Genetic parametres and performance for yield and its components for some varieties of eggplant under Mosul city environment

Abdelraheem Sultan Mohammad and Kamal Benyamin Esho
College of Agriculture and Forestry/ University of Mosul/ Republic of Iraq.
Corresponding author Email: kamalesho@uomosul.edu.iq
DOI: https://doi.org/10.36077/kjas/2024/v16i1.10879
Received date: 27/12/2022
Accepted date: 1/2/2023

Abstract

This study was conducted in the vegetable research field, college of agriculture and forestry, horticulture and landscape design, Mosul Univ., using RCBD design with three replicates, during the spring growing season (2018) for evaluation of the performance yield and its components in nine eggplant varieties under Mosul city environment Iraq at 36°2′ longitude and 43°7′ latitude. The data was recorded for the traits: plant height (cm), number of branches in each one of the plants, fruit weight (gm), number of fruits in each one of the plants, yield in each one of the plants (kg), length and diameter of fruit (cm), and total yield of fruits (ton /ha.). The results indicated that the nine varieties were different in most traits, the Alton kubry and karamleshy c.v gave high results in plant length(116.433, 130.00) respectively, the Mosal local c.v. and White beauty c.v were superior in the length of fruit than other genotypes under the study they gave (15.033 and 15.433 cm) respectively, whereas the number of the fruits per plant has been recorded in White long and Mosely c.v. (18.367 and 19.367) respectably. The genotype Alton kubry gave a high value in fruit weight (287.20gm). The phenotypic and genotypic variations (σ^2p and σ^2g) have been higher in the height of the plant, weight of the fruit, the number of fruits in each one of the plants, yield in each plant, and total yield of fruit for each unit area, the heritability ($H^2_{b.s.}$) was more than 65% for most traits under the study for nine c.v of eggplant. Also, the genetic advance was higher in most traits.

Keywords: Eggplant, Evaluation, Yield, Genotypic, Heritability, Genetic advance.

Introduction

Eggplant (*Solanum melongena L.*), known in aborigines, is a commonly grown vegetable in Asia, parts of Africa, and Europe. It belongs to the family Solanaceae (9). It is native to Southeast Asian regions and has been domesticated more than 40 decades ago; eggplants are diploid (i.e., 2 n = 2 x = 24) and are usually cross-pollinated vegetable crops. It has been considered a good source of minerals, nutrients, vitamins, antioxidants, dietary fibers, proteins, and bodybuilding factors (18 and 21). Estimations of the genetic variation in available crop accessions have been considered one of the most important prerequisites for genetic improvements. In comparison to the other tropical vegetable crops, there are published works dealing with the extent of the genetic variations of eggplant(22). The agronomic and morphological character evaluations, in addition to the nutritional compositions, may present useful information on the characteristics of the quality and yield, besides other information of high importance for the breeders and the horticulturists. Natural variations in the majority of yield-contributing characteristics of this crop have been quite high, and there is a necessity for restructuring the variation in the materials for higher yield (7**).** Planted over all the areas of Iraq during the spring season, growing and under the plastic houses (17). The breeding program choice is dependent on the knowledge about the magnitude and the nature of the variations in available material, the magnitude of character associated with the yield, the level to which those characters have been heritable, and the extent of the environmental impacts on them (3 and 16). Mehraj *et al*,(19) showed in their study the evaluation of the efficiency of 10 of the Japanese brinjal varieties, the high mean value in the characters tallest plant, the maximal number of the flower buds/plant, and longest fruit have been found from the M Line. Akpan *et al,(*1) indicated in their research that their study evaluated the estimation of the magnitudes of the genetic variability, relationships of some of the most significant agronomic characteristics, and their role in the yield. Results obtained have shown highly important difference values (P≤0.01) amongst genotypes in all of the studied traits. High broad-sense heritability ($H^2_{b.s}$) has been recorded for the number of fruits in each one of the plants, the circumference of the fruit, and fruit yield in each one of the hectares for the late planting, and comparable trends have been obtained for the early planting. The analysis of the correlation has shown that the fruit yield has been positively correlated with the circumference of the fruit and its diameter. The number of fruits in each one of the plants had positive and significant correlations with the number of branches in each one of the plants, the number of leaves in each one of the plants, and the height of the plant, applications of breeding methodology will improve the productivity of these eggplant genotypes since there is an existence of genetic variability among genotypes as progress in breeding depends on this variation. Garcha *et al*,(12) indicated in their study the variance analysis, which had depicted significant variations (i.e., P ≤ 0.05) for every character in each generation, high value in the values of the GCV and PCV have been noticed for the length of the fruit, the weight of the fruit, girth of the fruit, yield in each one of the plants and number of the fruits in each one of the plants in all of the generations, which indicated high

germplasm variability. High heritability in combination with high genetic advances has been discovered for the peduncle length, fruit girth, fruit length, number of fruits in each one of the plants, fruit weight, and yield in each one of the plants in every generation, which indicates the dominance of the additive actions of the genes for those features. This is why selections may be made from the present germplasm for developing enhanced CMS inbred lines with a variety of fruit characteristics. The genetic variability for the agronomic, morphological characteristics, heritability, genotype, and phenotype coefficient variation was stated by several workers in the cultivated and wild relatives of the eggplant(4, 5, 14, 25, 29, 31, and 33). High genetic advances, as well as high heritability, have been noticed for the fruit number in each plant, yield in each plant, and fruit weight. Moderate and low phenotypic and coefficient of variation have been noticed for all the features. The moderate phenotypic and coefficients of variation have been represented by the number of fruits in each plant, yield in each plant, and weight of the fruit. The selection of the genotypes that have high heritability in combination with the genetic advances for those features indicated the possibility for crop improvements by the selection (11 and 26)

The path coefficient analysis has been defined as one of the most important techniques for the partitioning of the correlation coefficient to indirect and direct impacts of the independent variables upon the dependent variable. The coefficient of the path can be a significant tool for a breeder for the enhancement of the productivity and production of eggplant**.**

The goal of this research was to evaluate the performance of yield and its components in eggplant varieties under Mosul city conditions. Iraq.

Materials and Methods

The present has been performed at the vegetable research field, college of agriculture and forestry, horticulture and landscape designs, Mosul Univ., during the spring growing season (2018) for evaluation and performance of the yield and its components in eggplant varieties under Mosul city environment Iraq. The seeds of genotypes were sowed at a nursery on 16/2/2018 plastic houses; when the seedlings reached 12 cm long and 2cm in diameter, the seedlings were translated and transplanted to the open field under dripping, and the spacing between seedlings was 80cm. The unit area for every one of the plots has been (2x0.80m.) with two rows in each plot under drip irrigation. experimentation included eight treatments (genotypes) that have been modeled in the Randomized Complete Blocks Design (RCBD) field within 3 replicates. All treatments have been supplied by adding 600kg/hectare of NPK fertilizer (11).

Table 1. The seeds of eggplant genotypes sources

No.	Name of genotypes	Location collected or sources
1	Purple stripe	Desi seed production company limited, India
2	Green round	Desi seed production company limited,

		India
3	Yashi, local	Talfer, Mosul, Iraq
4	Musuku	Desi seed production company limited, India
5	White long	Desi seed production company limited, India
6	White beauty	Desi seed production company limited, India
7	Mosuly, local	Mosul, Nenivah, Iraq
8	Alton kubry	Alton kubry, Kirkuk, Iraq
9	Karamleshy	Karamlash village, Nenevah, Iraq

The data was recorded for the traits; the number of branches in each one of the plants, plant height (cm), number of the fruits in each one of the plants, length, and diameter of the fruit (cm), fruit weight (gm), yield per plant (kg) and total yield of fruits (ton /ha.).The data have been statistically analyzed according to Steel and Torrie(32), with the use of SAS(30). The phenotypic and genotypic correlation coefficients were calculated according to Walter(34). Path coefficient analysis has been performed as has been explained by Dewey and Lu (10) for the assessment of associations, direct and indirect impacts of variance components on the value of the total yield; if the path analysis has been more than 1 it is a higher effect, 0.33-0.99 is higher, 0.2-.0.29 medium and 0.1- 0.19 lowest effect**.** For analyzing the indirect and the direct effects over the total yield, path analysis has been performed amongst the traits, with the estimates being obtained using the equations of regression, where the traits have been standardized earlier, through the use of the approach that has been described by Cruz(8). The values of the heritability limits have been mentioned in (8).

This means that if $H^2_{b.s}$.is less than 40% it's low, $H^2_{b.s}$. among 40-60% it's medium and $H^2_{b.s}$. more than 60 are high, as computed by estimated genetic advance (GA), and expected GA percentage from the mean (GAM) based on Ali(2), the estimated ratio of the GA has been reported by Johnson *et al*,(13) as less than 10 % it means low, among 10% to 30 % is medium and more than 30 % is high. $GA = K \times \dot{O}^2p \times H^2_{b.s}$, the genetic advance as a mean percentage):

GA means =(GA / $\hat{Y}$) × 100, Where K = is the intensity of the selection at 5% has been 2.06, $H^2_{b.s}$ = heritability as broad sense, $\dot{O}^2p$= phenotypic variation, $\hat{Y}$= general average value for the trait.

Results and Discussion

Analysis of sources variation :

Table 2 shows the analysis of the variance of the studied traits of the eggplant genotypes, as it is seen from the table, there are considerable variances for the studied traits in eight genotypes of eggplant, as they were significant at the level of 5% for most studied traits, and significant at the level of likelihood of 1% for the traits of the fruit weight and yield/plant, these result explained that the effect of the gene pool for each and genetic factor for each genotype. In addition, there may be an interference effect between the genetic factors of each combination with the environmental conditions and the conditions of the agricultural environment in the study

area. The significant difference values that have been observed amongst genotypes for all traits in planting under both seasons suggested the presence of adequate inherent genetic variability amongst the genotypes. This variation may be utilized for additional yield improvements of eggplants. Through Table 2, we conclude that there are significant differences between the genotypes under study. This is necessary to continue studying the genetic behavior of these genotypes in order to improve them in the future in breeding programs. one or more. These differences in traits between genotypes are explained by a difference in the genetic factors carried by each genotype, in addition to the extent to which each genotype responds to the environment in which it is cultivated, in addition to the overlap between the genotype and the farming environment. Those results have been consistent with each of Aruah *et al*, (3), Kumar and Arumugam(15), Kummer *et al*,(16), Mehraj *et al*,(19), Naik *et al*,(20), Obho et al,(21), Ptel et al,(23), Robinson(28) whose indicated that the eggplant genotypes or variety or cultivates were have differed in the mean squares of vegetative growth also in yield components.

Table 2. Anova table

S.O.V.	d.f.	Mean square*							
		1	2	3	4	5	6	7	8
Block	2	85.351	0.658	1.121	0.481	0.323	1592.775	0.267	3.104
Genotypes	8	141.04**	12.45**	501.47**	257.22**	7.720*	49.32**	29.350*	23.73**
Error	16	17.404	0.289	0.188	0.242	1.388	566.914	0.132	7.611
Total	26								

* 1= height of the plant (cm), 2=number of branches in each one of the plants, 3=fruits/plant, 4=fruit weight gm), 5= length of the fruit (cm), 6 = diameter of the fruit (cm), 7=yield in each one of the plants (kg), 8=total yield of fruits(ton /hectare). (*,** means significant at 5% and 1% respectfully)

Averages value of traits :

Table 3 shows the averages for eight traits that were studied for the genotypes in the eggplant; as can be seen, the genotype karamleshy gave the highest value in the mean for a trait plant height which was 130.00 (cm) and differed significantly from the genotypes, while the genotype white beauty produced the lowest reading In the trait it reached (57.52), and the limit of significance for this trait did not reach between the genotypes (purple stripe, green round, musuku and white long, and the limit of significance did not reach between the two genotypes mosuly and Alton kupry. As for the trait number of branches in each plant, the genotype green round produced the highest reading, amounting to (8.733), it differed significantly form the genotypes under study, the genotype karamleshy produced the lowest average of this trait, which was (5.067), there was no significant limit reached between the combinations of the genotypes (purple stripe, yashi, musuku, white long, white beauty, mosuly). From the same table, it appears that the trait fruits per plant varied between the genotypes; the genotype mosuly produced the highest value amounted to (19,367) and differed significantly from the genotypes under study, and the lowest

average for this trait was for the genotype purple stripe, which

Table 3. The mean value for the traits of eggplant genotypes during spring growing season 2018*

Genotypes	1	2	3	4	5	6	7	8
1	71.133d	5.333b-d	6.133g	5.400de	15.000a	117.70c	1.767c	46.190c
2	69.067d	8.733a	6.333fg	5.867d	12.367b	92.43cd	1.139cd	47.227c
3	110.133c	6.133bc	13.100d	18.100a	12.067b	327.230a	3.958a	62.860a
4	64.067de	5.200cd	7.033ef	11.333b	9.967c	111.47cd	1.107cd	51.231c
5	70.600d	6.267b	18.367b	3.633f	15.100a	66.63d	1.008d	49.053c
6	57.533e	5.700bc	7.400e	4.800e	15.433a	92.03cd	1.423cd	50.820c
7	120.733b	6.233bc	19.367a	4.967e	15.033a	71.30d	1.071d	36.523d
8	116.433bc	6.167bc	18.300b	8.100c	12.200b	287.20a	3.505a	59.067ab
9	130.00 a	5.067d	14.000c	5.900d	13.933ab	194.63b	2.708b	56.010b

* 1= height of the plant (cm), 2=number of branches in each one of the plants, 3=fruits/plant, 4=fruit weight gm), 5= length of the fruit (cm), 6 = diameter of the fruit (cm), 7=yield in each one of the plants (kg), 8=total yield of fruits(ton /hectare). (*,** means significant at 5% and 1% respictafelly)

reached (6.133) and differed significantly from the genotypes under study, the lowest average for this trait was for the genotype purple stripe which was 6.133. For the trait fruit weight (gm), the genotype yashil produced the highest average of (18,100 gm), it supervises significantly with the rest of the genotypes, the genotype musuku produce the lowest average that amounted to (3,633 gm), its limit of significance did not reach between the genotypes (purple stripe, green round, musuku, and karamleshy). The genotype white long produced the highest average for the fruit length trait (cm), but it did not reach the limit of significance with the genotypes (purple stripe, white ling, and mosuly), while the genotype white longe produced the lowest average for this trait, which amounted to (9.967). Also, there was a significant difference between yashil and Alton kubry, which were 327.2 and 287.2 respectively, the significant difference between them. But on the other hand, it was significantly varied with the rest of the genotypes. The genotype white long gave the lowest reading in that amounted to 66.63. As for the trait yield per plant (gm), it took the same pathway as the trait fruit diameter for the genotypes. It also appears from the same table that the trait total yield /hectare produced in the genotype yashil was highest average, which amounted to (62,860 ton/ha.), followed by the genotype karamleshy that produced (36,523ton/ha.), and these differed significantly with the genotypes under study, and the lowest average for this trait was of the Genotype mosuly. Through Table 3, we conclude that there are significant differences between all traits in the genotypes under study. These differences in traits between genotypes are explained by a difference in the genetic factors carried by each genotype, in addition to the extent to which each genotype responds to the environment in which it is cultivated. These results agree with the findings that have been discovered by Kummer *et al*,(16), Mehraj *et al*,(19), Akpan *et al*,(1), Garcha *et al*,(12), Patel *et al*,(24), Robinson(28) and Sawadogo *et al*,(29) Whose reported that the genotypes of the eggplant differed in the vegetative growth and yield characteristics.

Genetic parameters:

Table 4 indicates the genetic constants that have been represented in the genetic, phenotypic, and environmental variance, the inheritance ratio in a broad sense, the coefficient of genetic variation, the expected genetic improvement, the percentage as a rate of genetic improvement, R-Square, and the coefficient of variation Coefficient - var. For the studied traits of eight eggplant genotypes. As can be seen from the table that the genetic variance has been high for traits of the height of the plant, fruit diameter, fruits per plant, and total yield of fruits, and the phenotypic variance took the same path. As for the percentage of heritability in the broad sense, it can be seen from table 4 that it has exceeded 90% for traits of plant height, the weight of the fruit, fruits in each one of the plants, fruit diameter, and yield/plant, while it has been more than 80% for the total yield, and between 60- 80 for the traits fruit length and number of branches in each one of the plants. As for the expected genetic advance of the studied traits of the genotypes, it has been found high for most of the studied traits. This came as a result of the high genetic and phenotypic variances between the studied traits of the genotypes of eggplant. The percentage of the expected genetic advance has been high as well for traits of the weight of the fruit, fruits in each plant, fruit diameter, yield in each plant, and height of the plant, and low for the traits of the number of the branches in each one of the plants, fruit length and total yield/hectare. As for the analysis of the R-Square index, and through the statistical analysis of the traits data for the genotypes, the percentage exceeded 0.80% for most of the studied traits. The coefficient –var was broad for properties of yield /plant, the diameter of fruit, fruit length, and the number of branches in each one of the plants, and lowest for properties of the fruits in each one of the plants, plant height, and total yield per hectare. Genetic assessment of the germplasm is usually adopted by breeders to understand genetic differences and for discovering genetic diversity patterns. The analyses of the levels of genetic diversity in the germplasm are helpful in planting, for the breeders for making correct choices of the parents that are to be used in the programs of the breeding, and the high heritability in combination with the high expected GA had proven the involvements of the additive genetic variance, which is why the simple selection can be efficient to improve those characteristics. Our results collaborate with the results by(5)(6)(12)(16)(24)(25)(26)(27)(28)(29)(33).

Table 4. The genetic parameters in eggplant genotypes during spring growing season 2018*

	Traits							
Parameters	1	2	3	4	5	6	7	8
Mean value	89.967	6.093	12.226	7.567	13.456	151.181	1.965	50.996
Range	57.533-130.00	5.067-8.733	6.133-19.367	3.633-18.100	9.967-15.433	66.630-327.230	1.008-3.958	36.523-62.860
$\sigma^2 p$	829.820	1.394	31.575	20.870	4.498	9698.058	1.384	65.280
$\sigma^2 g$	812.416	1.105	31.387	20.628	3.110	9131.144	1.251	57.669
$\sigma^2 e$	17.404	0.289	0.188	0.242	1.388	566.914	0.132	7.611

$H^2_{b.s}$	97.903	79.244	99.404	98.843	69.137	94.154	90.432	88.341
GCV	31.682	17.252	45.824	60.024	13.106	63.207	56.921	14.891
GA	5809.700	192.754	1150.657	930.191	302.066	19100.732	219.125	1470.340
GA%	64.576	31.637	94.116	122.933	22.449	126.343	111.506	28.833
MSt	2454.652	3.604	94.350	62.127	10.718	27960.345	3.886	180.617
Mse	17.404	0.289	0.188	0.242	1.388	566.914	0.132	7.611
R-Square	0.986	0.867	0.996	0.992	0.795	0.962	0.937	0.923
Coeff. Var.	4.637	8.830	3.548	6.495	8.757	15.749	18.515	5.410

* 1=plant height (cm), 2=number of branches in each plant, 3=fruits in each one of the plants, 4= eight of the fruit (gm), 5= length of the fruit (cm), 6 = diameter of the fruit (cm), 7=yield per plant (kg), 8=total fruit yield (ton /hectare).

The phenotypic and genetic correlation coefficient among trait pairs

Table 5 shows the phenotypic and genetic correlation between eight traits of eggplant genotypes. As the table indicates, the trait plant height was associated with a positive phenotypic and genetically linked with each of the trait's total yield, yield per plant, the diameter of the fruit, and fruits per plant, the amount of this correlation was (0.227, 0.588, 0.560, 0.678, 0.238, 0.643, 0.595 and 0.689) respectively, while the number of branches in each plant has been associated with a negative genetically significant correlation with the trait of the trait yield per plant, it reached (-2.208). The trait of the fruits in each plant has shown a positive phenotypic and genetic correlation with traits yield/plant and total yield/hectare. While there has been a positive phenotypic and genetically considerable correlation between the trait of the fruit weight among total yield in each hectare, yield per plant, and fruit diameter that reached (0.635, 0.662, 0.661, and 0.745 respectively, and negatively with the trait fruit length, Also trait fruit length showed a negative phenotypic and genetically significant correlation with the traits of the total yield /ha., yield/plant and fruit diameter. The value of this correlation is (-0.422, -0.495, -0.343, -0.369, and -0.468), respectively. The same table indicates the presence of significant phenotypic and genotypic correlations for trait fruit diameter among traits yield per plant and total yield in each plant it reached (0.807, 0.878, 0.977, and 0.990). for the traits. The trait of the yield in each one of the plants has also shown a positive phenotypic and genetic correlation with the trait of the total yield per hectare, which was 0.753 and 0.872, respectively. Our result was in agreement with some researchers' works on the genotypic and phenotypic correlations between bares traits in eggplant (6, 23, 25, 26, 27, and 29).

Table 5. Phenotype, genotypes correlation coefficient among traits in eggplant genotypes during growing season spring 2018

Traits	Corr.	X8	X7	X6	X5	X4	X3	X2
1	Rp	0.227*	0.588**	0.560**	-0.025	0.213	0.678**	-0.135
	Rg	0.238*	0.643**	0.595*	-0.005	0.217	0.689**	-0.189
2	Rp	-.188	-0.165	0.133	-.051	-0.097	-0.071	

	Rg	-0.190	-0.208*	-0.155	-0.152	-0.102	-0.077
3	Rp	0.014	0.253*	0.232*	0.192	-0.079	
	Rg	0.011	0.264*	0.234*	0.244*	-0.080	
4	Rp	0.635**	0.618**	0.714**	-0.607**		
	Rg	0.662**	0.661**	0.745**	-0.728**		
5	Rp	-0.422**	-0.182	-0.369**			
	Rg	-0.495**	-	-0.468**			
			0.343**				
6	Rp	0.807**	0.977**				
	Rg	0.878**	0.990**				
7	Rp	0.753**					
	Rg	0.872**					

* 1= height of the plant (cm), 2=number of branches in each one of the plants, 3=fruits/plant, 4= weight of the fruit (gm), 5= length of the fruit (cm), 6 = diameter of the fruit (cm), 7=yield in each one of the plants (kg), 8=total yield of fruits(ton /hectare).

Path analysis

Table 6 indicates the path coefficient analysis between the traits of the total yield per hectare and other traits of genotypes in the eggplant under study. It appears from the table that the traits of the fruits in each plant, fruit diameter, and yield in each one of the plants had a negative and direct impact on the trait of the plant height. There is a direct positive moral effect for trait yield per plant on the trait of the weight of the fruit and a negative direct effect for trait fruit diameter and yield /plant on the trait of the weight of the fruit. It can also be seen from the table that there has been a positive and indirect significant effect of the traits plant height, fruits in each one of the plants, weight of the fruit, and yield per plant on the trait fruit diameter. It also appears from the path coefficient analysis there were indirect positive significant effects for traits plant height, fruit weight, fruit length, and yield in each one of the plants on total yield /ha., there is an indirect negative significance for fruit length on the total yield/ha. The same result was recorded from other researchers(1, 5, 7, 23 and 26).

Table 6. The path coefficient analysis in eggplant genotypes during spring growing season 2018

Traits	1	2	3	4	5	6	7
1	-0.557	0.105	-0.384	-0.121	0.003	-0.331	-0.359
2	0.025	-0.135	0.010	0.014	0.020	0.021	0.028
3	0.024	-0.003	0.035	-0.003	0.008	0.008	0.023
4	-0.078	0.037	0.029	-0.359	0.261	-0.267	-0.237
5	0.001	0.023	-0.038	0.112	-0.154	0.072	0.053
6	0.767	-0.200	0.301	0.961	-0.603	1.290	1.278
7	0.056	-0.018	0.057	0.057	-0.030	0.085	0.086
8	0.237	-0.190	0.010	0.662	-0.495	0.878	0.872

* 1= height of the plant (cm), 2=number of the branches per plant, 3=fruits in each plant, 4= weight of the fruit (gm), 5= length of the fruit (cm), 6 = diameter of the fruit (cm), 7=yield/plant (kg), 8=total yield of fruits(ton /hectare).

Conclusion

The conclusion obtained, the genotypes showed significant variation in most traits, the varieties Green round and Yashil produced the highest total yield of fresh fruits, and the heritability in the broad sense exceeded 60% for most of the traits. The results showed that there are genotypic and phenotypic positive significant correlations for traits plant height, fruit weight, fruit diameter, and yield per plant with the trait of the total yield per hectare. Also, there are direct and indirect positive significant effects of the traits diameter of fruit, yield per plant, the weight of fruit, and plant height on the quality of the total yield (fresh fruit) per heactare.

Conflict of Interest

The authors have no conflict of interest.

Acknowledgment

The authors would like to express their thanks to the Agriculture and Forestry College / University of Mosul for making their facilities available, which has resulted in great improvements with regard to the quality of the presented study **.**

References

1 - **Akpan, N. M.; P. E. Ogbonna; V. N. Onyia; E. C. Okechukwu and Atugwu, I. A.2016.** Variability studies on ten genotypes of eggplant for growth and yield performance in southeastern Nigeria. The Journal of Animal and Plant Sciences, 26(4): 1034-1041.

2 - **Ali, A. K. Ab.1999**.Heterosis and gene action in *Zea mays* L.. Ph.D. Thesis. College of Agriculture and Forestry. Mosul University. Iraq.

3 - **Aruah, B. C.; M. I. Uguru and Oyiga, B. C.2012**.Genetic variability and inter-relationship among some Nigerian Pumpkin Accessions (*Cucurbita* spp.) Intl. J. of Plant Breed. 6(1): 34-41.

4 - **Arivalagan, M.; R. Bhardwaj ; K. K. Gangopadhyay ; T.V. Prasad and S.K. Sarkar (2013).** Mineral composition and their genetic variability analysis in eggplant *(Solanum melongena* L.) germplasm. Journal of Applied Botany and Food Quality 86, 99 – 103. DOI:10.5073/JABFQ.2013.086 .014.

5 – **Bashar A.;R Hasan; N. Alam; M. K. Hossain; Vu. Ho. An. Nguyen and Huque, A. K. M. M.2015.**Assessment of Trait Efficiency and Selection of Parents in Brinjal (*Solanum melongena* L.). Plant Gene and Trait, 6(7): 1-12. doi: 10.5376/pgt.2015.06.0007.

6 - **Begum, F.; A. K. M. Aminul Islam1 ; M. Golam Rasul1; M. A. Khaleque Mian and Hossain, M. M.2013.** Morphological diversity of eggplant (*Solanum melongena*) in Bangladesh. Emir. J. Food Agric., 25 (1): 45-51 doi: 10.9755/ejfa.v25i1.4937.

7 - **Chaudhary, P.; S.. Kumar and Verma, P. P. S.2013.** Correlation and path coefficient analysis in brinjal. (*Solanum melongena* L.). HortFlora Research Spectrum, 2(4): 346-351.

8 - **Cruz, C. D.2013.**Genes. A software package for analysis in experimental statistics and quantitative genetics.Acta Scientarum. 35(3) : 271-276, Available from :http:// periodicos.uem. br/ojs/index. Php/ ActaSciAgron/article/view/ 21251.

9 - **Daunay, M. C.; R. N. Lester; R. N. Gebhardt; C. H, Hennart; J. W. Jahn; M. A. Frary and Doganlar, S.2001**.Genetic resources of eggplant (*Solanum melongena* L.) and allied species: A new challenge for molecular geneticists and eggplant breeders. Solanaceae V. Nijmegen University Press, Nijmegen, Netherlands. 251- 274.

10 - **Dewey, D. R. and K. H. Lu .1959**.A correlation and path coefficient analysis of components of crested wheat grass seed production.Agron.Jou.,51:515 - 518.

11 - **Esho, K. B. and N. R. Shekir .1993.**Effect of plant spacing and compound fertilizer NPK on growth and yield of eggplant c.v. local. Mesopotamia Agricultural Journal, 25(2):29-35.

12 - **Garcha, K. S.; A. S. Dhatt and Sidhu, M. K.2017**. Genetic variability in CMS backcross generations and their maintainers in eggplant (Solanum melongena L.). Journal of Applied and Natural Science 9 (3): 1854 -1860.

13 - **Johnson, H. W.; H. F. Robinson, and Comstock, R. F.1955.**Genotypic and phenotypic correlation in soybean and their implication in selection. Agronomy Journal, 47: 477-483.

14 - **Kumar, S.R.; T. Arumugam; T. C. R. Anandakumar and Prem-alakshmi, V.2013.** Genetic variability for quantitative and qualitative characters in Brinjal (*Solanum melongena* L.) African Journal of Agricultural Research, 8(39):4956-4959.

15 - **Kumar S. R and T. Arumugam. 2013**.Correlation and Path Coefficient Analysis for Some Yield-Related Traits in F2 Segregating Population of Eggplant. International Journal of Vegetable Science, 19:334–341.

16 - **Kummer, M. Kh.; K. B. Esho and Hanna, M. P.1992.** Performance and correlation of yield and it's component in eight cultivars of eggplant, Mesopotamia Agricultural Journal, 25(1):11-16.

17 - **Matlob, A. N.; Ez. S. Muhammed and Abdol, K. S.1989.**Vegetable Production (parts 1, 2). Ministry of High Education and Scientific Research, Mosul University, Iraq.

18 – **Matsubara, K.; T. Kaneyuki; T. Miyake and Mori, M.2005.** Antiangiogenic activity of nasunin, an anti-oxidant anthocyanin in eggplant peels. J. Agric. Fd. Chem. 53, 6272-6275.

19 - **Mehraj, H.; I. H. Shiam; S. Mutahera; K. Momena and Uddin, A. F. M. J. 2015.**Performance evaluation of ten japaneses brinjal (*Solanum melongena* L.) varieties. Int. J. Sustain. Crop Prod. 10(1):19-25.

20 - **Naik K.; G. B. Sreenivasulu; S. J. Prashanth; R. P. Jayaprakashnaraya; S. K. Nataraj and Mulge, R.2010**. Genetic variability in eggplant (*Solanum melongena L.*). Intl. J. Agric. Sci. 6(1): 229-231.

21 - **Obho G.; M. Ekperigin and Kazeem, M. I.2005.** Nutritional and Hemolytic Properties of Eggplant Solanum

macrocarpon) Leaves. J. Fd. Compos. Analy 8, 153-160.

22 - **Ofori, K.; E.T. Blay and Gamedoagbao, D. K.2008.** Inter-relationship between agronomic traits and fruit yield in scarlet eggplant. (*Solanum aethiopicum* (L.) gilo group). Plant Breeding and Seed Science. Pp 46-53.

23 - **Patel, V. K.; U. Singh; A. Goswami; S. K. Tiwari and Singh, M.2017A**.Genetic Variability, Interrelationships and Path Analysis for Yield Attributes in Eggplant. Environment and Ecology 35 (2A): 877—880.

24 - **Patel, S. N.; R. C. Popat; P. A. Patel and Vekariya, R. D.2018B.**Genetic diversity analysis in Brinjal (*Solanum melongena* L.) genotypes: A principal component analysis approach.Int.J.Curr.Microbiol. App.Sci. 7(1): 3296-3301

25 - **Prabhu, M.; S. Natarajan and Pugalendhi, L.2009**. Genetic parameters in eggplant (*Solanum melongena*) backcross progenies. American - Eurasian Journal of Sustainable Agriculture, 3(3):275-279.

26 - **Rad, M. RN.; M. Poodineh; Ab. Ghalandarzehi1 and Abkhoo, J.2015.**Variability, heritability and association analysis in eggplant (*Solanum melongena*). ARPN Journal of Agricultural and Biological Science. 10, (12):464-468.

27 - **Rajib R. C; S. Roy and Tah, J. 2011.**Estimation of heritable components of variation and character selection in eggplant (*Solanum melongena* L.) from mutation breeding programme. Continental J. Biological Sciences 4 (2): 31 – 36.

28 - **Robinson, H. F.1966.** Quantitative genetics in relation to breeding on the centennial of mendelsim. Indian Jou.Genet., 26 A : 171- 187.

29 - **Sawadogo, B.; P. Bationo-Kando; N. Sawadogo; Z. Kiebre; M. Kieber; K. R. Nanema; R.E. Traore; M. Sawdogo and Ongo, J. D. Z.2016.**Variation, correlation and heritability of interest characters for selection of African eggplant. African Crop Science Journal, 24 (2):213-221.DOI:http://dx.doi.org/10.4314/acsj.v24i2.9

30 - **SAS.1999.**Statistical Analysis SystemSAS.Institute Inc.Cary N.C.27511.U.S.A.

31 - **Singh, M.K.; J. R. Yadav and M Singh, B. M.2014.**Genetic variability and heritability in brinjal (*Solanum melongena* L.). HortFlora Research Spectrum, 3(1):103-105.

32 - **Steel,R.G.D. and J.H. Torrie .1980**.Principles and Proccedures of Statistics. A Biometrical Approach.McGraw Hill Book Company Inc., New York. USA.

33 - **Suhana, O.; O. Mohamad; M. Abd and Zubaid Akbar, M. A.2016.** Genetics of yield and its components in eggplant (*Solanum melongena* L.). J. Trop. Agric. and Fd. Sc. 44(1): 137 – 145.

34 - **Walter, A.B.1975**.Manual of Quantitative Genetic(3rd edition).Washington.StdeUniv. Press. USA.