salib (2006), Salem (2007), Abd El-Hady and Hussein (2008), Bhnan (2008), El-Dakkak and Hussein (2009) and Nosser (2011).

Table 2: Quantitative genetic parents obtained for characters in pea crosses.

Characters	Crosses	Potence ratio	Heterosis	Number of gene	BSH
Plant height	1x2	0.03	- 15.84	1.01	75.41
	1x3	2.08	1.36	1.84	70.66
	1x4	-.05	- 13.62	0.18	81.58
	2x4	2.37	28.10	1.21	84.42
	3x4	- 0.87	4.57	1.27	89.89
Total green pods yield	1x2	2.83	30.97	1.43	57.82
	1x3	1.46	21.89	1.89	32.56
	1x4	2.65	6.78	0.37	67.60
	2x4	1.49	5.11	1.20	42.90
	3x4	1.25	2.75	8.06	50.34
Pod length	1x3	1.07	0.81	0.74	71.62
	1x4	0.29	3.26	3.25	77.85
	2x3	0.04	0.34	0.76	66.46
	2x4	0.51	0.60	11.18	38.58
	3x4	1.14	- 14.26	1.38	77.78
number of pods/plant	1x2	2.79	17.02	1.26	68.42
	1x3	2.00	16.62	3.52	51.32
	1x4	2.72	22.83	0.48	38.56
	2x4	1.34	20.24	2.79	27.39
	3x4	1.07	10.63	2.53	47.50
number of seeds/pod	1x2	1.93	4.11	0.13	67.07
	1x3	0.71	- 5.48	5.85	52.34
	1x4	1.25	4.84	6.62	50.00
	2x3	1.26	4.27	1.47	63.07
	2x4	1.16	2.78	1.53	67.88

1- Master B , 2- Samroula, 3- Waver Top, 4- Kiados

Total green pods yield/plant

Data obtained on green pods yield/plant of parental, F_1, F_1r, and F_2 populations of the crosses Master B × Samroula, Master B × Waver Top, Master B × Kiados, Samroula × Kiados and Waver Top × kiados are presented in Table 3.

Parents were distinctively different in green pods yield/plant in all studied crosses. In each cross, F_1 means were higher than the better parent. F_2 means were shorter than the parents in all crosses except for Samroula × Waver Top who obtained intermediate between their parents in this trait. No significant differences were observed between F_1's and their reciprocals for total green pods yield/plant in all studied crosses indicating absence of maternal effect.

Table 3. Distribution, mean, and variance of total green pods yield/plant of parental, F_1, F_1r, and F_2 populations of pea crosses.

Population	Frequency of total green pods yield/plant in class [a]									Total No. of plants	Mean		Variance
	120	145	170	195	220	245	270	320	345		$(\bar{X} \pm S_{\bar{X}})$	b	(S^2)
Master B × Samroula													
Master B (P_1)				4	6	11				21	228.33 ± 4.34	-	386.24
Samroula (P_2)					1	6	12	2		21	265.24 ± 5.07	*	538.69
F_1							2	15	5	22	299.05 ± 4.19	NS	385.55
F_1r							2	11	6	19	312.11 ± 5.02	*	264.25
F_2			8	18	25	2	2	12		57	211.20 ± 4.08		948.46
Master B × Waver Top													
Master B (P_1)				4	6	11				21	228.33 ± 4.34	-	395.83
Waver Top (P_2)						8	12	2	1	23	268.91 ± 5.55	*	708.99
F_1						2	10	4	2	18	278.33 ± 5.18	NS	588.24
F_1r						4	11	4		19	275.26 ± 5.92	*	665.20
F_2		4	10	25	16	2		1		58	198.00 ± 3.74		813.10
Master B × Kiados													
Master B (P_1)				4	6	11				21	228.33 ± 4.34	-	395.83
Kiados (P_2)			2	11	6	5				24	209.58 ± 4.74	*	538.95
F_1					6	11	2	1		20	243.80 ± 5.28	NS	557.57
F_1r				2	4	9	2			17	236.20 ± 5.23	*	464.15
F_2	2		10	25	8	2	1			48	194.50 ± 3.83		704.51
Samroula × Waver Top													
Samroula (P_1)					1	6	12	2		21	265.24 ± 5.07	-	538.69
Waver Top (P_2)			2	11	6	5				24	209.58 ± 4.74	*	538.95
F_1						2	11	4		17	278.80 ± 6.04	NS	620.40
F_1r						3	13	2		18	271.40 ± 1.74	*	402.37
F_2		4		5	18	15	4			46	233.30 ± 4.64		989.13
Waver Top × Kiados													
Waver Top (P_1)						6	12	2	1	23	268.91 ± 5.55	-	708.99
Kiados (P_2)			2	11	6	5				24	209.58 ± 4.74	*	538.95
F_1					1	3	11	5		20	276.30 ± 5.70	NS	847.40
F_1r					1	7	6	3		17	265.60 ± 5.20	*	877.76
F_2	2	15	17	21	5		2			62	178.10 ± 4.64		917.50

[a] Each class represents a range of 25 (g) and class values indicated represent class center.

[b] Pairs of means were either significantly (*) or not significantly (NS) different from each other according to t- test.

Quantitative genetic parameters obtained for total green pods yield/plant are presented in Table 2. High positive values of potence ratio indicated over dominance for this trait in the crosses Master B × Samroula and Master B × Kiados which showed over dominance. While partial dominance were showed for the crosses Master B × Waver Top, Samrpula × Kiadoa and Waver Top × Kiados. These results are in agreement with Panda *et al.,* (1994) and Bhnan (2008). On the other hand, Nosser (2005) reported partial dominance for this character.

Positive heterosis values were observed for this trait in all crosses ranger from 2.75 % to 30.97 % in the crosses Waver Top × Kiados and Master B × Samroula, respectively. Similar results were reported by Sarawat *et al.,* (1994) and Bhnan (2008).

Total green pods yield/plant was found to be controlled by number of genes ranged from one pair to nine pairs. These results were in agreement with Ranal and Mari (1993) and Nosser (2005).

Estimates of BSH for total green pods yield/plant were moderate to high being 32.56 % to 67.60 % in all crosses. These results were partially agree with estimates of Panda *et al.,* (1994), Nosser (2005), Bhnan (2008) and Nosser (2011).

Pod length

Data obtained on pod length of parental, F_1, F_1r, and F_2 populations of the crosses Master B × Waver Top, Master B × Kiados, Samroula × Waver Top, Samroula × Kiados and Waver Top × kiados are presented in Table 4.

Parents were distinctively different in pod length in all studied crosses. In each cross, F_1 mean was higher than the better parent except for the cross Waver Top × Kiados who obtained intermediated between parent. Meanwhile, the F_2 mean was intermediate between parents in all crosses. No significant differences were observed between F_1's and their reciprocals in this trait in all studied crosses indicating absence of maternal effect.

Quantitative genetic parameters obtained for pod length are presented in Table 2. positive values of potence ratio indicated partial dominance in all crosses. These results are agreement with Kumar *et al.,* (1997) and Salib (2006).

Positive heterosis values were estimated for all crosses ranged from 0.60 % to 3.26 %, while negative heterosis observed in the cross Waver Top × Kiados. These results were in agreement with Sarawat *et al.,* (1994) and Bhnan (2008).

Pod length was found to be controlled by one pairs in the crosses Master B × Waver Top and Samroula × Waver Top to twelve pair of genes in the cross Samroula × Kiados. These results were in agreement with those of Ranal and Mari (1993) and Nosser (2005).

Estimates of BSH for pod length ranged from 38.58 % to 77.85 %. These results were partially agree with estimates of Nosser (2005), Salem (2007) Abd El-Hady and Hussein (2008.

Table 4: Distribution, mean, and variance of pod length of parental, F_1, F_1r, and F_2 populations of pea crosses.

Population	Frequency of pod length in class [a]										Total No. of plants	Mean ($\bar{X} \pm S_{\bar{X}}$) b	Variance (S^2)
	5	6	7	8	9	10	11	12	13	14			
Master B × Waver Top													
Master B (P_1)							2	16	5	2	25	12.28 ± 0.15	0.54
Waver Top (P_2)					8	14	2				24	9.75 ± 0.12	0.37
F_1							1	11	9		21	12.38 ± 0.13 NS	0.35
F_1r							1	10	11		22	12.45 ± 0.13	0.36
F_2				4	12	22	11	8	2		59	10.22 ± 0.16	1.48
Master B × Kiados													
Master B (P_1)							2	16	5	2	25	12.28 ± 0.15 *	0.54
Kiados (P_2)		2	9	8	2						21	7.48 ± 0.18	0.66
F_1							2	6	8	3	19	12.63 ± 0.21 NS	0.80
F_1r							5	2	7	3	17	12.47 ± 0.27	1.26
F_2			2		12	10	24	6			54	10.33 ± 0.16	1.35
Samroula × Waver Top													
Samroula (P_1)						2	4	8	6		20	11.90 ± 0.21 *	0.79
Waver Top (P_2)					8	14	2				24	9.75 ± 0.12	0.37
F_1						2	3	11	5		21	11.91 ± 0.19 NS	0.50
F_1r						2	8	11			21	11.43± 0.15	0.46
F_2				2	4	10	8	29	6		59	11.29 ± 0.16	1.58
Samroula × Kiados													
Samroula (P_1)						2	4	8	6		20	11.90 ± 0.21 *	0.79
Kiados (P_2)		2	9	8	2						21	7.47 ± 0.18	0.66
F_1						1	6	8	4		19	11.97 ± 0.19 NS	0.93
F_1r						2	7	7	2		18	11.50 ± 0.20	0.74
F_2					4	8	21	11	8		52	10.21 ± 0.16	1.27
Waver Top × Kiados													
Waver Top (P_1)					8	14	2				24	9.75 ± 0.12 *	0.37
Kiados (P_2)		2	9	8	2						21	7.47 ± 0.18	0.66
F_1				2	5	8	4				19	8.36 ± 0.21 NS	0.87
F_1r				1	6	7	2				16	8.30 ± 0.20	0.65
F_2	2	4	15	22	12	8	2				66	8.15 ± 0.18	2.06

[a] Each class represents a range of 1 (cm) and class values indicated represent class center.

[b] Pairs of means were either significantly (*) or not significantly (NS) different from each other according to t- test.

Number of pods/plant.

Data obtained on number of pods/plant of parental F_1, F_1r, and F_2 populations of the crosses Master B × Samroula, Master B × Waver Top, Master B × Kiados, Samroula × Kiados and Waver Top × kiados are presented in Table 5.

Parents were distinctively different in number of pods/plant in all studied crosses. In each cross, F_1 mean was higher than the better parent.

Meanwhile, the F_2 mean was intermediate between parents except for the crosses Master B × Samroula and Master B × Kiados who observed higher than the better parent.

No significant differences were observed between F_1's and their reciprocals for number of pods/plant in all crosses indicating absence of maternal effect.

Quantitative genetic parameters obtained for number of pods/plant are presented in Table 2. Positive values of potence ratio were detected in all crosses indicating over dominance of the high number of pods/plant for the crosses Master B × Samroula and Master B × Waver Top and Master B × Kiados. Meanwhile, partial dominance was obtained for another crosses for this trait. These results were in agreement with Nosser (2005).

Positive heterosis values were estimated for all crosses ranged from 10.63 % in the cross Waver Top × Kiados to 22.83 % in the cross Master B × Kiados, respectively. Similar results were reported by Sarawat *et al.*, (1994), Sharma *et al.*, (1998), Nosser (2005) and El-Dakkak and Hussein (2009).

Number of pods/plant was found to be controlled by number of genes ranged from one pair to four pairs of genes. These results are in agreement with Ranal and Mari (1993), Nosser (2002 and 2005) and Bhnan (2008).

Estimates of BSH for number of pods/plant ranged from 27.39 % to 68.42 % in crosses Samroula × Kiados, and Master B × Samroula, respectively (Table 2). These results are agree with estimates of Nosser (2002), Farag and Darwish (2005), Nosser (2005), Salem (2007), Abd El-Hady and Hussein (2008), Bhnan (2008) and Nosser (2011).

Number of seeds/pod.

Data obtained on number of seeds/pod of parental, F_1, F_1r, and F_2 populations of the crosses Master B × Samroula, Master B × Waver Top, Master B × Kiados, Samroula × Waver Top and Samroula × kiados are presented in Table 6.

Parents were distinctively different in number of seeds/pod than all crosses. In each cross, F_1 means were higher than the highest parent in all crosses except for the cross Master B × Waver Top who observed intermediated between the parents. F_2 means were intermediate between its two parents except for the cross Master B × Samroula where F_2 mean was less than the short parent. No significant differences were observed between F_1's and their reciprocals for number of seeds/pod in all crosses indicating absence of maternal effect.

Quantitative genetic parameters obtained for number of seeds/pod are presented in Table 2. Positive values of potence ratio indicated partial dominance in all crosses. These results are in agreement with Nosser (2005).

Table 5: Distribution, mean, and variance of number of pods/plant of parental, F_1, F_1r, and F_2 populations of some pea crosses.

Population	Frequency of number of pods/plant in class [a]											Total No. of plants	Mean ($\bar{X} \pm S_{\bar{x}}$) b	Variance (V)
	7	16	25	34	43	52	61	70	79	88	97			
Master B × Samroula														
Master B (P_1)		2	11	11								24	28.38 ± 1.19	33.89
Samroula (P_2)				2	8	9	2	2				23	49.65 ± 1.98	89.96
F_1						4	11	4	2			21	58.10 ± 1.44 NS	43.69
F_1r						9	10		1			20	57.40 ± 1.20	28.90
F_2				4	6	21	8	20	8			67	59.79 ± 1.55	161.74
Master B × Waver Top														
Master B (P_1)		2	11	11								24	28.38 ± 1.19	33.89
Waver Top (P_2)				2	6	10	4	2				24	51.25 ± 1.95	90.98
F_1					2	4	12	3	1			22	59.77 ± 1.81 NS	71.71
F_1r				2	8	9	4					25	55.46 ± 1.78	57.17
F_2		2	2	22	12	13	9	8	6	2	1	63	50.43 ± 1.40	124.22
Master B × Kiados														
Master B (P_1)		2	11	11								24	28.38 ± 1.19	13.96
Kiados (P_2)	4	4	12	2								22	20.91 ± 1.75	6.69
F_1			6	9	4	2						21	34.86 ± 1.85 NS	20.03
F_1r		2	4	15	2							23	31.65 ± 1.41	18.30
F_2		2	2	22	12	4	9	8	6	2	1	68	39.79 ± 1.27	72.19
Samroula × Kiados														
Samroula (P_1)				2	8	9	2	2				23	49.65 ± 1.98	7.75
Kiados (P_2)	4	4	12	2								22	20.91 ± 1.75	6.69
F_1					2	11	6	4				23	56.70 ± 1.69 NS	32.51
F_1r					47	9	5	1				19	53.42 ± 1.72	26.29
F_2		2		5	11	23	10					51	48.65 ± 1.45	76.38
Waver Top × Kiados														
Waver Top (P_1)				2	6	10	4	2				24	51.25 ± 1.95	90.98
Kiados (P_2)	4	4	12	2								22	20.91 ± 1.75	6.96
F_1					5	8	5	3	2			23	56.70 ± 2.32 NS	124.22
F_1r					3	10	5	3				21	55.43 ± 1.81	68.66
F_2	2		9	9	27		8	2				57	40.95 ± 1.77	179.41

[a] Each class represents a range of 9 (N.O) and class values indicated represent class center.
[b] Pairs of means were either significantly (*) or not significantly (NS) different from each other according to t- test.

Table 6. Distribution, mean, and variance of number of seeds/pod of parental, F_1, F_1r, and F_2 populations of pea crosses.

Population	Frequency of number of seeds/pod in class [a]									Total No. of plants	Mean $(\bar{X} \pm S_{\bar{x}})$ b	Variance (S^2)
	3	4	5	6	7	8	9	10	11	12		
Master B × Samroula												
Master B (P_1)							3	11	8		22	10.23 ± 0.15) **	0.47
Samroula (P_2)						2	11	8	1		22	9.36 ± 0.16)	0.53
F_1							2	5	11	2	20	10.65 ± 0.18) NS	0.66
F_1r							2	6	10	2	20	10.60 ± 0.18)	0.67
F_2					8	15	13	10	8		54	8.91 ± 0.18	1.67
Master B × Waver Top												
Master B (P_1)							3	11	8		22	10.23 ± 0.15) **	0.47
Waver Top (P_2)			2	10	5	2					19	6.37 ± 0.19)	0.69
F_1						2	7	8	4		21	9.66 ± 0.19) NS	0.44
F_1r						1	5	11			17	9.59 ± 0.18)	0.83
F_2				2	13	9	22	9			55	8.42 ± 0.15	1.28
Master B × Kiados												
Master B (P_1)							3	11	8		22	10.23 ± 0.15) **	0.47
Kiados (P_2)			3	10	5	1					19	6.21 ± 0.18)	0.62
F_1						2	5	8	4		19	10.74 ± 0.21) NS	0.87
F_1r						2	8	6	1		17	10.35 ± 0.19)	0.62
F_2			2	15	25	8		4			54	7.02 ± 0.15	1.26
Samroula × Waver Top												
Samroula (P_1)						2	11	8	1		22	9.36 ± 0.15) **	0.50
Waver Top (P_2)			2	10	5	2					19	6.37 ± 0.19)	0.69
F_1						2	5	10	4		21	9.76 ± 0.19) NS	0.79
F_1r						3	5	10	2		20	9.55 ± 0.19)	0.79
F_2				5	14	14	22		6		61	8.26 ± 0.17	1.76
Samroula × Kiados												
Samroula (P_1)						2	11	8	1		22	9.36 ± 0.16) **	0.53
Kiados (P_2)			3	10	5	1					19	6.21 ± 0.18)	0.62
F_1						2	7	9	3		21	9.62 ± 0.19) NS	0.75
F_1r						4	7	8	1		20	9.30 ± 0.19)	0.74
F_2	1	4		5	21	18	8		2		59	7.42 ± 0.18	1.93

[a] Each class represents a range of 1 (seed) and class values indicated represent class center.
[b] Pairs of means were either significantly (*) or not significantly (NS) different from each other according to t- test.

Positive heterosis values were estimated in all crosses and ranged from 2.78 % to 4.84 % while the cross Master B × Waver Top which showed negative heterosis. Similar results were reported by Sarawat *et al.*, (1994), Sharma *et al.*, (1998) and Nosser (2005).

Number of genes estimated for the number of seeds/pod ranged from one pair to seven pairs. Similar results were reported by Ranal and Mari (1993) and Nosser (2005).

Estimates of BSH for number of seeds/pod ranged from 50.00 % in the cross Master B × Kiados to 67.88 % in the Samroula × Kiados. These results were partially agree with estimates of Nosser (2002), El-Dakkak *et al.*, (2009) and Nosser (2011).

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دراسات وراثية على بعض الصفات الاقتصادية فى البسله

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اجريت هذه الدراسة فى محطة بحوث البساتين بالقناطر الخيريه محافظة القليوبية خلال الفترة من ٢٠٠٨ الى ٢٠١٠ واستخدمت فيها اربعة أصناف من البسلة وهى ماستر بى ، و سامرولة ، و ويفر توب ، و كيادوس. تم التهجين بين الاباء الاربعه و انتجت بذور الجيل الاول ، و الجيل الاول العكسى، و الجيل الثانى ثم قيمت لدراسة وراثة بعض الصفات الاقتصادية.

لم يلاحظ تاثير للام فى كل الصفات محل الدراسة كما وجدت انواع مختلفة من درجات السياده بين الصفات المختلفة ، حيث وجدت سياده فائقه فى كل الصفات فيما عدا صفة طول القرن ، عدد البذور فى القرن. بينما ظهرت السيادة الجزئية فى بعض الهجن لبعض الصفات تحت الدراسة .

وجدت قوة هجين موجبة تراوحت بين ١.٣٦% – ٢٨.١٠ % ، ٢.٧٥ % – ٣٠.٩٧ ، ٠.٦٠ % – ٣.٢٦ % ، ١٠.٦٣ % – ٢٢.٨٣ ، ٢.٧٨ % – ٤.٨٤ % لصفات ارتفاع النبات ، المحصول الاخضر الكلى للنبات ، طول القرن ، عدد القرون للنبات ، عدد البذور فى القرن على التوالى. بينما وجدت قوة هجين سالبة تراوحت بين – ١٥.٨٤ % لصفة ارتفاع النبات الى – ٥.٤٨ % لصفة عدد البذور فى القرن.

قدر عدد العوامل الوراثية المتحكمة فى الصفات المدروسة ب ١-٢ ، ١-٩ ، ١-١٢ ، ١ – ٤ ، ١ – ٧ زوج للصفات ارتفاع النبات ، المحصول الاخضر الكلى ، طول القرن ، عدد القرون للنبات ، و عدد البذور فى القرن على التوالى.

قدرت درجة التوريث على المدى الواسع للصفات السابقة فكانت على التوالى ٧٠.٦٦ % – ٨٩.٨٩ % ، و ٣٢.٥٦ % – ٦٧.٦٠ % ، و ٣٨.٥٨ % – ٧٧.٨٥ ، و٢٧.٣٩ % – ٦٨.٤٢ ، و ٥٠.٠٠ % – ٦٧.٨٨ % لنفس الصفات.

عموما تم انتخاب بعض النباتات المبشرة من الجيل الثانى والتى يمكن ان تدخل فى برنامج للتربية لانتاج اصناف جديدة من البسلة.

قام بتحكيم البحث

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