RESEARCH | Egyptian Journal of Agricultural Research | Horticulture

Inheritance of earliness, yield, and yield components in dry beans

Ashraf A. Hamed, Entsar M.E. Abo-Hamda, Amani H.A.M. Gharib *

Address:

Vegetable, Medical and Aromatic Plant Breeding Department, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt

*Corresponding Author: ***Amani H.A.M. Gharib***, e-mail: amani2468@gmail.com

Received: 20-11-2023; **Accepted:** 26-03-2024; **Published:**22-04-2024 **DOI**: 10.21608/EJAR.2024.230740.1444

ABSTRACT

The study was conducted at the Horticulture Research Institute, Agriculture Research Center, Egypt, from 2022 to 2023 to study the inheritance of some economic characters in dry beans. Three dry bean cultivars, namely DB 435, Giza 6, and Nebraska, were chosen to produce two crosses and their reciprocals. The direct crosses were DB 435 × Giza 6 and DB 435 × Nebraska. Seeds of the P1, P2, F1, F1r, and F2 populations from the two crosses were planted on March 2, 2023, using a randomized complete block design. The results indicated that over-dominance or complete dominance was estimated for the high parent in all studied traits. Positive heterosis over the better parent was detected for most of the studied traits, suggesting the presence of additive gene action affecting these traits. High or moderate broad-sense heritability was recorded for all traits, indicating that these characteristics could be used as suitable criteria for selection and improvement in dry bean breeding programs, except for the trait number of seeds per pod, which showed low heritability. Results indicated that selection for dry yield per plant could be substituted by the number of pods per plant and average seed weight traits.

Keywords: *Phaseolus vulgaris*, Dominance, Heterosis, Heritability, Yield component.

INTRODUCTION

Dry bean (*Phaseolus vulagris L*), known as kidney bean, common bean, and field bean, also known as white bean, locally in Egypt. It is an important legume crop grown all-over the world and belongs to Fabaceae family crop that grows for both local market and export. Dry bean is widely cultivated in tropical and subtropical countries, where it is widely cultivated in a warm region with temperatures ranging from 18 to 24°C (Assefa *et al.*, 2015). Dry bean contains considerable amounts of protein, fiber, carbohydrates, vitamins, and minerals (Mukankusi *et al*., 2019). Besides, nutritional and cash value of dry bean, it has a short cycle with few inputs such as fertilizer or soil requirements as well as the lack of pest problems and pesticides (Souza *et al.*, 2016; Padilla-Chacón *et al.*, 2017). These features of the crop make it a valuable technology in developing countries.

Recently, in Egypt, there are intensive efforts for improvement of new cultivars of dry bean with early and high productivity through breeding procedures depending mainly on the presence of genetic differences that permits effective selection using hybridization which considered an effective factor for inducing variability. Also, farmers often prefer early maturity bean cultivars to reduce water and cost in addition to avoiding late season stresses such as pests or heat stresses. So, in developing countries, many bean breeding programs have cited the need to improve early maturing cultivars (Mukankusi *et al*., 2019).

Understanding of nature and magnitude of genetic variability existing in the breeding material is necessary for breeder (Yagdi, 2009). Moreover, phenotypic expression of plant traits is mainly controlled by its genetic and environment, in which it is grown and their interaction between them. Further, it becomes necessary to partition the observed phenotypic variability into genotypic (heritable) and environmental (non-heritable) components with suitable parameters, such as maternal effect, potence ratio, heterosis, minimum number of genes controlling the trait and heritability in broad sense which can be used to predict the efficiency of selection. So, choice of promising genotypes from diverse genetic base, and their subsequent utilization for hybridization is one of the strategies for improvement of productivity of dry beans (Mulugeta *et al.,* 2013).

This investigation aims to study the nature of gene action influencing some important traits of dry bean to produce and select new genotypes with high production and suitable traits which can be included in subsequent breeding programs.

MATERIALS AND METHODS

This investigation was carried out during the period from 2022 to 2023 at Al-Kanater Horticulture Research Station, Agriculture Research Center, Qalubia governorate, Egypt under open field condition. Three dry bean cultivars, *viz,* DB 435, Giza 6 and Nebraska were chosen for genetic studies based on their performance of earliness, yield and other desirable economic characters, *viz.*, number of pods/plants, seed weight and number of seeds/pods. Seeds of parents were cultivated in the open field on mid-February, 2022. Two crosses, *viz.,* DB 435 × Giza 6 and DB 435 × Nebraska and their reciprocals were produced. Seeds of F_1 crosses were cultivated on September 5, 2022. Flowers on F_1 plants were left for selfing to produce F_2 seeds. At the same time, F_1 seeds production were completed.

Evaluation of genetic populations was carried out at Al-Kanater Horticulture Research Station. Seeds of P_1, P_2, F_1, F_1r and F_2 populations of the two crosses were cultivated on March 2, 2023, in a randomized complete block design with three replicates. Plot sizes varied by type of population in each replicate. Every non-segregating population, *i.e.,* P_1, P_2, F_1 and their reciprocals were sown in one row, meanwhile, four rows were kept for each F_2. Seeds were sown in 3.0 m long and 0.7 m wide rows at a density of 10 plants m^{-1}. Agricultural practices such as chemical fertilization, irrigation and pest control were practiced as commonly followed in this district.

For the different populations, data were recorded on individual plants in each cross for the traits plant length, number of branches/plants, number of days to flowering, dry yield/plant, number of pods/plants, number of seeds/pod and average seed weight.

Maternal effect was estimated by measuring significance of difference between each F_1 and its reciprocal means by (t) test. Potence ratio was used to determine the direction of dominance according to the formula of Smith (1952). Heterosis was calculated on better parent basis using the formula of Sinha and Khanna (1975). Minimum number of genes controlling the trait in each cross was calculated using Wright formula as obtained by Burton (1951). Broad senses heritability was estimated using the equation of Allard (1960).

RESULTS

Obtained data regarding studied characters of P_1, P_2, F_1, F_1r and F_2 populations of each cross are presented in Tables 1 to 7.

Table 1. Distribution, mean and variance of plant length (cm) of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of plant length (cm)in class[z]							Total no. plants	Mean $\bar{X}$ ± SE [y]	Variance (δ^2)
	18	25	32	39	46	53	60			
	DB 435 × Giza 6									
DB 435 (P_1)		15	21	4				40	30.08 ± 0.71 **	20.071
Giza 6 (P_2)			7	15	9	7	2	40	42.85 ± 1.25	62.695
F_1				10	30			40	44.25 ± 0.49 NS	09.423
F_1r			2	9	29			40	43.73 ± 0.63	16.051
F_2		7	27	32	33	26	5	130	42.18 ± 0.78	79.852
	DB 435 × Nebraska									
DB 435 (P_1)		15	21	4				40	30.08 ± 0.71 *	20.071
Nebraska (P_2)		7	23	10				40	32.53 ± 0.73	21.076
F_1			16	16	8			40	37.60 ± 0.84 NS	28.144
F_1r		1	14	18	7			40	37.43 ± 0.85	28.866
F_2	14	25	52	23	10	6		130	32.43 ± 0.76	75.022

[z] Each class represents a range of 7 cm and class values indicated represent class centers.

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

Table 2. Distribution, mean and variance of number of branches/plant of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of number of branches/plant in class[z]								Total no. plants	Mean $\bar{X}$ ± SE [y]	Variance (δ^2)
	1	2	3	4	5	6	7	8			
	DB 435 × Giza 6										
DB 435 (P_1)		11	28	1					40	2.75 ± 0.08 **	0.244
Giza 6 (P_2)		8	14	9	9				40	3.48 ± 0.17	1.128
F_1				10	22	8			40	4.95 ± 0.11 NS	0.459
F_1r				13	19	7	1		40	4.90 ± 0.12	0.605
F_2	3	63	51	8	2	2		1	130	2.65 ± 0.08	0.913
	DB 435 × Nebraska										
DB 435 (P_1)		11	28	1					40	2.75 ± 0.08 NS	0.244
Nebraska (P_2)		17	15	7	1				40	2.80 ± 0.13	0.677
F_1					6	6	22	6	40	6.70 ± 0.14 NS	0.831
F_1r					4	6	25	5	40	6.78 ± 0.13	0.640
F_2	27	38	48	13	4				130	2.45 ± 0.09	1.056

[z] Each class represents a range of 1 branch and class values indicated represent class centers.

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

Table 3. Distribution, mean and variance of number of days to flowering of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of number of days to flowering in class[z]								Total no. plants	Mean $\bar{X}$ ± SE [y]	Variance (δ^2)
	38	41	44	47	50	53	56	59			
	DB 435 × Giza 6										
DB 435 (P_1)		11	29						40	43.18 ± 0.21 **	1.840
Giza 6 (P_2)						8	29	3	40	55.63 ± 0.24	2.394
F_1				20	12	8			40	49.10 ± 0.38 NS	5.631
F_1r				23	10	6	1		40	48.88 ± 0.40	6.317
F_2		2	2	4	11	53	42	16	130	53.95 ± 0.30	11.865
	DB 435 × Nebraska										
DB 435 (P_1)		11	29						40	43.18 ± 0.21 **	1.840
Nebraska (P_2)					8	24	8		40	53.00 ± 0.30	3.692
F_1	7	23	10						40	41.23 ± 0.31 NS	3.871
F_1r	6	22	9	3					40	41.68 ± 0.38	5.763
F_2		8	33	44	23	15	6	1	130	47.60 ± 0.34	14.847

[z] Each class represents a range of 3 days and class values indicated represent class centers.

[y] Pairs of means were either highly significantly (**), or not significantly (NS) different from each other according to (t) test

Table 4. Distribution, mean and variance of dry yield/plant (g) of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of dry yield/plant (g) in class[z]												Total no. plants	Mean[y] $\bar{X} \pm SE$	Variance (δ^2)
	3.5	8.6	13.7	18.8	23.9	29.0	34.1	39.2	44.3	49.4	54.5	59.6			
	DB 435 × Giza 6														
DB 435 (P_1)	11	19	7	3									40	08.86 ± 0.71 **	19.941
Giza 6 (P_2)	3	12	9	8	4	4							40	14.98 ± 1.17	54.354
F_1			3	7	17	8	2	3					40	24.92 ± 1.00 NS	40.282
F_1r		1	4	8	16	8	3						40	23.26 ± 0.93	34.930
F_2	22	27	19	24	10	15	6	2	2	1		2	130	15.54 ± 1.22	192.097
	DB 435 × Nebraska														
DB 435 (P_1)	11	19	7	3									40	08.86 ± 0.71 **	19.941
Nebraska (P_2)	3	20	9	3	3	1		1					40	12.55 ± 1.15	52.670
F_1					1	1	9	15	7	7			40	40.09 ± 0.96 NS	37.198
F_1r					3	3	8	13	8	5			40	38.56 ± 1.11	49.602
F_2	28	48	24	16	5	4	4		1				130	11.97 ± 0.70	63.938

[z] Each class represents a rangeof 5.1 g and class values indicated represent class centers.
[y] Pairs of means were either highly significantly (**), or not significantly (NS) different from each other according to (t) test.

Table 5. Distribution, mean and variance of number of pods/plant of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of number of pods/plant in class[z]									Total no. plants	Mean[y] $\bar{X} \pm SE$	Variance (δ^2)
	3	8	13	18	23	28	33	38	43			
	DB 435 × Giza 6											
DB 435 (P_1)	18	19	3							40	06.13 ± 0.50 **	09.856
Giza 6 (P_2)	5	16	10	9						40	10.88 ± 0.78	24.215
F_1				1	6	15	15	3		40	30.50 ± 0.82 NS	26.923
F_1r					8	12	12	8		40	29.63 ± 0.72	21.010
F_2	18	40	25	21	13	7	2	3	1	130	13.81 ± 0.76	75.118
	DB 435 × Nebraska											
DB 435 (P_1)	18	19	3							40	06.13 ± 0.50 NS	09.856
Nebraska (P_2)	11	23	4	2						40	07.63 ± 0.60	14.599
F_1					14	13	13			40	27.88 ± 0.66 NS	17.292
F_1r				1	10	20	9			40	27.63 ± 0.60	14.599
F_2	37	60	19	5	5	3	1			130	08.92 ± 0.53	36.738

[z] Each class represents a range of 5 pods and class values indicated represent class centers.
[y] Pairs of means were either highly significantly (**), or not significantly (NS) different from each other according to (t) test.

Table 6. Distribution, mean and variance of number of seeds per pod of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of number of seeds per podin class[z]							Total no.plants	Mean[y] $\bar{X} \pm SE$	Variance (δ^2)
	1.4	2.3	3.2	4.1	5.0	5.9	6.8			
	DB 435 × Giza 6									
DB 435 (P_1)			5	5	13	15	2	40	5.09 ± 0.16 NS	0.989
Giza 6 (P_2)				9	23	8		40	4.98 ± 0.09	0.353
F_1			5	9	18	8		40	4.75 ± 0.13 NS	0.706
F_1r			6	10	14	10		40	4.73 ± 0.14	0.839
F_2		5	2	33	58	27	5	130	4.90 ± 0.08	0.824
	DB 435 × Nebraska									
DB 435 (P_1)			5	5	13	15	2	40	5.09 ± 0.16 **	0.989
Nebraska (P_2)			3	19	18			40	4.44 ± 0.09	0.319
F_1			4	6	16	12	2	40	5.05 ± 0.15 NS	0.870
F_1r			2	7	16	14	1	40	5.11 ± 0.13	0.672
F_2	1	7	26	40	45	11		130	4.72 ± 0.08	0.927

[z] Each class represents a range of 0.9 seeds and class values indicated represent class centers.
[y] Pairs of means were either highly significantly (**), or not significantly (NS) different from each other according to (t) test.

Table 7. Distribution, mean and variance of average seed weight (g) of P_1, P_2, F_1, F_1r and F_2 populations of dry bean crosses.

Population	Frequency of average seed weight in class[z]											Total no. plants	Mean $\bar{X}$ ± SE[y]	Variance (δ^2)
	0.22	0.27	0.32	0.37	0.42	0.47	0.52	0.57	0.62	0.67				
	DB 435 × Giza 6													
DB 435 (P_1)	1	7	15	16	1							40	0.33 ± 0.007 **	0.002
Giza 6 (P_2)			2	15	15	8						40	0.41 ± 0.007	0.002
F_1				2	6	23	7	2				40	0.47 ± 0.007 NS	0.002
F_1r					7	26	7					40	0.47 ± 0.005	0.001
F_2	11	22	26	31	19	15	6					130	0.36 ± 0.007	0.007
	DB 435 × Nebraska													
DB 435 (P_1)	1	7	15	16	1							40	0.33 ± 0.007 **	0.002
Nebraska (P_2)				4	5	11	10	6	4			40	0.50 ± 0.011	0.005
F_1					2	7	13	10	8			40	0.54 ± 0.009 NS	0.003
F_1r						8	16	8	8			40	0.54 ± 0.008	0.003
F_2	1	3	11	19	31	30	16	14	4	1		130	0.45 ± 0.007	0.007

[z] Each class represents a range of 0.05 g and class values indicated represent class centers.
[y] Pairs of means were either highly significantly (**), or not significantly (NS) different from each other according to (t) test.

Parents were distinctively different in all traits. Means of F_1's was higher than their respective parents in the traits plant length, no. branches/plant, dry yield/plant, no. pods/plant and average seed weight. For the trait number of days to flowering, its F_1 mean was between the two parents in the cross DB 435× Giza 6 and earlier than the early parent in the cross DB 435 × Nebraska. Regarding the trait number of seeds per pod, mean of $F_1$was very close to the high parent in the cross DB 435 × Nebraska, however, it was very close to the low parent in the cross DB 435 × Giza 6. Means of F_2's was higher than their respective parents in the two studied crosses for the trait number of pods per plant. For the traits number of days to flowering and average seed weight, means of F_2's was intermediate between their respective parents in the two studied crosses. Means of F_2's was very close to their high parents for the traits plant length and dry yield per plant, however, it was close to their low parents for the trait number of seeds per pod. For the trait number of branches/plant, means of F_2's was close to their low parents in the two studied crosses. In all traits, F_2 plants of each cross were distributed between its parents with transgressive segregations over the highest parent except the traits number of days to flowering and number of seeds per pod.

Non-significant differences were observed between F_1's and their reciprocals for all studied characters in the two studied crosses suggesting absence of maternal effect (Tables 1-7).

The obtained quantitative genetic parameters for the traits plant length, number of branches per plant, number of days to flowering, dry yield per plant, number of pods per plant, number of seeds per pod and average seed weight are presented in Table 8.

Table 8. Genetic parameters estimated for studied characters in dry bean crosses.

Characters	Crosses	Parameters			
		P	H (%)	MNG	BSH (%)
Plant length	DB 435 × Giza 6	1.22	3.27	0.38	71.44
	DB 435 × Nebraska	5.14	15.60	0.10	69.56
No. branches per plant	DB 435 × Giza 6	5.07	42.45	0.83	45.06
	DB 435 × Nebraska	157.00	139.29	16.67	51.18
No. days to flowering	DB 435 × Giza 6	-0.05	13.72	9.33	75.42
	DB 435 × Nebraska	-1.40	-4.52	7.44	79.97
Dry yield per plant	DB 435 × Giza 6	4.25	66.41	0.11	81.67
	DB 435 × Nebraska	15.90	219.40	6.23	46.93
No. pods per plant	DB 435 × Giza 6	9.26	180.46	1.60	75.25
	DB 435 × Nebraska	28.00	265.57	4.90	63.12
No. seeds per pod	DB 435 × Giza 6	-1.64	-4.62	0.21	23.99
	DB 435 × Nebraska	0.86	-0.79	3.18	29.84
Average seed weight	DB 435 × Giza 6	-0.06	16.00	0.19	71.81
	DB 435 × Nebraska	1.52	8.56	0.97	56.30

P: Potence ratio, H: Heterosis, MNG: Minimum number of genes and BSH: Broad sense heritability.

Over-dominance or complete dominance was found for the tallest plants, high number of branches per plant, high dry yield per plant, high number of pods per plant and high number of seeds per pod in the two studied crosses (Table 8). Meanwhile, negative P value indicated partial and over-dominance of earliness in the crosses DB 435 × Giza 6 and DB 435 × Nebraska, respectively. For the trait average seed weight, complete dominance towards the low parent was detected in the cross DB 435 × Giza 6, however, the opposite (over-dominance towards the high parent) was found in the cross DB 435 × Nebraska.

Positive heterosis over better parent was estimated in the two studied crosses for all studied traits except the cross DB 435 × Nebraska in the trait number of days to flowering (based on the early flowering parent) and the two studied crosses in number of seeds/pod trait which gave negative heterosis (Table 8), implying the presence of additive gene action involving the most traits (Ceyhan *et al.*, 2014). Heterosis values were 3.27% and 15.60% for plant length, 42.45% and 139.29% for number of branches/plant, 13.72% and -4.52% for number of days to flowering, 66.41% and 219.40%for dry yield/plant, 180.46% and 265.57% for number of pods/plant, -4.62% and -0.79% for number of seeds/pod and 16.00% and 8.56% for average seed weight in the F_1 generation of the crosses DB 435 × Giza 6andDB 435 × Nebraska, respectively.

Minimum number of estimated genes controlling the traits plant length and average seed weight was one pair of genes in the two studied crosses. Meanwhile, it was 1 and 17 for number of branches per plant, 10 and 8 for number of days to flowering, 1 and 7 for dry yield per plant, 2 and 5 for number of pods per plant and 1 and 4 for number of seeds per pod in the crosses DB 435 × Giza 6 and DB 435 × Nebraska, respectively.

High broad-sense heritability (>60%) was recorded for the traits plant length (71.44% and 69.56%), number of days to flowering (75.42% and 79.97%) and number of pods per plant (75.25% and 63.12%) in the crosses DB 435 × Giza 6 and DB 435 × Nebraska, respectively, indicating additive gene influence in controlling the characters and these characters could be used as suitable criteria for improving dry bean in breeding programs. Meanwhile, moderate heritability (30%-60%) was estimated for the trait number of branches per plant (45.06% and 51.18%) in the crosses DB 435 × Giza 6 and DB 435 × Nebraska, respectively. For the traits dry yield/plant and average seed weight, the cross DB 435 × Giza 6 gave high heritability, meanwhile, the cross DB 435 × Nebraska gave moderate heritability. However, low heritability (<30%) was estimated for number of seeds per pod (23.99% and 29.84%) in the crosses DB 435 × Giza 6 and DB 435 × Nebraska, respectively.

DISCUSSION

Inheritance of agronomic traits is very important to develop the yield and quality of dry bean. The results of these study agree with those of Lobato *et al.* (2014) who observed transgressive segregation for the traits grain yield and number of pods per plant. Also, Mulanya *et al.* (2019) found transgressive segregation for the trait number of pods/plant, while, for number of days to flowering transgressive segregant was absent. Hamed and Khalil (2010) indicated that there were non-significant differences between F_1's and their reciprocals for all studied characters. Also, they found overdominance or complete dominance towards high parent for the traits plant length, yield/plant and number of pods/plant in all studied crosses, meanwhile, earliness was dominant in some crosses and the opposite was obtained in others.

In terms of heterosis, the results are agreed with those of Mulugeta *et al.* (2013), meanwhile, Hamed and Khalil (2010), Kimutai (2018) and Mulanya *et al.* (2019) estimated positive heterosis over better parent in all studied crosses for yield/plant and number of pods/plant traits, while, for plant length and number of days to flowering (based on the early flowering parent) characters, positive heterosis was estimated in some crosses and the opposite was found in the others. On the other hand, Torche *et al.* (2018) recorded significant heterosis relative to better parent for days to dry maturity and seed weight traits. These previous different results might be due to using different genotypes by different researchers.

Our results explains that minimum number of genes controlling studied traits was one or few genes, except the traits number of branches per plant and number of days to flowering. These results partially in agreement with those of Hamed and Khalil (2010), Lobato *et al.* (2014) and Kimutai (2018).

High heritability was recorded for most traits indicating that direct selection for these traits would be more effective for genetic improvement. These results are partially in agreement with those of Wondimu and Bogale **(**2017**)**, Ejara *et al. (*2018), Jhanavi *et al.* (2018), Anunda *et al.* (2019), Ghimire and Mandal (2019), Mhlaba *et al.* (2019), Mulanya *et al.* (2019) and Bekana *et al.* (2021) who found that heritability was high for studied traits. Meanwhile, moderate heritability was estimated for the traits plant height (Mesera *et al*, 2022), number of branches/plant (Bekana *et al.,* 2021), number of pods/plant (Mesera *et al*, 2022) and grain yield (Anunda *et al.,* 2019, Mesera *et al*, 2022 and Castiano *et al,* 2023).

CONCLUSION

Previous results indicated that some characters, *viz,* plant length, number of pods per plant and average seed weight were controlled by just one or few numbers of genes, moreover, it had moderate to high heritability. Therefore, selection for these characters could preferred in early generations. On the opposite, the traits number of branches per plant and number of seeds per pod showed polygenic effect and had low to moderate heritability, so, selection in the late generations for these characters is suggested to be done. Moreover, selection for dry yield per plant trait could be substituted by number of pods per plant and average seed weight traits.

REFERENCES

Allard, W. R. (1960). Principles of Plant Breeding. *John Wiley and Sons, Incorporated*, 473 p.

Anunda, H. N., Nyaboga, E. N., & Amugune, N. O. (2019). Evaluation of genetic variability, heritability, genetic advance and correlation for agronomic and yield components in common bean landraces from South western Kenya. *Journal of Plant Breeding and Crop Science,* 11(5), 144-157.

Assefa, T., Wu, J., Beebe, S. E., Rao, I. M., Marcomin, D., & Claude, R. J. (2015). Improving adaptation to drought stress in small red common bean: phenotypic differences and predicted genotypic effects on grain yield, yield components and harvest index. *Euphytica,* 203(3), 477-489.

Bekana, G., Girma, E., Abebe, A., Sisay, A., Alemayehu, D., Wagaw, K. M., ... & Tesfaye, D. (2021). Evaluating the genetic variations among improved haricot bean varieties (*Phaseolus vulgaris* L.) based on their agronomic traits and performing their half diallel cross. *American Journal of BioScience,* 9(5), 168-174.

Burton, G. W. (1951). Quantitative inheritance in pearl millet, *Pennisetum Glaucum*. *Agronomy Journal,* 43, 409-417.

Castiano, B. U. L., Kimurto, P. K., & Ojwang, P. P. O. (2023). Combining ability of common bean (*Phaseolus vulgaris*) genotypes for root traits across diverse environments. *Plant Breeding,* 142(1), 74-85.

Ceyhan, E., Harmankaya, M., & Kahraman, A. (2014). Combining ability and heterosis for concentration of mineral elements and protein in common bean (*Phaseolus vulgaris* L.). *Turkish Journal of Agriculture and Forestry,* 38(5), 581-590.

Ejara, E., Mohammed, W., & Amsalu, B. (2018). Genetic variability, heritability and expected genetic advance of yield and yield related traits in common bean genotypes (*Phaseolus vulgaris* L.) at Abaya and Yabello, Southern Ethiopia. *African Journal of Biotechnology,* 17(31), 973-980.

Ghimire, N. H., & Mandal, H. N. (2019). Genetic variability, heritability and genetic advance of common bean (*Phaseolus vulgaris* L.) genotypes at mountain environment of Nepal. *International Journal of Advanced Research in Biological Sciences,* 6(10), 46-56.

Hamed, A. A., & Khalil, E. M. E. A. (2010). Inheritance of growth habit, time of flowering and yield components in snap beans (*Phaseolus vulgaris* L.). *Annals of Advanced Agricultural Sciences, Moshtohor,* 48(1), 153-172.

Jhanavi, D. R., Patil, H. B., Justin, P., Hadimani, R. H., Mulla, S. W. R., & Sarvamangala, C. (2018). Genetic variability, heritability and genetic advance studies in french bean (*Phaseolus vulgaris* L.) genotypes. *Indian Journal of Agricultural Research*, *52*(2), 162-166.

Kimutai, J. J. C. (2018). Inheritance and selection for yield components and multiple disease resistance in snap bean. M.Sc. Thesis, *Faculty of Agricultural, Nairobi University,* 208 p.

da Silva Lobato, A. K., Gonçalves-Vidigal, M. C., Vidigal Filho, P. S., da Silva Ramos, V. M., Poletine, J. P., & de Bastos Andrade, C. A. (2014). Genetic parameters of grain production and its components in common bean (*Phaseolus vulgaris* L.) under drought stress. *Australian Journal of Crop Science,* 8(8), 1152-1159.

Mesera, E., Shifaraw, G., Alamerew, S., & Amsalu, B. (2022). Genetic variability analysis and association of traits in common bean (*Phaseolus vulgaris* L.) landraces collected from Ethiopia at Jimma. *Advances in Agriculture,* 2022, 1-14.

Mhlaba, Z. B., Shimelis, H. A., Amelework, B., Modi, A. T., & Mashilo, J. (2019). Variance components and heritability of yield and yield-related traits in tepary bean (*Phaseolus acutifolius*). *South African Journal of Plant and Soil,* 36(2), 117-128.

Mukankusi, C., Raatz, B., Nkalubo, S., Berhanu, F., Binagwa, P., Kilango, M., ... & Beebe, S. (2019). Genomics, genetics and breeding of common bean in Africa: A review of tropical legume project. *Plant Breeding,* 138(4), 401-414.

Mulanya, M. M., Kimani, P. M., Narla, R. D., & Ojwang, P. O. (2019). Genetic inheritance of photoperiod sensitivity in Runner bean (*Phaseolus coccineous* L.). *Australian Journal of Crop Science,* 13(9), 1511-1519.

Mulugeta, A. T., Hussein, M. A. & Habtamu Z. (2013). Estimation of better parent and economic heterosis for yield and associated traits in common beans. *Journal of Applied Biosciences*, 71, 5706-5714.

Padilla-Chacón, D., Martínez-Barajas, E., García-Esteva, A., Leal-Delgado, R., Kohashi-Shibata, J., & Peña-Valdivia, C. B. (2017). Biomass remobilization in two common bean (*Phaseolus vulgaris* L.) cultivars under water restriction. *South African Journal of Botany,* 112, 79-88.

Sinha, S. K., & Khanna, R. (1975). Physiological, biochemical, and genetic basis of heterosis. *Advances in Agronomy,* 27, 123-174.

Smith, H. H. (1952). Fixing transgressive vigor in *Nicotiana rustica*. *Heterosis,* 161-174.

Souza, J. V., Saad, J. C., Sánchez-Román, R. M., & Rodríguez-Sinobas, L. (2016). No-till and direct seeding agriculture in irrigated bean: Effect of incorporating crop residues on soil water availability and retention, and yield. *Agricultural Water Management,* 170, 158-166.

Torche, Y., Blair, M., & Saida, C. (2018). Biochemical, physiological and phenological genetic analysis in common bean (*Phaseolus vulgaris* L.) under salt stress. *Annals of Agricultural Sciences,* 63(2), 153-161.

Wondimu, W. & Bogale, A. (2017). Genetic variability, heritability and genetic advance of some haricot bean (*Phaseolus vulgaris* L.) varieties at Bench-Maji zone, Southwest Ethiopia. *Asian journal of crop science,* 9, 133-140.

Yagdi, K. (2009). Path coefficient analysis of some yield components in durum wheat (*Triticum durum* Desf.). *Pakistan Journal of Botany,* 41(2), 745-751.

وراثة التبكير والمحصول ومكوناته في الفاصوليا الجافة

أماني حافظ عبدالله محمود غريب* , أشرف عبدالله حامد ,انتصار مصطفى اسماعيل أبوحمده

قسم بحوث تربية الخضر والنباتات الطبيه والعطريه . معهد بحوث البساتين ، مركز البحوث الزراعية – الجيزه ، مصر

*بريد المؤلف المراسل: amani2468@gmail.com

أجريت هذه الدراسة بمعهد بحوث البساتين – مركز البحوث الزراعية – مصر خلال الفترة من 2022 إلى 2023 وذلك بهدف دراسة وراثة بعض الصفات الاقتصادية في الفاصوليا الجافة. إستخدم فى الدراسة 3 أصناف من الفاصوليا الجافة هم DB 435 ، وجيزه 6 ، ونبراسكا. درست وراثة بعض الصفات الاقتصادية في عشائر كل من الآباء والجيل الأول والجيل الأول العكسي والجيل الثاني لكل من الهجينين DB 435 × جيزه 6 ، DB 435 × نبراسكا. وقد أوضحت النتائج وجود سيادة فائقة أو تامة للأب الأفضل فى جميع الصفات المدروسة. أعطت معظم الصفات تفوقا موجبا مقارنة بالأب الأفضل مما يؤكد وجود فعل الإضافة للجينات لمعظم الصفات المدروسة. قدرت درجة التوريث على النطاق العريض فكانت عالية الى متوسطة لجميع الصفات ما عدا صفة عدد البذور بالقرن مما يؤكد امكانية استخدام تلك الصفات للانتخاب والتحسين الوراثى فى الفاصوليا. وتؤكد البيانات أنه يمكن الإنتخاب لصفتى عدد القرون/النبات ، ومتوسط وزن البذرة بديلا عن صفة المحصول الجاف للنبات لتحسين الفاصوليا الجافة.

الكلمات الدالة: الفاصوليا الجافة ، الوراثة ، السيادة ، قوة الهجين ، عدد الجينات ، درجة التوريث ، المحصول.