**14th Conf. Agric. Develop. Res., Fac. of Agric., Ain Shams Univ., March, 2019., Cairo, Egypt**
**Special Issue, 27(1), 271 - 280, 2019**
**Website: http://strategy-plan.asu.edu.eg/AUJASCI/**



# ASSESSMENT OF SOME AGRO-MORPHOLOGICAL TRAITS IN GENOTYPES OF EGYPTIAN FABA BEAN (*VICIA FABA* L.).

**[24]**

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Received 11 February, 2019, Accepted 10 March, 2019

**ABSTRACT**

This investigation aimed to evaluate of some faba bean genotypes for some morphological and agronomic traits in order to determine the promissing genotypes which can be used in breeding program for improving faba bean. The study carried out at El-Gemmeiza Agricultural Research Station in two successive seasons; 2016/2017and 2017/2018. 50 different landraces collected by the National Gene Bank (from different region of Egypt) and one commercial cultivar (Giza716) used as a check were used. Data analysis showed that there were highly significant differences in all studied characters among genotypes and replications except days to 50% flowering, plant height and number of branches per plant for replicates only. This indicates that there is wide diversity among genotypes which will enrich plant breeding programs to get high new commercial varieties and adapted to climate change of faba bean. The data for genetic parameters showed that the extent of phenotypic and genotypic variances diversed from one character to another according to result data from broad sense heritability ($h^2$) estimates clears that there was graduation for all of studied characters with values from ranged 73.92 % to 95.03 %.which indicate that the effects of environment were lower than genetic effects inheritance of studied traits. In addition, high estimates of heritability could be successful for improving faba bean. Results of mean performance note that although commercial cultivar Giza 716 was outweigh for days to flowering and maturity traits, L47 recorded the highest mean values for 100-seed weight and seed yield/plant. In addition, L39 recorded the highest mean values for number of pods and number of seeds/plant. So lines 39 and 47 may be used in breeding programs for improving the performance of seed yield characters. The results of correlation coefficient showed that there were thirteen significant and highly significant positive phenotypic correlation in addition, four significant and highly significant negative phenotypic correlation. The direct contribution of 100- seed weight per plant had highest mean values followed by number of seeds per plant. Number of seeds per plant had the highest indirect effect via number of pods per plant, and number of branches per plant via number of seeds per plant. In addition, 100 seeds weight via number of branches per plant, 100-seed weight also had an appreciable indirect effect via leaflet width and number of branches per plant. Cluster analysis for investigated traits showed diversity among investigated fifty-one faba bean genotypes. All genotypes divided into two groups at a distance of 5.924. The first group contain line 47. The second group contains other genotypes. 100-seed weight and seed yield per plant are valuable in splitting the studied genotypes into two groups high value included the first group, however low vale included the second group.

**Key words:** Faba bean- broad sense heritability- phenotypic and genotypic variances- correlation coefficient- path coefficient - Cluster analysis.

## INTRODUCTION

Faba bean (*Vicia faba* L.), is a significant crop worldwide and a diploid plant with a relatively few number of large chromosomes (2n = 12). It is the most important legume crop and favorable dishes for the Egyptian people that why is ranking the second favorite food after bread wheat in Egyptian table. **Bond and Poulsen (1983)** found that faba bean has an average rate of cross-fertilization around 35% (ranging from 4 to 84%). **Terzopoulos et al (2008)** showed that landraces could be represented as an economically valuable opportunity for farmers and become the basis for plant breeders to develop new varieties. In addition, **Chahal and Gosal (2002)** refer that autochthonous landraces, in fact, evolved from ancient types through conscious and unconscious phenotypic selection by farmers, contain adaptive genes to different agro-ecological conditions

The characterization of landrace collections is important for their usage in faba bean improvement. It is not surprising; therefore many researchers have already characterized and evaluated faba bean (*Vicia faba* L.) landraces **Abdalla (1982,1992), Abdalla et al (1982 a, b), Della (1988), Ding et al (1993) and Arab et al (2013 and 2018).**

Crop germplasm collections are assemblies of genotypes or populations representative of cultivars, genetic stocks, etc., which are maintained in the form of plants, seeds, etc. and populations in the wild or on-farm (Frankel and Soulé 1981; Ramanatha **Rao et al 1997).** Functionally, plant genetic resources (PGR) constitute landraces, advanced/ improved cultivars and wild and weedy relatives of crop plants (either domesticated or non-domesticated).

Yield in *Vicia faba* , is a complex trait and constitute by morphological and physiological traits that correlated each other. The most important traits improvement for increasing seed yield are plant height, number of stems and pods per plant, biological yield, 100-seed weight, days to flowering and maturity due to direct and indirect correlation with seed yield **(Loss and Siddique, 1997).** In addition, both of morphological and agronomic traits are access to genetic diversity.

**Abdel Aziz and Osman (2015),** showed that heritability defined as the share of the phenotypic variance in population attributed to the hereditary factors. It determines which degree of difference among phenotypes that results from genetic causes. Heritability used to show the degree which a trait inherited to the offspring generation. The investigation aimed to evaluate of some faba bean genotypes for some morphological and agronomic traits in order to determine the promissing genotypes which can be used in breeding program for improving faba bean.

## MATERIALS AND METHODS

This study carried out in two successive seasons (2016/2017 and 2017/2018) at El-Gemmeiza Agricultural Research Station. Fifty different genotypes collected by the National Gene Bank (from different regions of Egypt) in addition, one commercial cultivar (Giza716) as a check were used and evaluated in this study **(Table 1).** The field experiment was conducted in a randomize complete block design(RCBD) with three replicates,. Each genotype was grown in 3 rows, 3 meters long and 60 cm. in width and seeds were planted in single seeded per hills, 20 cm apart.

**Table 1.** Source of the studied faba bean genotypes.

| No. | Sources | No. | Sources | No. | Sources | No. | Sources |
|---|---|---|---|---|---|---|---|
| 1 | New valley | 14 | Assiut | 27 | Assiut | 40 | New valley |
| 2 | New valley | 15 | Assiut | 28 | Qena | 41 | Ismailia |
| 3 | New valley | 16 | Assiut | 29 | Sohag | 42 | Ismailia |
| 4 | Qena | 17 | Assiut | 30 | Sohag | 43 | Ismailia |
| 5 | Luxor | 18 | Assiut | 31 | New valley | 44 | Beheira |
| 6 | Luxor | 19 | Assiut | 32 | New valley | 45 | Beheira |
| 7 | Luxor | 20 | Assiut | 33 | New valley | 46 | Beheira |
| 8 | Sohag | 21 | Sohag | 34 | New valley | 47 | Beheira |
| 9 | Luxor | 22 | Sohag | 35 | south Sinai | 48 | Beheira |
| 10 | Luxor | 23 | Sohag | 36 | New valley | 49 | Aswan |
| 11 | Luxor | 24 | Sohag | 37 | New valley | 50 | New valley |
| 12 | Qena | 25 | Sohag | 38 | New valley | 51 | Giza 716 |
| 13 | Assiut | 26 | Sohag | 39 | New valley | | |

Field experiment taken all recommended fertility treatments and normal irrigation throughout the two seasons. Morphological identification was measured and recorded using the recommended scales reported by the International Union for protection of new varieties (UPOV 2003) descriptors (**Table 2).** The statistical analysis carried out by Paleontological Statistics (PAST) Version 3.**08 (Dryden and Mardia, 1998)** to determine mean square, mean performance, correlation coefficient, path coefficient and cluster analysis. The genotypic and phenotypic variances were calculated from the partitioning mean squares expectation; where, g and r are number of genotypes and replications, respectively. Broad sense heritability ($H^2{}_B$) was estimated from the formula of **Roy( 2000)** as follows;

$\delta^2_g = MS_g\text{-}MS_e/r$ , $\delta^2_{ph} = \delta^2_g + \delta^2_e/r$ , $H^2 = \delta^2_g / \delta^2_{ph}$

Genetic advance (GA) calculated according to the method suggested by Allard (1960) and Singh and Chaudhury (1985) using Equation:

$GA = K.\ \sigma^2 ph.\ H^2$

Where:

GA: genetic advance

K: constant = 2.06 at 5% selection intensity, $\sigma^2$ph: phenotypic variance and $H^2$: Heritability

**Table 2.** A list of scored traits according to UPOV 2003.

| Traits | Code | Description | Score |
|---|---|---|---|
| **Foliage intensity of green color** | FIGC | Light | 3 |
| | | Medium | 5 |
| | | Dark | 7 |
| **Leaflet width** | LW | Narrow | 3 |
| | | Medium | 5 |
| | | Broad | 7 |
| **Leaflet length (basal pair of leaflet at secondary node)** | LL | Short | 3 |
| | | Medium | 5 |
| | | long | 7 |
| **Leaflet folding (along the main vein, terminal pair of leaflets)** | LF | Weak | 3 |
| | | Medium | 5 |
| | | Strong | 7 |
| **Raceme: number of flowers** | NOF | Few | 3 |
| | | Medium | 5 |
| | | Many | 7 |
| **Flower length** | FL | Short | 3 |
| | | Medium | 5 |
| | | long | 7 |
| **Days to 50 % flowering** | DF | | |
| **Days to 90 % maturity** | DM | | |
| **Plant height (cm.)** | PH | | |
| **First pod height (cm.)** | FPH | | |
| **Number of branches /plant** | No.B/P | | |
| **Number of pods/plant** | No.P/P | | |
| **Number of seeds/plant** | No.S/P | | |
| **100-seed weight** | 100-SW | | |
| **Seed yield/plant (gm.)** | SY/P | | |

## RESULTS AND DISCUSSION

Data analysis that represented of the fifty-one faba bean genotypes are shown in **(Table 3).** There were highly significant differences in all studied characters among genotypes and replications except days to 50% flowering, plant height and number of branches per plant for replicates only. This indicates that there is wide diversity among genotypes which will enrich faba bean breeding programs to get high new commercial varieties and adapted to climate change. These results agree with **Peyman (2015) and Fatih et al (2017).**

Estimates of genotypic and phenotypic variances and broad sense heritability from the mean squares are presented in **(Table 4).** The results indicated that the extent of phenotypic and genotypic variances diversed from one character to another. Results of broad sense heritability ($h^2$) estimates clear that there was graduation for all of studied characters with values ranged from 73.92% to 95.03%. The highest value observed was 95.03% for number of seeds/plant, followed by plant height given with value of 93.32% and100-seed weight with value of 92.88% and 91.96% for seed yield/plant. There were moderately high broad sense heritability values for days to 90% maturity, number of pods/plant, and days to 50% flowering with value of 90.79%, 90.54%, 89.83%, respectively. Meanwhile the lowest values had recorded for first pod height with value of 73.92 % followed by number of branches /plant with value of 84.79%.

Results showed that broad sense heritability was high for all traits studied which indicating that the effect of environment was lowest than genetic effect in the inhirtance of the studied traits .In addition, high estimates of heritability could be successful for improving faba bean. These results agree with **Alghamdi (2007), Ibrahim (2010) and Peyman (2015).** There was a wide range of variation expressed by the genetic advance, the data varied from 1.98 for no. branches /plant to 25.10 for 100- seed weight. **Ramgiry (1997), Kalia and Sood (2004)** showed high $h^2$ and high GA for pod yield per plant which indicated high additive gene action and possibility of trait improvement through selection.

**Table 3.** Mean squares of faba bean characters from combined data of the two seasons.

| S.O.V. | Df | Days to 50% flowering | Days to 90% maturity | Plant height (cm.) | First pod height (cm.) | Number of branches /plant | Number of pods /plant | Number of seeds /plant | 100-seed weight (g.) | Seed yield/plant (g.) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rep. | 2 | 0.59 | 16.37** | 0.24 | 6.63** | 0.05 | 12.59** | 3.82* | 14.45** | 19.25** |
| Genotypes | 50 | 38.12** | 10.39** | 207.96** | 38.59** | 3.48** | 70.69** | 356.24** | 491.921** | 243.99** |
| Error | 100 | 1.39 | 0.34 | 4.85 | 4.06 | 0.20 | 2.38 | 6.10 | 12.26 | 6.90 |

*, ** significant at P< 0.05 and 0.01, respectively.

**Table 4.** Genetic parameters for different agronomic traits in faba bean genotypes

| Traits | $δ^2e$ | $δ^2g$ | $δ^2ph$ | H² | GA |
|---|---|---|---|---|---|
| Days to 50% flowering | 1.38 | 12.25 | 13.63 | 89.83 | 6.83 |
| Days to 90% maturity | 0.34 | 3.35 | 3.69 | 90.79 | 3.59 |
| Plant height (cm.) | 4.85 | 67.70 | 72.55 | 93.32 | 16.37 |
| First pod height (cm.) | 4.06 | 11.51 | 15.57 | 73.92 | 6.01 |
| Number of branches /plant | 0.20 | 1.09 | 1.29 | 84.79 | 1.98 |
| Number of pods/plant | 2.38 | 22.77 | 25.15 | 90.54 | 9.35 |
| Number of seeds/plant | 6.11 | 116.71 | 122.82 | 95.03 | 21.70 |
| 100-seed weight (g.) | 12.26 | 159.89 | 172.15 | 92.88 | 25.10 |
| Seed yield/plant (g.) | 6.91 | 79.03 | 85.94 | 91.96 | 17.56 |

$δ^2e$ = Environment variance, $δ^2g$ = Genotypic variance, $δ^2ph$ = Phenotypic variance, H² = Broad sense heritability, GA = Genetic advance

Mean performance of faba bean genotypes under study for agronomic, yield and yield components characters are given in **(Table 5).** Results showed that foliage intensity of green color trait was medium in all genotypes except line9 (L9) was dark. Concerning to leaflet width trait, the data of fifty one genotypes classified into three classes the first class was nine genotypes which gave narrow leaflet width the second class was twenty seven genotypes which gave medium leaflet width and the last class was fifteen genotypes which gave broad leaflet width.

For leaflet length (basal pair of leaflet at secondary node) trait located into three groups; the first one included eighteen genotypes and were short, the second group included twenty-five genotypes, which gave medium, and the last group included eight genotypes were long. Leaflet: folding (along the main vein, terminal pair of leaflets) divided to three classes the first one clearly fifteen genotypes had weak meanwhile, the second class had thirty-one genotypes medium and the last five genotypes and were strong. As for number of flowers nineteen genotypes gave few number of flowers while, eighteen genotypes gave medium and fourteen genotypes gave many flowers. Regarding to flower length trait most of flowers studied showed short (thirty-two genotypes) while, eighteen genotypes included medium and there was only cultivar (Giza 716) included long flowers. From these data, we can conclude that the morphological traits released differentiation among faba bean genotypes, which could be beneficial for plant breeding program.

The average of mean performances for number of days to 50 %flowering and 90% maturity dates of plants/plot showed that the commercial cultivar Giza 716 possessed the earliest flowering and maturity ((53.67 and 136.17 days) meanwhile, the two lines (L30 and L40) was the latest genotypes for flowering and maturity (68.33 and145.00). The data demonstrated clearly that there were marked differences among genotypes in days to flowering and maturity.

Concerning to yield and yield components, the line 17 (L17) possessed the shortest plants (69.93 cm) while, L30 gave the tallest plants (106.94 cm). Respecting to first pod height date showed that the highest mean value was recorded for L30 (32.61 cm), whereas L1 gave the lowest mean value (14.99 cm). For number of branches /plant L13 revealed the highest values (7.56) on the other hand L8 gave the lowest value (1.69). Regarding to number of pods/plant the highest number of pods per plant for L39 (32.78) and the lowest number of pods per plant for L23 (12.08). As for number of seeds/plant refer that L39 gave the highest number of seed per plant (75.89) while, L23 gave the lowest number of seed (27.13). On the other hand, data from 100-seed weight trait showed that L47 recorded the highest 100-seed weight (99.05 g.) and the lowest weight recorded

**Table 5.** Mean performance of faba bean genotypes under study for morphological, yield and yield components characters from the combined data of two seasons.

| No. | FIGC | LW | LL | LF | NOF | FL | DF | DM | PH | FPH | No.B/p | No.P/p | No.S/P | 100-SW | SY/P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 7 | 7 | 5 | 3 | 5 | 62.17 | 140.17 | 82.92 | 14.99 | 3.21 | 19.94 | 49.06 | 58.34 | 28.22 |
| 2 | 5 | 5 | 5 | 3 | 3 | 3 | 58.67 | 138.89 | 91.46 | 17.64 | 3.42 | 27.81 | 60.86 | 65.57 | 37.77 |
| 3 | 5 | 5 | 5 | 5 | 5 | 3 | 60.00 | 139.83 | 82.18 | 17.90 | 2.58 | 13.37 | 33.60 | 52.06 | 17.76 |
| 4 | 5 | 7 | 7 | 5 | 5 | 3 | 59.67 | 138.17 | 75.50 | 26.11 | 4.04 | 26.65 | 52.10 | 52.69 | 27.24 |
| 5 | 5 | 5 | 5 | 5 | 5 | 3 | 59.17 | 139.67 | 83.75 | 23.96 | 2.69 | 20.62 | 47.29 | 51.44 | 21.95 |
| 6 | 5 | 7 | 7 | 5 | 5 | 3 | 57.67 | 136.61 | 73.32 | 18.06 | 3.70 | 14.50 | 40.45 | 60.90 | 24.79 |
| 7 | 5 | 5 | 5 | 3 | 7 | 3 | 56.33 | 138.61 | 82.86 | 17.08 | 3.15 | 20.68 | 57.26 | 59.29 | 33.07 |
| 8 | 5 | 5 | 5 | 5 | 5 | 3 | 56.17 | 139.56 | 83.83 | 23.14 | 1.69 | 20.92 | 44.81 | 64.47 | 31.81 |
| 9 | 7 | 5 | 5 | 5 | 5 | 5 | 61.00 | 141.33 | 86.67 | 21.78 | 3.45 | 18.75 | 45.08 | 58.71 | 25.22 |
| 10 | 5 | 5 | 5 | 5 | 5 | 3 | 59.33 | 140.67 | 70.25 | 18.29 | 3.21 | 21.38 | 46.57 | 57.70 | 26.57 |
| 11 | 5 | 5 | 5 | 3 | 5 | 3 | 61.33 | 141.00 | 84.17 | 21.11 | 3.06 | 14.33 | 33.22 | 53.36 | 17.68 |
| 12 | 5 | 5 | 5 | 5 | 5 | 5 | 57.67 | 140.17 | 98.03 | 27.01 | 1.88 | 18.57 | 44.53 | 62.24 | 30.00 |
| 13 | 5 | 3 | 3 | 5 | 3 | 3 | 64.50 | 143.61 | 86.80 | 16.08 | 7.56 | 28.32 | 53.90 | 46.80 | 25.14 |
| 14 | 5 | 5 | 5 | 5 | 7 | 3 | 61.33 | 139.50 | 82.08 | 18.42 | 2.42 | 24.33 | 51.61 | 58.16 | 30.64 |
| 15 | 5 | 3 | 3 | 5 | 7 | 3 | 61.83 | 140.50 | 82.03 | 23.40 | 2.60 | 19.00 | 45.44 | 63.31 | 29.30 |
| 16 | 5 | 3 | 3 | 5 | 7 | 3 | 66.67 | 141.72 | 74.79 | 24.16 | 2.80 | 18.92 | 42.00 | 49.71 | 20.51 |
| 17 | 5 | 3 | 3 | 5 | 7 | 3 | 66.00 | 139.83 | 69.93 | 20.76 | 3.14 | 19.56 | 45.47 | 45.93 | 21.62 |
| 18 | 5 | 5 | 5 | 5 | 7 | 5 | 57.33 | 140.06 | 81.97 | 22.46 | 3.17 | 19.83 | 44.47 | 59.40 | 27.93 |
| 19 | 5 | 5 | 5 | 5 | 3 | 5 | 56.00 | 140.00 | 79.65 | 22.71 | 2.40 | 14.94 | 39.21 | 69.16 | 26.90 |
| 20 | 5 | 7 | 7 | 3 | 3 | 3 | 60.83 | 142.95 | 96.36 | 29.31 | 4.03 | 18.89 | 46.92 | 77.66 | 33.25 |
| 21 | 5 | 5 | 5 | 3 | 7 | 5 | 64.83 | 141.72 | 97.06 | 22.92 | 4.47 | 25.31 | 63.96 | 60.14 | 37.07 |
| 22 | 5 | 5 | 5 | 5 | 5 | 5 | 56.67 | 140.89 | 89.72 | 29.44 | 2.72 | 15.54 | 33.33 | 54.14 | 16.37 |
| 23 | 5 | 3 | 3 | 3 | 3 | 3 | 61.83 | 142.28 | 92.94 | 23.11 | 2.56 | 12.08 | 27.13 | 49.68 | 24.53 |
| 24 | 5 | 5 | 5 | 5 | 5 | 3 | 57.50 | 139.78 | 90.56 | 23.58 | 3.62 | 23.26 | 60.97 | 57.98 | 34.96 |
| 25 | 5 | 7 | 7 | 3 | 7 | 5 | 55.17 | 139.17 | 100.14 | 20.63 | 1.83 | 16.00 | 40.47 | 74.08 | 29.40 |
| 26 | 5 | 5 | 5 | 3 | 7 | 3 | 58.33 | 141.89 | 93.54 | 24.94 | 3.18 | 19.13 | 50.72 | 42.03 | 21.80 |
| 27 | 5 | 3 | 3 | 5 | 3 | 3 | 56.00 | 140.00 | 88.82 | 21.81 | 3.10 | 19.14 | 44.49 | 69.25 | 30.91 |
| 28 | 5 | 5 | 5 | 5 | 5 | 5 | 58.50 | 141.28 | 95.13 | 25.92 | 3.83 | 20.44 | 55.57 | 65.12 | 36.32 |
| 29 | 5 | 5 | 3 | 5 | 5 | 3 | 58.50 | 140.11 | 87.03 | 18.19 | 4.11 | 23.51 | 61.83 | 60.65 | 37.60 |
| 30 | 5 | 7 | 7 | 3 | 3 | 3 | 68.33 | 142.95 | 106.94 | 32.61 | 2.28 | 16.45 | 37.03 | 58.62 | 25.47 |
| 31 | 5 | 3 | 3 | 5 | 7 | 5 | 56.67 | 140.00 | 74.17 | 17.47 | 2.58 | 24.07 | 54.71 | 51.26 | 26.08 |
| 32 | 5 | 7 | 3 | 7 | 3 | 5 | 59.17 | 140.45 | 86.17 | 22.42 | 2.88 | 22.81 | 53.25 | 41.48 | 23.34 |
| 33 | 5 | 5 | 3 | 3 | 5 | 5 | 60.00 | 139.83 | 85.65 | 19.58 | 3.27 | 30.40 | 64.61 | 57.16 | 39.99 |
| 34 | 5 | 5 | 5 | 3 | 5 | 5 | 55.50 | 142.06 | 86.67 | 20.28 | 3.00 | 24.78 | 62.47 | 49.84 | 32.99 |
| 35 | 5 | 5 | 5 | 5 | 3 | 5 | 56.67 | 140.00 | 77.43 | 19.82 | 4.40 | 22.31 | 61.37 | 55.06 | 37.92 |
| 36 | 5 | 7 | 5 | 5 | 5 | 5 | 57.56 | 144.33 | 94.43 | 19.00 | 3.35 | 24.10 | 61.07 | 75.35 | 43.22 |
| 37 | 5 | 7 | 7 | 3 | 7 | 5 | 57.17 | 143.11 | 94.81 | 20.69 | 2.89 | 18.71 | 47.26 | 75.87 | 33.72 |
| 38 | 5 | 5 | 3 | 7 | 3 | 5 | 55.78 | 144.00 | 94.45 | 21.67 | 2.50 | 29.86 | 73.36 | 63.36 | 45.48 |
| 39 | 5 | 5 | 3 | 7 | 3 | 5 | 59.17 | 143.78 | 92.64 | 24.81 | 5.25 | 32.78 | 75.89 | 74.46 | 54.68 |
| 40 | 5 | 3 | 3 | 5 | 5 | 3 | 66.33 | 145.00 | 97.78 | 27.11 | 4.43 | 15.22 | 30.52 | 53.51 | 18.61 |
| 41 | 5 | 7 | 3 | 3 | 3 | 3 | 67.17 | 138.61 | 77.71 | 24.86 | 5.18 | 15.72 | 45.33 | 85.36 | 41.03 |
| 42 | 5 | 5 | 5 | 5 | 3 | 3 | 59.44 | 139.22 | 78.56 | 19.33 | 3.60 | 13.44 | 48.95 | 86.39 | 28.29 |
| 43 | 5 | 7 | 7 | 3 | 3 | 3 | 67.11 | 140.67 | 83.47 | 17.99 | 6.13 | 17.76 | 45.44 | 91.36 | 47.76 |
| 44 | 5 | 7 | 5 | 7 | 3 | 3 | 57.33 | 139.06 | 76.11 | 23.06 | 3.32 | 15.26 | 33.67 | 78.70 | 28.72 |
| 45 | 5 | 5 | 5 | 5 | 3 | 3 | 59.44 | 140.83 | 95.44 | 21.47 | 2.81 | 15.46 | 36.50 | 47.64 | 19.56 |
| 46 | 5 | 7 | 3 | 5 | 7 | 3 | 56.89 | 139.45 | 84.50 | 18.75 | 3.97 | 23.86 | 62.94 | 70.65 | 45.52 |
| 47 | 5 | 3 | 3 | 5 | 3 | 3 | 64.33 | 142.83 | 86.97 | 20.90 | 5.00 | 21.71 | 62.40 | 99.05 | 55.41 |
| 48 | 5 | 7 | 3 | 3 | 5 | 3 | 59.67 | 140.78 | 81.96 | 23.40 | 2.54 | 14.59 | 46.74 | 77.88 | 36.07 |
| 49 | 5 | 7 | 5 | 7 | 7 | 3 | 61.56 | 138.95 | 83.06 | 24.66 | 2.50 | 15.88 | 41.47 | 56.63 | 26.79 |
| 50 | 5 | 5 | 3 | 5 | 3 | 3 | 58.56 | 143.06 | 74.11 | 20.90 | 3.46 | 21.58 | 47.14 | 54.01 | 25.60 |
| 51 | 5 | 5 | 5 | 5 | 7 | 7 | 53.67 | 136.17 | 78.83 | 21.67 | 3.30 | 13.63 | 42.55 | 79.81 | 32.41 |
| L.S.D. 5% | | | | | | | 1.92 | 0.95 | 3.59 | 3.29 | 0.72 | 2.52 | 4.03 | 5.72 | 4.29 |

**FIGC:** Foliage intensity of green color**, LW:** Leaflet width**, LL**: Leaflet length (basal pair of leaflet at secondary node)**, LF:** Leaflet folding (along the main vein, terminal pair of leaflets)**, NOF:** Raceme number of flowers **, FL:** Flower length**, DF:** Days to 50 % flowering **,DM:** Days to 90 % maturity **, PH:** Plant height (cm.), **FPH:** First pod height (cm.)**, No.B/P:** No. of branches/ plant, **No.P/P:** No. of pods/plant, **No.S/P:** No. of seeds /plant**, 100-SW:** 100-seed weight, **SY/P:** seed yield/plant.

for L32 (41.48 g). The data from seed yield/plant trait clearly that L47 recorded the highest mean values (55.41g) whereas; L22 recorded the lowest mean values (16.37g).

According to the previous results of mean performance, it could be noted that although commercial cultivar Giza 716 was outweigh for days to flowering and maturity traits but L47 recorded the highest mean values for 100-seed weight and seed yield/plant. In addition, L23 recorded the lowest mean values in number of pods and number of seeds/plant, on contrary, L39 outweigh for the same characters. So lines 39 and 47 could be used in breeding programs for improving the performance of seed and number seeds yield plant in faba bean.

**Table 6.** Correlation coefficients of morphological, yield and yield components of faba bean genotypes under study from the combined data of two seasons.

| | FIGC | LW | LL | LF | NOF | FL | DF | DM | PH | FPH | No.B/p | No.P/p | No.S/P | 100-SW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LW** | -0.02 | | | | | | | | | | | | | |
| **LL** | 0.04 | **0.60**** | | | | | | | | | | | | |
| **LF** | 0.05 | -0.09 | **-0.29*** | | | | | | | | | | | |
| **NOF** | 0.02 | -0.04 | 0.05 | -0.13 | | | | | | | | | | |
| **FL** | 0.16 | 0.09 | 0.10 | 0.12 | 0.16 | | | | | | | | | |
| **DF** | 0.05 | -0.13 | -0.11 | -0.20 | -0.16 | **-0.43**** | | | | | | | | |
| **DM** | 0.05 | -0.23 | -0.24 | -0.03 | -0.25 | 0.02 | **0.31*** | | | | | | | |
| **PH** | 0.02 | 0.10 | 0.18 | -0.26 | -0.09 | 0.18 | 0.04 | **0.52**** | | | | | | |
| **FPH** | -0.01 | 0.08 | 0.08 | 0.00 | 0.00 | -0.01 | 0.19 | 0.24 | **0.42**** | | | | | |
| **No.B/P** | 0.01 | -0.06 | -0.14 | -0.02 | **-0.40**** | -0.14 | **0.41**** | 0.22 | -0.06 | -0.20 | | | | |
| **No.P/P** | -0.04 | -0.11 | -0.26 | 0.17 | -0.04 | 0.19 | -0.10 | 0.26 | 0.08 | -0.23 | **0.32*** | | | |
| **No.S/P** | -0.05 | 0.01 | -0.24 | 0.12 | -0.02 | 0.26 | -0.20 | 0.16 | 0.08 | **-0.29*** | **0.33*** | **0.87**** | | |
| **100-SW** | -0.04 | **0.30*** | 0.14 | -0.10 | -0.22 | 0.05 | 0.00 | -0.07 | 0.05 | -0.02 | 0.25 | -0.14 | 0.13 | |
| **SY/P** | -0.09 | 0.19 | -0.14 | -0.01 | -0.16 | 0.18 | -0.05 | 0.13 | 0.16 | -0.17 | **0.40**** | **0.52**** | **0.74**** | **0.68**** |

*, ** significant at P< 0.05 and 0.01, respectively.

The correlation coefficient among morphological, yield and yield components traits computed for the studied faba bean genotypes was presented in **(Table 6).** It showed that there are thirteen significant and highly significant positive phenotypic correlations, in addition, four significant and highly significant negative phenotypic correlation.

The phenotypic correlation between yield and yield component traits showed that correlation coefficients between number of pods/plant and number of seeds/plant recorded the highest positive highly significant value(r= 0.87**) followed by correlation between number of seeds/plant and seed yield/plant (r=0.74**).The results confirmed that No. of pods, seeds /plant and seed yield /plant are considered as good criteria for selection to improve the performance of seeds and seed yield/ plant characters. The value of correlation coefficient between seed yield/plant and both of number of pods/plant and 100-seed weight was positive and highly significant (r=0.68** and 0.52**, respectively). A positive highly significant correlation was recorded between plant height and both of first pod height and days to 90% maturity (0.42** and 0.52**, respectively). No. of branches /plant had positive highly significant correlation with days to 50% flowering (0.41**) and seed yield /plant (0.40**) These results were in agreement with **Ouji et al (2011), Sharifi (2014), Tofiq et al (2016) and Arab et al (2018).**

The correlation coefficient between morphological, yield and yield component traits showed that No. of branches /plant had highly significant negative correlation with No. of flowers (-0.40**), as well as days to 50% flowering possessed highly significant negative correlation with flower length (-0.43**). A non-significant negative correlation coefficient was found between leaflet length and No. of branches/plant (-0.26) also between days to 50% flowering with leaflet width (-0.13) meanwhile the correlation coefficient between both leaflet width and leaflet length was (0.60**); these results were in agreement with **Ouji et al (2011).**

The path coefficient analysis appeared as a clue to the contribution of various yield components for seed yield per plant in the genotypes under the study. It provides an effective way of finding out direct and indirect sources of correlation **(Table 7).** The maximum positive direct contribution was in 100- seed weight (0.611) followed by number of seed per plant (0.488), Meanwhile the maximum negative direct effect was found in leaf length (-0.143). Number of seed per plant had the highest indirect effect via number of pods per plant (0.423), but via number of branches per plant it was (0.160). In addition, 100- seed weight had indirect effect via both number of branches per plant (0.155), and via leaflet width (0.185). From these results we can concluded that 100-seed weight and No. of seeds/plant had positive effect on seed yield/plant directly or indirectly, therefore direct and indirect selection for higher seed yield may be effective for improving these traits as had be shown by **Sharifi (2014) and Tofiq et al (2016)**

**Table 7.** Direct and indirect effects of different traits on seed yield/plant in faba bean.

| | FIGC | LW | LL | LF | NO.F | FL | DF | DM | PH | FPH | No. B/p | No. P/p | No. S/P | 100-SW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIGC | **-0.031** | -0.002 | -0.006 | -0.001 | 0.001 | 0.002 | 0.003 | -0.001 | 0.002 | 0.000 | 0.000 | -0.006 | -0.025 | -0.025 |
| LW | 0.001 | **0.089** | -0.086 | 0.002 | -0.001 | 0.001 | -0.008 | 0.005 | 0.011 | -0.002 | -0.002 | -0.015 | 0.004 | 0.185 |
| LL | -0.001 | 0.053 | **-0.143** | 0.006 | 0.001 | 0.001 | -0.006 | 0.005 | 0.020 | -0.002 | -0.003 | -0.036 | -0.115 | 0.083 |
| LF | -0.001 | -0.008 | 0.041 | **-0.022** | -0.003 | 0.002 | -0.012 | 0.001 | -0.029 | 0.000 | -0.001 | 0.024 | 0.056 | -0.062 |
| NO.F | -0.001 | -0.004 | -0.008 | 0.003 | **0.026** | 0.002 | -0.009 | 0.006 | -0.010 | 0.000 | -0.010 | -0.006 | -0.012 | -0.133 |
| FL | -0.005 | 0.008 | -0.015 | -0.003 | 0.004 | **0.013** | -0.026 | 0.000 | 0.020 | 0.000 | -0.003 | 0.026 | 0.127 | 0.029 |
| DF | -0.002 | -0.011 | 0.015 | 0.004 | -0.004 | -0.006 | **0.060** | -0.007 | 0.005 | -0.005 | 0.010 | -0.014 | -0.097 | -0.003 |
| DM | -0.002 | -0.020 | 0.034 | 0.001 | -0.007 | 0.000 | 0.019 | **-0.023** | 0.057 | -0.006 | 0.006 | 0.037 | 0.080 | -0.040 |
| PH | 0.000 | 0.009 | -0.026 | 0.006 | -0.002 | 0.002 | 0.003 | -0.012 | **0.110** | -0.010 | -0.002 | 0.011 | 0.039 | 0.030 |
| FPH | 0.000 | 0.007 | -0.012 | 0.000 | 0.000 | 0.000 | 0.012 | -0.005 | 0.047 | **-0.024** | -0.005 | -0.033 | -0.141 | -0.012 |
| No.B/p | 0.000 | -0.005 | 0.019 | 0.001 | -0.010 | -0.002 | 0.024 | -0.005 | -0.007 | 0.005 | **0.025** | 0.045 | 0.160 | 0.155 |
| No.P/p | 0.001 | -0.009 | 0.037 | -0.004 | -0.001 | 0.002 | -0.006 | -0.006 | 0.008 | 0.006 | 0.008 | **0.142** | 0.423 | -0.084 |
| No.S/P | 0.002 | 0.001 | 0.034 | -0.002 | -0.001 | 0.003 | -0.012 | -0.004 | 0.009 | 0.007 | 0.008 | 0.123 | **0.488** | 0.080 |
| 100-SW | 0.001 | 0.027 | -0.019 | 0.002 | -0.006 | 0.001 | 0.000 | 0.001 | 0.005 | 0.000 | 0.006 | -0.020 | 0.064 | **0.611** |

### Cluster analysis

Measurement of genetic distance should be very important for breeder when is based on a broad range of traits relevant to breeding objectives. Cluster analysis for investigated traits showed diversity among the fifty-one faba bean genotypes **(Fig. 1).** All genotypes divided into two groups at a distance of 5.924. The first group contains line 47. The second group contains other genotypes.100-seed weight and seed yield per plant are valuable in splitting the studied genotypes into two groups high vale included the first group, however low vale included the second group.

The second group divided into two subgroups at a distance of 4.504. The remaining accessions of (38 and 39) delimited in a separate subgroup, while other accessions separated in the other subgroup. Number of pods per plant was valuable in splitting the studied genotypes into two groups. Accessions38 and 39 had high vale in these traits. Maximum similarity recorded between lines (3 and 11). Minimum similarity computed between lines (30 and 47). **Keneni et al (2005),** used cluster analysis to study the genetic diversity of one hundred sixty random germplasm accession in Ethiopian faba bean landraces, seven diversity classes of different sizes were found. **Yahia et al (2012),** analyzed morphological diversity of southern Tunisia faba bean germplasm and revealed eight main groups. The variation within the same oasis agro-ecosystems was extremely important.

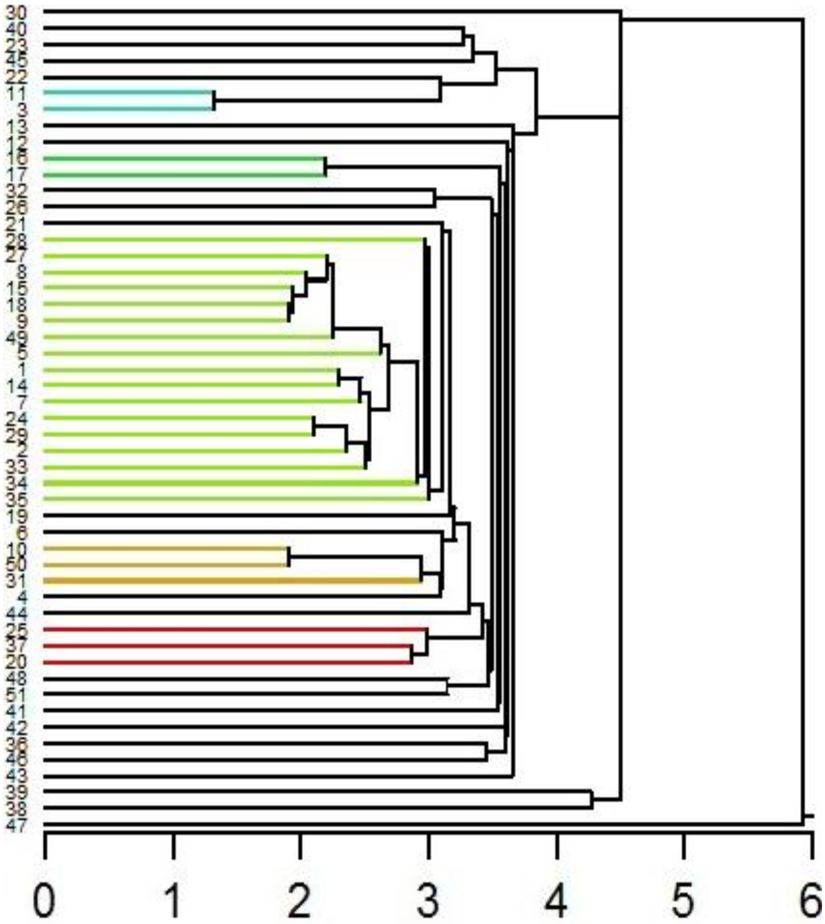


**Fig. 1.** Phenogram showing the relationships between 51 genotypes of faba bean, using distance metric of Euclidean correlation coefficient and average linkage method.

**Al-Barri and Shtaya (2013)** studied the variation among nineteen Palestinian faba bean landraces and clustered the lines into four groups based on morphological and agronomic traits.

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# تقييم بعض الصفات المورفولوجية والزراعية في تراكيب وراثية من الفول البلدي المصري

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Received 11 February, 2019, Accepted 10 March, 2019

## الموجـــــــز

أجريت هذه التجربة بمحطة البحوث الزراعية بالجميزة خلال الموسمين 2017/2016، 2018/2017. تم استخدام 50 تركيب وراثي من الفول البلدي والتي تم تجميعها بواسطة البنك القومي للجينات (من مناطق مختلفة من مصر) بالإضافة إلي الصنف التجارى جيزة716 كصنف للمقارنة. أظهرت نتائج تحليل التباين الوراثي أن الإختلافات بين التراكيب الوراثية تحت الدراسة كانت عالية المعنوية لكل الصفات المدروسة. والتي ظهرت من خلال هذه النتائج مدي التباين الواسع بين جميع التراكيب الوراثية تحت الدراسة والتي يمكن أن تساهم في برامج التربية للفول البلدي لإنتاج أصناف تجارية تتلاءم مع التغيرات المناخية، كما أظهرت نتائج التباين المظهري والوراثي وجود تباين واسع بين جميع التراكيب الوراثية تحت الدراسة وكان التأثير البيئي أقل من التأثير الوراثي في إظهار الصفات ،أظهرت نتائج درجة التوريث علي النطاق الواسع قيم عالية تراوحت من 73.92 %إلي 95.03 % والتي قد تساهم في تطوير وإنتاج أصناف جديدة من الفول البلدي عالية الإنتاج. علي الرغم من أن الصنف التجاري جيزة 716 أظهر تفوق في كثير من الصفات وخاصة صفة ميعاد التذهير وميعاد النضج إلا أن السلالة 47 أظهرت تفوق في وزن 100 بذرة ومحصول البذور للنبات بالإضافة لذلك أظهرت السلالة 39 تفوق في كل من صفتي عدد الأفرع للنبات وعدد القرون للنبات.لذلك يمكن استخدام السلالتين 47،39 فى برامج التربية لتحسين صفات المحصول ومكوناته. كما أظهرت نتائج الإرتباط المظهري وجود ثلاث عشرة قيم عالية المعنوية موجبة بالإضافة إلي أربع قيم عالية معنوية سالبة بين الصفات تحت الدراسة. أظهرت نتائج تحليل معامل المرور وجود تأثير مباشر عالي بالنسبة لصفة وزن 100 بذرة للنبات تبعه التأثير المباشر لصفة عدد البذور للنبات، وأظهرت نتائج التأثير غير المباشر بين كل من صفة عدد البذور للنبات وصفة عدد القرون للنبات أعلي القيم تبع ذلك التأثير غير المباشر بين كل من صفة عدد الأفرع للنبات ووزن 100 بذرة للنبات. أظهرت نتائج الشجرة العنقودية مدي التنوع الوراثي بين ال 51 أصل وراثي حيث تم تقسيمهم إلي مجموعتين عند مسافة 5.923 وكانت هذه التقسيمة بناءا علي البيانات المتحصل عليها من صفة وزن 100 بذرة حيث أعطت المجموعة الأولي أعلي القيم والمجموعة الثانية أقل القيم.

**الكلمات الدالة:** الفول البلدي، درجة التوريث على النطاق الواسع، التباين المظهر والوراثي، معامل الارتباط، معامل المرور، الشجرة العنقودية

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