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GENETIC PARAMETERS FORSOME IMPORTANT CHARACTERS IN ALFALFA (*Medicago Sativa* L.) CROSS.

Abd El-NabyZeinab M. [1]*, Fadia M. Sultan[1]and Zeinab S. Ghareeb[2]

[1]Forage Crops Research Dept., Field Crop Research Inst., ARC, Giza, Egypt

[2]Central Lab of Statistical Design Research, ARC, Giza, Egypt

*Corresponding author e-mail: zeina_bree@yahoo.com

ABSTRACT

The assessment of gene effect for some vegetative, fertility traits and detection of epistasis in alfalfa was studied in a cross between New valley and Ismaelia-94 genotypes through six generations mean analysis during three successive seasons from 2011/12 till 2013/14 at the Experimental Farm of the Forage Research Department, Field Crops Research Institute, Agriculture Research Center, Giza, Egypt. The nature of gene effects for agronomic and fertility traits were analyzed through six generations for detecting the gene effects responsible for inheritance. Significant differences were detected among generations viz, P_1, P_2, F_1, F_2, BC_1 and BC_2 for most of the studied traits. F_2 generation indicated better performance for number of tiller and fresh yield (32.63 and 93.99, respectively). Bc_1 generation recorded the best values among number of pods tiller^{-1} and number of seed tiller^{-1} with (51.87 and 156.73). F_2 mean performance was greater than the better parents for all traits except number of inflorescences plant^{-1} and 1000-seed weight. Bc_1 recorded the best average mean across the most of agronomic and fertility traits. Broad sense heritability (H^2_b) recorded high values of plant height, No tillers and fresh yield (0.845, 0.941 and 0.878, respectively), while leaf stem ratio and dry yield were low values of H^2_b (0.420 and 0.290, respectively). So, H^2_b ranged from 0.520 for the number of florets inflorescence to 0.972 for the number of inflorescences plant^{-1}) respectively, whereas the narrow sense heritability (h^2_n) illustrated low values across agronomic and fertility traits. The estimated values of additive variance (d) for the most of studied traits recorded highly significant positive sign, it is revealed that both additive and dominance gene effects were important in the performance of these traits. Duplicate epistasis was prevailing for all agronomic traits and number of inflorescence plant^{-1} except for leaf stem ratio%. Complimentary epistasis of non-allelic gene interaction was showed only for number of pods plant^{-1}.

Key words: Alfalfa, Cross, Inheritance, Genetic parameters, Gen action, Epistasis.

INTRODUCTION

Alfalfa (*Medicago Sative* L.) is one of the most important forage crops throughout the world. Since it is a natural auto-tetraploid, characterized by high allogamy and self-incompatibility, its inheritant patterns are particularly complex (**Rumbaugh*et al* 1988**). Yielding ability and flower characteristics are important in choosing cultivars or hybrids for planting in certain area. As a result of plant breeding, the modern cultivars often have higher crop indices than the old ones. The success in developing alfalfa cultivars depends the most on the breeding method used (**Katic *et al* 2008**). Alfalfa hybrids more economically feasible are the "semi hybrid" approach described by **Brummer (1999)**. Heterosis, or the superiority of hybrid progeny relative to their parents, is a phenomenon of great agricultural relevance yet the genetic control of heterosis is unknown.

Genetic parameters that can estimate the performance of quantitative characters with higher accuracy have been greatly pursued by breeders aiming at a higher efficiency in the selection process. In this sense, generation analysis is an important tool for the estimation of genetic effects, besides enabling the measurement of episthatic effects that interfere in the expression of the character (**Bertan *et al* 2009**).

Several genetic studies were conducted on hybrid vigor and were found by many investigators (**Rotili, 1976, Simon 1984 and Bober and Kharba, 1987**). The most F_1 crosses exceeded their respective better parent in early yield. **Pusbice and Wilsie** (**1966**) reported that the transgressive segregation was observed in the F_2 generation. According to several authors, the average number of inflorescences on stems, and of flowers in racemes, is sufficient to produce satisfactory yields of alfalfa seeds (**Wilczek 1981, Skalska 1993, Dyba and Rogalska 1995)**. Investigations aimed at increasing seed yield indicate that improvement of pod and seed setting is possible by breeding (**Jaranowski and Dyba 1983, Bocsa and Pummer 1994, 1997).**

The present investigation was conducted to: 1) determine the extent of heterosis, phenotypic and genotypic coefficients of variations as well as the nature of gene action involved in the inheritance of yield and some agronomic characters of alfalfa cross, 2) estimate genetic parameters for hybrid generations and 3) select plants superior for agronomic and fertility traits to improve plant vigor, forage and seed yield.

MATERIALS AND METHODS

This study was carried out at the Experimental Farm, Giza, Egypt, during three successive seasons from 2011/12- 2013/14. The breeding genotypes (New valley and Ismaelia-94) illustrated in Table 1, which were widely different in their characteristics, were used as parents. In the first winter season (2011/12), the plants were grown in the field. Manual crossing was made between the two parents to produce F_1 seeds, at the same time, the two parents were caged by glycine bags and rolling three times, before standard petal opened at mid-blooming stage (after 24-36hr from budding), to produce selfed seeds. In the second season (2012/13), the F_1 plant and their parents were grown; the F_1 plants were crossed to both parents to develop the BC_1 and BC_2 seeds. In the third season (2013/14), the six generations; i.e., P_1, P_2, F_1, F_2, BC_1 and BC_2, were grown in randomized complete blocks design (RCBD), with three replicates. Plot size was (4m x 4m), besides plants were sown in rows with 4 m long and 60 cm apart with 25 cm between plants. Each plot consists of 6 rows and each row contained 14 plants. Number of rows was three for each of the non- segregating genotypes (P_1, P_2 and F_1), six for each of Bc_1, Bc_2 and F_2 generations. All recommended field practices for alfalfa production were adopted in all growing seasons. Data were recorded on all plantsplot^{-1} of each generation, regarding the studied characters, during the harvest period. Growth and yield characteristics measured were, plant height cm, number of tillers, leaf stem^{-1} ratio, fresh yield g, dry yield g and fertility characters (number of inflorescences plant^{-1} and number of florets inflorescences $^{-1}$). Five florets were randomly taken from each plant at blooming stage to calculate number of pods tiller^{-1}, number of seeds tiller^{-1} and weight of 100 seeds g). Data were statistically analyzed using the standard method of a randomized complete blocks design (RCBD).

Table 1. Genotypes origin and characters.

Genotype	Origin	Characters
New valley	FCRI*. ARC**, Egypt	Recommended for planting in newly reclaimed lands at new valley, alfalfa populations were collected by staff members of forage crops research, from different locations in New Valley.
Ismaelia 94	FCRI. ARC, Egypt	Recommended for planting in newly reclaimed lands at sandy soil.

*FCRI: Field Crop Research Institute and **ARC: Agric. Research Center.

Gene effects:

The following notations for gene effects were used: [m]-mean, [a]-additive, [d]-dominance, [i]-additive x additive, [j]-additive x dominance and [I]-dominance x dominance effects.

Statistical and genetic procedures:

Heterosis estimate was based on a model similar to that initially described by **Gardner and Eberhart (1966).** The phenotypic (σ^2P), genetic (σ^2 G), additive (σ^2 A), dominance (σ^2 D) and environmental (σ^2E) variances were estimated according to **Allard (1999**). The Phenotypic coefficient of variation (P.C.V.) and genotypic coefficient of variation (G.C.V.) were estimated using the formula suggested by **Dudley and Moll (1969**). The significance of the genetic parameter was verified by the t test. Loss of vigrous (L.V.), inbreeding depression, was calculated as the difference between the F_1 and F_2 means expressed as a percentage of the F_1 mean (**Wynn *et al* 1970**). Predicted genetic gain as mean percent from selection (G adv. %) was calculated according to **Johanson *et al.* (1955**). Both broad and narrow-sense heritability (h^2b and h^2n, respectively) were calculated according to Mather procedure (**Mather, 1949**).

The genetic effects for cross was estimated for the characters using the generalized weighted least square method and testing the adjustment of the model of six parameters genetic model (complete model): "m", "a", "d", "i", "j" and "I") according to **Mather and Jinks (1982**).

RESULTS AND DISCUSSION

The means of the alfalfa cross generations of agronomic and fertility traits are presented in Table (2). The hybrid generations and their respective parents exhibited highly significant differences for the studied traits.

a- Agronomic traits

Results show that Bc_1 had the best plant height, number of tiller, fresh and dry yield, respectively (84.36, 37.86, 121.19 and 29.70, respectively). F_2 generation indicated better performance of number of tiller and fresh yield g (32.63 and 93.99, respectively) across all generations. The values of F_2 generation across studied traits were better than the parental one. First and second backcrosses showed differences due to parental participation in particular cross. The differences amid analyzed generations were sufficient to perform generation mean analysis (Table 2).

b- Fertility traits

The mean values for seed yield components recorded higher values of Bc_1 generation of pods tiller^{-1} and number of seed tiller^{-1} with (51.87 and 156.73). F_2 mean performances were greater than the better parents for all traits except number of inflorescences plant^{-1} and 100-seed weight. F_1 had lower means across all fertility traits whereas higher means than the superior parent for number of inflorescences plant^{-1} and for 100-seed weight. The generations mean were close to the superior parent except number of florets tiller^{-1} and number of seeds tiller^{-1}. Both BC generations mean were greater than the superior parent for all the traits, except the 100-seed weight means which were close to mid parents (Table 2).

Genetic parameter

Plant breeders have been investigated the possibility of developing hybrid genotypes. Thus, the utilization of heterosis in various crops through the world has tremendously increased the production. The estimates of heterosis over mid parent (H_{MP}), heterosis over better parent (H_{BP}), loss of vigorous (LV), phenotypic coefficient variance (PCV), genotypic coefficient variance (GCV), environmental coefficient variance (ECV) and broad and narrow-sense heritability (h^2b and h^2n) with genetic advance (G adv.%) are shown in Table (3). Heterosis is expressed as the percentage deviation of F_1 mean performance from the better or mid parent of the traits.

a- Agronomic traits:

Heterosis (H_{MP}) had higher values across all traits comparing with (H_{BP}). Number of tillers plant^{-1} indicated the highest value of H_{MP} (49.68%). A large phenotypic coefficient variance (PCV) values than environmental coefficient variance (ECV) for all the components under evaluated. It contributed down to 1.49 and 3.46 of the total (PCV) for No. of tillers and fresh yield per plant, respectively. This led to high broad-sense heritability values, which varied from 0.845 to 0.941 and medium value for leaf stem^{-1} ratio (0.420). Plant height, leaf stem^{-1} ratio and dry yield were decreased in vigorous but no. tillers and fresh yield were demonstrated increasing values in hybrid generation (1.37, 8.92 and 6.19%, respectively). Heritability in broad sense (H^2_b) recorded high values of plant height, No. of tillers and fresh yield (0.941, 0.845 and 0.878, respectively), while leaf stem ratio and dry yield were low values of H^2_b (0.420 and 0.290, respectively). Narrow sense heritability (H^2_n) observed lowest values across all traits and ranged from 0.039 of plant height to 0.262 of dry yield. Fresh recorded higher values of genetic advance (27.02%), whereasdry yield has notachievedanygeneticadvance (Table 3).

b- Fertility traits:

Heterosis (H_{MP}) and (H_{BP}) reported negative signs across all fertility traits except number of inflorescences plant^{-1} and 100 seeds weight. Number of inflorescences plant^{-1} had the highest value of H_{MP} (23.35%) while H_{BP} value was (11.98%) of 100 seeds weight. Regarding the characters, number of inflorescencesplant^{-1} and100 seed weight, a depressed in vigrous expression was observed with (6.62 and 4.76%, respectively), which showed increased vigours of number of florets tiller^{-1}, number of pods tiller^{-1} and number of seeds

Table 2. Generation means and standard errors (SE) for agronomic traits in the alfalfa cross generations.

Generations	a- Agronomic traits					b- Fertility traits				
	Plant height	No. tillers	Leaf stem^{-1} ratio	Fresh yield	Dry yield	No. Inflor. plant^{-1}	No. florets tiller^{-1}	No. pods tiller^{-1}	No. seeds tiller^{-1}	Weight 100 seeds g
	Mean ±SE									
P_1	81.74±2.97	29.07±1.26	1.38±0.08	85.95±6.38	23.05±2.18	165.30±2.06	92.99±0.97	42.88±0.88	112.37±5.75	0.395±0.019
P_2	74.57±2.24	13.95±0.55	1.328±0.11	75.40±6.88	20.00±1.25	120.46±1.38	87.56±1.14	35.15±0.93	84.48±0.89	0.344±0.021
F_1	83.91±1.87	32.19±0.37	1.51±0.07	86.29±2.30	24.96±1.11	176.24±3.07	78.91±0.79	31.37±0.10	92.18±0.48	0.414±0.019
F_2	76.86±4.25	32.63±1. 90	1.36±0.08	93.99±8.10	23.41±2.19	132.60±14.87	106.83±2.32	51.87±1.07	156.73±10.68	0.382±0.038
BC_1	84.36±5.23	37.86±1.94	1.22±0.06	121.19±9.73	29.70±2.68	202.39±7.87	112.47±0.31	49.58±0.14	139.3±3.37	0.370±0.004
BC_2	82.05±1.19	29.24±0.73	1.24±0.07	88.75±1.70	23.15±0. 96	168.52±7.28	105.89±1.66	44.82±0.16	120.72±16.11	0.352±0.003
Mean	80.58±3.40	29.16±1.13	1.34±0.07	91.93±5.77	24.04±1.72	160.92±0.926	97.44±0.16	42.61±0.083	117.63±1.01	0.376±0.003

SE=standard error.

tiller^{-1}, respectively, with values (15.14, 26.84 and 17.97%, respectively). Cross that reveal heterosis in F_1, followed by loss of vigour (L.V. %) in F_2, can produce a higher number of genotypic classes for selection, and these information can be extremely useful for the breeder, especially regarding selection intensity (**Crestani *et al* 2012**).

Based on the genetic parameters, a less and distinct phenotypic coefficient variance (PCV) was observed for fertility traits (Table 3). When compared the values of PCV and GCV, it can be observed a higher contribution between them with narrow effects values across all studied character except for leaf stem ratio and dry yield PCV higher than GCV (Table 3). The ECV recorded lower values ranged from 0.91 to 5.17% however, the variance attributed to the genetic effects (GCV) expressed higher magnitude when compared to (ECV) for all fertility traits. This may result due to the involvement of low environmental and genotype x environment effects in character expression.

The broad sense heritability (h^2_b), ranged from 0.520 for the number of florets tiller^{-1}to 0.972 for the number of inflorescences plant^{-1}) respectively, whereas the narrow sense heritability (h^2_n) ranged from 0.023 for the number of florets tiller^{-1} to 0.019for the 100 seed weight and noted lower expression for all fertility traits. High heritability estimates indicates that these characters are least affected by environmental effects. However, the selection for improvement of such characters may not be useful as broad sense heritability is based on total genetic variance which includes both fixable (additive) and non-fixable (dominance epistatic) variance. On the other hand, if broad sense heritability is low, it revealed that the character is highly influenced by environmental effect and genetic improvement through selection will be difficult due to masking effects of the environment on the genotypic effects. GCV and heritability are not sufficient to determine the amount of variation which is heritable. Fertility traits recorded low percentages of genetic advance ranged from (0.18 to 7.07%) (Table 3). **Burton (1952)** and **Johnson *et al* (1955)** found that it was more useful to estimate heritability value together with genetic advance in predicting the expected progress to be achieved through selection.

Estimates of gene action

1- Scaling test

The results of scaling test (A, B, C and D) in Table (4) were varied between significant across studied traits in alfalfa cross except for leaf stem ratio % and 1000- seed weigh were insignificant negative sign for (A,B and C) scaling test with insignificant positive sign for scaling test (D). Number of seeds pod^{-1} had insignificant positive sign across all scaling test. This suggests the presence of epistasis across the most of traits. Insignificant of the scaling test estimates of leaf stem ratio %, number of seeds pod^{-1}and 100-seed weigh indicate the absence of non-allelic interactions and the additive-dominance model is adequate in this case for these traits. The significance of any one of these scales is an indication the presence of non-allelic interaction. Hence, data indicate the presence of non-allelic interaction for all the studied characters. These results were in agreement with those of **El-Hady *et al* (2009)**.

Table 3. Genetic parameters of yield and fertility traits.

Generations	a- Agronomic traits					b- Fertility traits				
	Plant height	No. tillers	Leaf stem^{-1} ratio	Fresh yield	Dry yield	No. Inflor. plant^{-1}	No. florets tiller^{-1}	No. pods tiller^{-1}	No. seeds tiller^{-1}	Weight 100 seeds g
Heterosis Mp	7.36	49.65	11.48	6.96	15.96	23.35	-19.60	-12.59	-6.34	11.98
Heterosis Bp	2.65	10.73	9.21	0.40	8.29	6.62	-26.84	-15.14	-17.97	4.76
Loss vigours	8.40	-1.37	9.66	-8.92	6.19	24.76	-65.33	-35.38	-70.02	7.66
P.C.V.	9.58	10.08	9.98	14.92	8.96	19.43	3.58	3.77	11.80	17.48
G.C.V.	8.88	9.74	6.89	13.66	4.83	19.20	2.58	3.42	11.20	15.01
E.C.V.	2.08	1.49	4.17	3.46	4.36	1.72	1.43	0.91	2.15	5.17
Heritability h^2b	0.845	0.941	0.420	0.899	0.290	0.9717	0.520	0.838	0.925	0.741
Heritability h^2n	0.039	0.084	0.102	0.039	0.262	0.089	0.023	0.073	0.130	0.019
Genetic Adv.%	4.130	4.343	2.097	27.022	0.000	3.573	0.179	0.574	3.164	7.073

2- Gene action

The genetic variation includes all the components corresponding to an auto-tetraploid species, including higher order intra-locus and epistatic interactions (**Rumbaugh *et al* 1988).** Different types of gene effects were presented in Table (4), the estimated mean effect (m) was found to be highly significant across all studied traits except for number of seeds pod^{-1} and 100-seed weigh. It is mentioned that the most of studied traits were quantitatively inherited.

The additive (d) gene effects were found to be highly significant positive for all traits except for leaf stem ratio% indicated negative highly significant and insignificant positive for number of seeds pod^{-1} and 100 seeds weight.

Either leaf stem ratio% or noted insignificant negative difference for both additive and dominance gene effects. On other hand, positive and highly significant dominance (h) were obtained for plant height, fresh and dry yield but number of tiller reported positive and significant dominance gene effect. Leaf stem ratio%, number of florets inflorescence^{-1}, number of seeds tiller^{-1} and 100 seeds weigh recorded insignificant negative dominance effect. Results were indicated that the dominance gene effects were high important in the inheritance of agronomic traits and number of inflorescence plant^{-1}. These results are in harmony with these reported by **Abd Elkader (2006).** He found that dominance effect were importance in inheritance of cowpea legume crop. The additive gene was importance in the inheritance of mostly fertility traits. The number of tiller plant^{-1} not affected by additive or dominance genes.

Fresh and dry yield indicated that highly significant positive additive x additive (i) and additive x dominance (j) type of epistasis also, they had highly significant negative dominance x dominance (I) type of epistasis. Plant height had highly significant positive additive x additive (i) whereas, highly significant negative additive x dominance (j) and dominance x dominance (I) type of epistasis.

Additive x additive (i) type of epistasis recorded highly significant positive sign for number of inflorescence plant^{-1} and significant negative sign for number of pods tiller^{-1}. Additive x dominance (j) type of epistasis indicated insignificant positive sign across all traits except for 100 seed weight was insignificant negative sign. Dominance x dominance (I) type of epistasis reported highly significant negative sign for number of inflorescence plant^{-1}, number of florets tiller $^{-1}$ and significant negative sign for number of pods tiller^{-1}.

Both of Additive x additive (i) and dominance x dominance (I) types of epistasis were highly important in the genetic system controlling in the most of yield and yield component studied traits, agronomic traits, and in number of inflorescences plant^{-1}.

Duplicate epistasis of non-allelic gene interaction (Table 4) was observed, as revealed by different signs of (d) and (dd) in alfalfa cross which exhibited significant epistasis. This illustrated that duplicate epistasis was prevailing for all agronomic traits and number of inflorescence plant^{-1} except for leaf stem ratio%. Complimentary epistasis of non-allelic gene interaction was showed only for number of pods plant^{-1}. Duplicate type of epistasis was evident for all characters in a few crosses, while

Table 4. The estimates of scaling test and gene action effects for quantitative traits of alfalfa cross generations.

Generations	a- Agronomic traits					b- Fertility traits				
	Plant height	No. tillers	Leaf stem^{-1} ratio	Fresh yield	Dry yield	No. Inflor. plant^{-1}	No. florets tiller^{-1}	No. pods tiller^{-1}	No. seeds tiller^{-1}	Weight 100 seeds g
Scaling Test										
A	3.08±2.47	14.46±2.44**	-0.44±0.56	70.14±6.69**	59.40±9.0**	63.24±6.05**	53.04±1.73**	24.91±1.24**	74.04±4.44	-0.067±0.231
B	5.61±2.69*	12.35±1.79**	-0.35±0.61	15.81±3.59**	1.35±2.26	40.32±5.79**	45.31±2.93**	23.11±1.29**	64.79±8.11	-0.053±0.231
C	-16.68±8.85	23.13±5.73**	-0.27±1.27	42.03±12.08**	0.69±5.07	-107.84±15.93**	88.94±6.51**	66.69±4.40**	245.69±13.39	-0.038±0.856
D	-12.69±4.32*	-1.84±3.07	0.26±0.65	-21.96±6.62**	-30.03±5.03**	-105.70±8.64**	-4.70±3.36	9.33±2.14*	53.43±7.87	0.041±0.402
Type of gene action										
Mean	76.86±2.06**	32.63±1.38**	1.36±0.28**	93.99±8.09**	23.41±1.10**	132.60±3.86**	106.83±1.52**	51.87±1.04**	156.73±3.27	0.382±0.196
Additive effect (d)	2.316±1.30**	8.61±1.36**	-0.016±0.34	32.44±3. 38**	30.55±4.53**	33.87±3.89*	6.578±1.40**	4.77±0.54**	18.57±4.41	0.018±0.084
Dominance effect (h)	31.13±8.79**	14.36±6.20*	-0.371±1.34	49.55±13.41**	63.49±10.15**	244.76±17.39**	-1.96±6.81	-26.31±4.35*	-113.10±15.84	-0.038±0.821
Type of gene interaction										
Additive x additive(i)	25.37±8.65**	3.67±6.15	-0.526±1.31	43.95±13.34**	60.05±10.07**	211.40±17.28**	9.41±6.71	-18.66±4.28*	-106.85±15.77	-0.083±0.804
Additive x dominance (j)	-1.26±3.09**	1.05±2.90	-0.044±0.75	27.16±7.28**	29.02±9.16**	11.46±8.00	3.87±3.16	0.99±1.73	4.63±9.20	-0.007±0.261
Dominance x dominance (I)	-34.06±10.26**	-30.48±6.90*	1.323±1.86	-129.89±18.13**	-120.80±18.81**	-314.96±22.27**	-107.75±8.6**	-29.36±4.91*	-31.98±22.16	0.203±0.920
Type of epitasis	Duplicate	Duplicate	-	Duplicate	Duplicate	Duplicate	-	Comp.	-	-

complementary type of epistasis was observed for pod length each for on cross in cowpea was stated by **Bhor and Dumber (1998)** and similar results in berseem clover crosses was reported by **Abd El-Naby *et al* (2014).**

Based on above findings, in may be suggested that in these cross where additive and additive x additive gene effects were predominant across the most of agronomic traits and little of fertility traits, one should follow the pedigree or modified pedigree method of selection, whereas in these cross where dominance and dominance x dominance gene effect were significant, heterosis-breeding would be effective. To exploit all types of gene effects, reciprocal recurrent selection could be the most effective breeding procedure for breaking the yield barrier in alfalfa breeding program.

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القياسات الوراثية لبعض الصفات الهامة في هجين البرسيم الحجازي

زينب محمد عبد النبي[1] و فادية محمد سلطان[1] و زينب السيد غريب[2]

١- قسم بحوث العلف- معهد المحاصيل الحقلية – مركز البحوث الزراعية– الجيزة- مصر
٢- المعمل المركزي لبحوث التصميم و التحليل الإحصائي - مركز البحوث الزراعية – الجيزة- مصر

أقيمت التجربة في محطة البحوث الزراعية التابعة لمركز البحوث الزراعية بالجيزة في الحقل و الصوبة و ذلك خلال ثلاثة مواسم زراعية شتوية (٢٠١١/٢٠١٢ وحتى عام ٢٠١٣/٢٠١٤). تم أجراء التهجين اليدوي بين عشيرتين من البرسيم الحجازي P_1 (الوادي الجديد) و P_2 (إسماعيلية-٩٤) في إتجاه واحد وذلك للحصول على الأجيال (F_1-F_2- BC١ -BC٢) , مع الإنتخاب خلال الأجيال المتتالية لقوة النمو و المحصول الخضري. وقد تم تقييم الأجيال الإنعزالية مع الإباء الأصلية لبعض الصفات الخضرية مثل طول النبات و التفريع القاعدي و إنتاجية العلف الطازج والجافو كذلك بعض صفات الخصوبة (عدد النورات علي النبات و عدد الأزهار علي الفرع و عدد القرون علي الفرع و عدد البذور علي الفرع و وزن ال ١٠٠ بذرة). و قد صممت التجربة في تصميم القطاعات التامة العشوائية في ثلاث مكرارات.

هدفت الدراسة إلي تقدير القياسات الوراثية ،معامل التوريث ، قوة الهجين ، والتدهور. تم تحليل المتوسطات و استخدام تحليل six parameter لتقدير التباين الوراثي ، و التفاعل و التوريث في الأجيال الإنعزالية في هجن البرسيم الحجازي.

و كانت النتائج كالتالي:

- ظهرت إختلافات معنوية مرتفعة بين متوسطات الصفات المدروسة بين الأجيال (P_1، P_2، F_1، F_2، BC_1و BC_2).
- حقق الجيل F_2 أفضل أداء لصفة عدد الفروع القاعدية و كذلك للوزن الأخضر (٣٢.٦٣ و ٩٣.٩٩ ، على التوالي) مقارنة بالأجيال الأخري .
- سجل الجيل BC_1 أعلي متوسطات لعدد القرون علي الفرع وكذلك عدد من البذور علي الفرع حيث كانت (٥١.٨٧ و١٥٦.٧٣).
- أظهر F_2 تفوقا علي آباء لجميع الصفات تحت الدراسة باستثناءعدد النورات علي الفرع و وزن ال١٠٠ بذرة، كما سجل BC_1 أفضل المتوسطات لمعظم الصفات الخضرية وكذلك صفات الخصوبة.

- سجل معامل التوريث بالمعنى الواسع (H^2_b) قيما عالية للصفات الخضرية مثل طول النبات و عدد الأفرع القاعدية علي النبات و الوزن الأخضر و أيضا الوزن الجاف (٠.٨٤٥ و0.941 و 0.899 و 0.877 على التوالي)، في حين سجلت نسبة الأوراق إلي السيقان قيمة منخفضة لمعامل التوريث H^2_b (٠.٤٢٠).
- تراوحت قيم معامل التوريث بالمعنى الواسع (H^2_b) لصفات الخصوبة من ٠.٥٢٠ لعدد الإزهار علي الفرع إلى ٠.٩٧٢ لعدد النورات علي النبات على التوالي)، في حين أن معامل التوريث بالمعنى الضيق (h^2_n) سجل قيما منخفضة لكلا من الصفات الخضرية و صفات الخصوبة تحت الدراسة.
- كان تباين الفعل السيادي أعلي من تباين الفعل المضيف و ذو معنوية موجبة الإشارة للصفات الخضرية ما عدا صفة نسبة الأوراق إلي السيقان، كما أظهر تباين الفعل المضيف معنوية عالية موجبة الإشارة لصفة عدد الأزهار علي الفرع و كذلك عدد القرون علي الفرع.
- كان نوع التفوق epitasis متضاعف Duplicate للصفات الخضرية (ماعدا صفة نسبة الأوراق إلي السيقان) و كان كذلك لصفة عدد النورات علي النبات بينما كان التفوق من النوع المكمل Complementary لصفة عدد القرون علي الفرع.
- كان هناك تحسن وراثي ملحوظ لصفات المحصول الأخضر مما يشير إلي أهمية الإنتخاب لهذه الصفات في برامج التربية لمحصول البرسيم الحجازي.