*Egypt. J. Plant Breed. 25(1):1– 14(2021)*

# HALF- SIB FAMILY SELECTION OF SOME EGYPTIAN CLOVER POPULATIONS TO IMPROVE YIELD AND SOME OF ITS COMPONENTS

**Mofeeda A. Seiam, Shereen M. El-Nahrawy and Magda N. Rajab**
Forage Crops Res. Department, Field Crops Institute. ARC, Egypt

## ABSTRACT

***The objective of the present study was to calculate the gain from selection and compare between the base population (C0) and the best five half – sib families (5% selection intensity). Mass selection cycles C1, and C2 were evaluated for fresh forage yield and yield components.C1 significantly dominated the base population; also C2 significantly dominated C1. The realized gains after the two mass selection cycles were 25.11 , 24.42, 48.41, 72.72, 81.17, 27.46, 21.84 and 73.72% for plant height, leaf /stem ratio, No. of branches/plant, fresh forage yield, dry forage yield, seed number/head, 1000-seed weight and seed yield kg/fad (one Fadden=4200m$^2$), respectively over the base population. The results reveal that the mass selection resulted in high improvement of fresh forage yield, dry forage yield and seed yield, but low gain for plant height, leaf/stem ratio, number of branches /plant, 1000-seed weight and seed No. per head. In general, both genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) values were low for all studied traits. The values of GCV and PCV were 3.74% and 4.33% for plant height, 6.28 and 9.81% for leaf/stem ratio, 8.08% and 8.38% for No. of branches/plant, 15.39and 16.98% for fresh forage yield, 27.02 and 28.85% for dry forage yield, 11.02 and 11.04% for seed No/head, 8.52and 8.73% for 1000 seed weight and 24.81, 24.83% for seed yield /fad. The heritability estimate increased when the difference between GCV and PCV was low. High estimates of heritability in broad sense were observed for plant height, No of branches/plant, seed No /head, 1000-seed weight and seed yield kg/fad with values of 74.65%, 96.04%, 99.66%, 95.40% and 99.92% respectively. While heritability values for fresh forage yield and dry forage yield were 82.13% and 87.77%, respectively, and was medium for leaf/stem ratio (41.92%).***

Key words: **(*Trifolium alexandrinum*, L.)*, Mass selection, Seed yield, Selection cycles, Realized gains from selection, Heritability, Genotypic and phenotypic coefficient of variability.***

## INTERODUCTION

Egyptian clover is an important winter annual forage crop in Egypt. It is a legume crop and enriches soil with pronounced nitrogen fertility under the Egyptian agricultural system of intensive cropping. Also, it improves soil physical properties (Graves *et al* 1996). Mass selection is an effective method for improvement of fresh forage yield in multi-cut clover varieties (Koraiem *et al* 1980, Omara and Hussien 1982, Radwan *et al* 1983 and Younis *et al* 1986). Mass selection in multi-cut Egyptian clover varieties was successful for improving forage yield (Mikhiel, 1987). Abdel-Galil *et al* (2008) reported that the isolated selection and cross- pollination process appears to be a useful technique for developing highly efficient populations. Family selection was more beneficial than mass selection and provided higher results of 15.5% of the unselected base family mean after one selection period (Bakheit 1985).

In Egyptian clover, Ahmed (2000) estimated heritability in broad sense as 92.56 % Abdel-Galil *et al* (2008) found that fresh forage yield heritability was as high as 88.7%. Rajab (2010) estimated heritability in Egyptian clover and it was 83.93% in broad sense for most cuts. Ahmed (1992) recorded heritability for fresh yield value as 80%.

Wide genetic variation gab was observed for morphological characteristics with a forage yield (Bakheit 1989 a and b, Martinello *et al* 1992, Ahmed 2000 and 2006 a and b, Badawy 2013 and 2017 and Ahmed *et al* 2015) and any progression in a breeding program depends on the degree of the populations' genetic variation and the extent of the desirable traits heritability. Abdel-Galil *et al* (2008) recorded that considerable progress was achieved by selection in seven Egyptian clover varieties, heritability in broad sense was high for seasonal fresh and dry forage yields (88.7 and 82.3% respectively).

Bakheit (2013) calculated the influences by 4.94% and 14.38% for fresh forage yield and 13.22% for dry yield as a result of two selection cycles in Berseem. Badawy (2013) studied the effect of seed yield selection in Helaly variety fresh forage yield and found that the highest heritability estimated among traits in both half sib and $S_1$ family from 0.64 to 0.75, respectively. Abdel-Naby *et al* (2014) reported wide heritability in broad sense of Berseem at first cut in one season. They obtained (98.2%, 98.7% and 100% for fresh forage yield, dry forage yield and leaf/stem ratio).

The success of any program of selection to improve seed yield will depend on the genetic variation existing within the initial population, heritability of seed yield, the nature of correlations between seed yield and other traits, especially forage yield and the intensity of selection applied. Most of breeders have selected directly for seed yield to improve it variability in multi-cut type of berseem clover has been studied for forage yield and plant characters (Radwan and Abou-El-Fittoh 1970, Ali 1971, Bakheit 1985, Rady 2008, Badawy 2013, Abd El-Naby *et al* 2014 and Ahmed *et al* 2015). Large genetic variability has been found for seed yield and seed yield components. Recorded estimates for seed yield heritability reached 0.63 (Bakheit 1989 a), 0.97 (Ahmed 1992), 0.52 (Martiniello and Lannucci 1998a) and 0.595 (Rajab, 2010). Farid *et al* (1972) found that seed setting percentage was responsible for most of seed yield variations rather than 1000-seed weight .Phenotypic variation in seed yield amounted to 27% of obtained mean yield (Ahmed 1992),19.0% (Martiniello and Lannucci 1998b), 27.3% (Ahmed 2000) and 12.7% (Rady 2008).

The objective of the present study was to calculate the gain from selection and compare between the base population (C0) and the best five half – sib families, and calculate genetic variance, heritability and phenotypic correlation in order to improve the population's productivity.

## MATERIALS AND METHODS

This investigation was conducted at Nubaria Research Station during three successive seasons from 2016/2017 to 2018/2019. Random seed samples of one hundred and ten farmer's seed lots of multi cuts of berseem populations collected from some Governorates of Egypt was established as a base population in a breeding program to develop new forage berseem varieties in Egypt.

**First growing season 2016/2017:-**

Equal quantities of the seeds of the 110 farmer's lots were taken and mixed together and then planted in an isolated place to form the base population (C0).

The first season experiment was laid out in a randomized complete blocks design with 3 replicates. The plot size was 2x2m. Seeds were drilled in 20cm apart with seeding rate of 20 kg/fad$^{-1}$. All cultural practices were done according to the optimum levels for maximum production and performance of berseem growing in the location. Four cuts were taken during each growing season. At flowering, 16 populations with overall visual characters were selected. The best plants in each plot for seed yield/plant (300 plants = 5% selection intensity) were selected as parents to produce the next cycle. Those plants were left for open pollination setting. Seeds were harvested from each selected population separately and equal parts were mixed to form bulk of the first cycle of family selection (C1).

**Second growing season 2017/2018:**

The selected populations (16 populations) and the check cultivar (Gemmeiza-1) were grown in a randomized complete block design with 4 replications. Plot size was 2x2m and seeds were drilled in 20 cm apart with a seeding rate of 20 kg/fad.$^{-1}$ four cuts were obtained. Five populations were visually selected and random matted. The best plants in each plot for seed yield/plant (300 plants = 5% selection intensity) were selected as parents to produce the next cycle. Seeds were harvested from each selected population separately and equal parts were mixed to form bulk of the second cycle of family selection ($C_2$).

**Third growing season 2018/2019:**

The selected bulk population (C2) was evaluated against the selected population (C1), the original (base) population and the five promising families with the check cultivar Gemmeiza-1 for forage yield and yield components at Nubaria Agric. Research Station during 2018/2019 growing winter season. The experiment was arranged in randomized complete blocks design with four replicates. Plot size was 3m x 4m. The first cut was taken after 50 day from sowing date and the followed 3 cuts were taken at 30 days cut interval. Fresh forage yield, dry forage yield, plant height, number of branches/plant, number of seeds/head and 1000-seed weight were determined. A statistical analysis for all the studied traits was performed according to El-Nakhlawy (2010) using ANOVA procedure of SAS Software (2014) then the differences between the means were tested for significance using LSD test at 0.05 level of probability.

The realized gains from selection was measured as the deviation percentage of the overall cycle mean from the base population (Falconer 1989) as follows:

Realized gain (%) relative to base population = $[(C_1 \text{ or } C_2 - C_0)/C_0] \times 100$.

The phenotypic and genotypic variances for the studied traits were estimated by the method suggested by Al-Jibouri *et al* (1958).

The genotypic coefficient of variability (GCV) and phenotypic coefficient of variability (PCV) were measured according to Burton (1952) as follows:

$$\text{G.C.V.} = (\sigma_G / \text{grand mean}) \times 100$$

$$\text{P.C.V.} = (\sigma_p / \text{grand mean}) \times 100$$

Where; $\sigma_G$: represents genetic standard deviation.

$\sigma_p$ : represents the phenotypic standard deviation

Heritability in broad sense was determined according to Falconer and Mackawy, (1996) as follows;

$$H = \sigma^2_G / \sigma^2_p \times 100$$

Where: $\sigma^2_G$ is genotypic variance and $\sigma^2_p$ is phenotypic variance.

## RESULTS AND DISCUSSION

Table (1) showed that highly significant differences were observed among the selection cycles in the analysis of variance for plant height, leaf/stem ratio, No of branches/plant, fresh forage yield, dry forage yield, seed No/head, seed yield kg/fad and 1000- seed weight. Highly Significant differences were detected between the base population and the two cycles of mass selection for all studied traits. Highly significant differences were also shown between population of C2 and C1, for No of branches/plant, seed No/head and seed yield kg/fad. On the other hand, non- significant differences were observed for plant height, and 1000-seed weight. This indicates that characters showing significant variations are considered as quantitative traits (used in designing a breeding strategy for the improvement of Berseem crop). This is in harmony with that reported by Abou El-Shawareb (1971), Bakheit (1989 b), Ahmed (2000), Ahmed (2006 a) and Bakheit *et al* (2007).

**Table 1. Analysis of variance of plant height, leaf/stem ratio, No of branches/plant, fresh and dry forage yield, seed No /head, 1000- seed weight and seed yield/of the base population, first (C1) and second (C1) cycles of mass selection of berseem.**

| SOV | df | MS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Plant height | Leaf/ stem ratio | No of branches/ plant | Fresh forage yield | Dry forage yield | Seed No/head | 1000- Seed weight | Seed yield Kg/fad |
| Replicates | 3 | 9.778 | 0.00020 | 0.0099 | 0.498 | 0.0271 | 0.1558 | 0.1177 | 3.205 |
| Among cycles | 2 | 61.75** | 0.0201** | 1.489** | 29.26** | 1.011** | 87.030** | 0.813* | 47762.59** |
| Base vs cycle | 1 | 108.37** | 0.040** | 2.312** | 46.76** | 1.511** | 172.53** | 1.440** | 92994.04** |
| C1 vs C2 | 1 | 15.125NS | 0.0002** | 0.667** | 11.76** | 0.511** | 1.522** | 0.186NS | 2531.16** |
| Error | 6 | 9.527 | 0.00005 | 0.0045 | 0.486 | 0.042 | 0.046 | 0.134 | 5.713 |

**Ns: not significant at p ≤ 0.05. *, **: significant at p≤ 0.05 and p ≤0.01, respectively.**

Table (2) showed the means of plant height, leaf/stem ratio, No of branches/plant, fresh forage yield, dry forage yield, seed yield, seed No./head and 1000-seed weight of the base population and selected cycles grown together under the same field conditions. Means of both the C1 and C2 cycles for all studied berseem traits were significantly greater than the base population (C0). Means of the C2 cycle were significantly higher than those of the C1 for No of branches/plant, seeds No/head and seed yield kg/fad, leaf/stem ratio, fresh forage yield and dry forage yield. The results indicated the positive effect of selection to improve berseem forage yield. The highest mean value for plant height was observed for C2 with value of 68.50 cm. Fresh forage yield was increased by selection and the highest value was 12.825kg/$m^2$ for second cycle selection (C2). Also for dry forage yield, the highest value was 2.23kg/$m^2$ for C2 .Also seed No/head, 1000-seed weight and seed yield, showed the same trend.

**Table 2. Means of plant height, leaf/stem, No of branches/plant, fresh and dry forage yield, seed No /head, 1000-seed weight and seed yield/of the base population, first (C1) and second (C2) cycles of mass selection of berseem.**

| Character | Plant height (cm) | Leaf/stem ratio | No of branches/ plant | Fresh forage yield (kg/m2) | Dry forage yield (kg/m2) | Seed No/ head | 1000 Seed weight (g) | Seed yield kg/fad |
|---|---|---|---|---|---|---|---|---|
| Base population (C0) | 54.75 | 0.520 | 2.520 | 7.425 | 1.229 | 30.882 | 4.060 | 277.413 |
| First cycle of selection (C1) | 65.75 | 0.637 | 3.162 | 10.400 | 1.729 | 38.490 | 4.642 | 446.368 |
| Second cycle of selection (C2) | 68.50 | 0.647 | 3.740 | 12.825 | 2.234 | 39.362 | 4.947 | 481.943 |
| LSD: (0.05) | 5.34 | 0.012 | 0.117 | 1.206 | 0.354 | 0.373 | 0.634 | 4.135 |

Table (3) showed the realized gains from selection estimated as the percentage deviation of the mean of the base population. The results reveal that direct selection was effective in improving the studied/traits after the second cycle of mass selection by 25.11% for plant height, 24.42% for leaf/stem ratio, 48.41% for No of branches /plant, 72.72% for fresh forage yield, 81.17% for dry forage yield, 27.46% for seed No/head, 21.84 for 100 seed weight and 73.72%for seed yield kg/fad. However, the realized gain from selection after C1 were 20.09, 22.50, 25.47, 40.06, 40.68, 24.63, 14.33 and 60.90% for the previous traits, respectively. This result is in agreement with Bakheit (1989a) and Martiniello and Lannucci (1998a) discussed that the response of berseem to selection was mainly directed for high yield expression.

**Table 3. Realized gain from two cycles of mass selection for plant height, leaf/stem ratio, No of branches/plant, fresh forage yield, dry forage yield, seed No /head, 1000- seed weight and seed yield kg/fad in the two cycles of selection measured in percentage relative to base population.**

| Base pop. | Cycle of selection | Plant height (cm) | Leaf/ stem ratio | No. of branches/ plant | Fresh forage yield (kg/m$^2$) | Dry forage yield (kg/m$^2$) | Seed No/ head | 1000- Seed weight | Seed yield kg/fad |
|---|---|---|---|---|---|---|---|---|---|
| C0 | C1 | 20.09 | 22.50 | 25.47 | 40.06 | 40.68 | 24.63 | 14.33 | 60.90 |
| | C2 | 25.11 | 24.42 | 48.41 | 72.72 | 81.17 | 27.46 | 21.84 | 73.72 |

Table 4 showed highly significant differences among families at P> 6.01 for all the studied traits. Also the differences between the five selected families and the base population were significant at P> 0.01.Significant differences at P≤ 0.01 were found among the selected five families concerning all the studied traits.

**Table 4. Analysis of variance of plant height, leaf/stem, No of branches/plant, fresh and dry forage yield, seed No/head, 1000- seed weight and seed yield for the base population, C1, C2, five selected families and the check cultivar of berseem.**

| SOV | df | MS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Plant height | Leaf/ stem ratio | No. of branches/ plant | Fresh forage yield | Dry forage yield | Seed No/head | 1000- Seed weight | Seed yield |
| Replicates | 3 | 142.76 | 0.0004 | 0.005 | 0.732 | 0.0209 | 0.308 | 0.124 | 26.175 |
| Genotypes | 8 | 58.375** | 0.0088** | 0.520** | 19.660** | 0.835** | 57.298** | 0.546** | 30431.87** |
| Base vs selected families | 1 | 210.67** | 0.009** | 1.386** | 29.601** | 1.282** | 57.796** | 0.756** | 14695.86** |
| check vs selected families | 1 | 203.01* | 0.006** | 1.075** | 21.41** | 1.160** | 30.876** | 0.189** | 13218.03** |
| Between selected families | 4 | 33.175** | 0.0053** | 0.294** | 12.494** | 1.138** | 62.407** | 0.638** | 29146.38** |
| Error (Genotypes) | 24 | 17.97 | 0.00005 | 0.0086 | 2.967 | 0.096 | 0.141 | 0.054 | 15.05 |
| Error (selected families) | 12 | 8.408 | 0.00007 | 0.0119 | 2.234 | 0.139 | 0.212 | 0.031 | 21.983 |

***, **: significant at p≤ 0.05 and p ≤0.01, respectively.**

Table (5) presented the means of all studied traits for base population and the selected families. Regarding plant height, mean values ranged from 70.25 to 62.50 cm for H.S families Compared with 54.75 cm for base population. Significant differences were detected among the five H.S. families and the base population. All the H.S were taller than the base population. Considering leaf/stem ratio, it ranged from 0.630 to 0.540 for the H.S families compared with 0.520 for base population for their more, five H.S families were significantly higher than the base population after one cycle of family selection. Regarding No of branches/ plant, mean values ranged from 3.455 to 3.050 for H.S families compared with 2.520 for base population. As for fresh forage yield, it ranged from 9.40 to 12.375 kg/ $m^2$. Five families were significantly higher than the base population. 7.430 kg/ $m^2$ in fresh forage yield. Dry forage yield ranged from 1.584 to 2.046 kg/ $m^2$ for family G.5 and five families were significantly higher than the base population at 1.229 kg/ $m^2$.

**Table 5. Means of plant height, leaf/stem ratio, No of branches/plant, fresh and dry forage yield, seed No /head, 1000- seed weight and seed yield kg/fad for the base population, C1, C2, five selected families and the check cultivar of berseem.**

| Genotype | Plant height (cm) | Leaf/ stem ratio | No of branches/ plant | Fresh forage yield ($kg/m^2$) | Dry forage yield ($kg/m^2$) | Seed No/head | 1000- seed weight (g) | Seed yield (kg/fad) |
|---|---|---|---|---|---|---|---|---|
| G.1 | 70.25 | 0.630 | 3.455 | 12.375 | 2.004 | 38.165 | 5.202 | 435.355 |
| G.2 | 65.25 | 0.540 | 3.307 | 9.850 | 1.777 | 40.030 | 4.585 | 436.423 |
| G.3 | 62.50 | 0.580 | 3.050 | 10.525 | 1.834 | 30.815 | 4.395 | 261.313 |
| G.4 | 66.50 | 0.580 | 3.257 | 9.40 | 1.584 | 34.200 | 4.315 | 303.378 |
| G.5 | 67.75 | 0.617 | 3.117 | 10.875 | 2.046 | 38.090 | 4.185 | 282.588 |
| Check cultivar | 58.50 | 0.542 | 2.755 | 9.600 | 1.780 | 32.017 | 4.775 | 406.783 |
| C2 | 68.50 | 0.647 | 3.74 | 12.325 | 2.234 | 39.360 | 4.947 | 481.943 |
| C1 | 65.75 | 0.637 | 3.162 | 10.40 | 1.729 | 38.490 | 4.642 | 446.368 |
| Base Pop.(C0) | 54.75 | 0.520 | 2.520 | 7.430 | 1.229 | 30.883 | 4.060 | 277.413 |
| LSD (0.05) | 6.187 | 0.011 | 0.135 | 2.514 | 0.453 | 0.549 | 0.340 | 5.672 |

Estimates of the genetic parameters for all the studied traits. Table 6 showed that the GCV and PCV values were 3.74% and 4.33% for plant height, 6.281 and 9.81% for leaf/stem ratio, 8.38% and 8.08% for No of branches/plant, 15.39 and 16.98% for fresh forage yield, 27.02% and 28.85% for dry forage yield, 11.02 and 11.04% for seed No/head, 8.52%

and 8.73% for 1000-seed weight and 24.81% and 24.83% for seed yield, respectively. Broad-sense heritability values were high for plant height, No of branches/plant, fresh forage yield, dry forage yield, seed No/head, 1000 seed weight and seed yield with values of 74.65%, 96.04%, 82.13%, 87.77% , 99.66%,95.45% and 99.92% respectively. But it was of medium value for leaf/stem ratio with value of 41.92%. Similar results were reported by Farid *et al* (1972) who detected large figures of variability for seed yield. They added that seed setting percentage was responsible for most of seed yield variations rather than 1000 seed weight. Ahmed (1992) pointed out that phenotypic differences among berseem entries in seed yield amounted to 30.31 and 27% of obtained mean yield for the first, second season and combined yield. Ahmed (2000) revealed that, phenotypic coefficient of variation for seed yield was 27.32%. El-Nahrawy (2007), reached that PCV for yield across seasons was high. Rady (2008) showed a (PCV) for seed yield as 12.7%. Rajab (2010) recorded the highest (PCV) values for seed yield followed by number of seed inflorescence$^{-1}$. Rady (2008) found the lowest significant PCV values for seeds per inflorescence in Saidi and Meskawi populations, which were insignificantly different (37.13 and 41.6% seed head$^{-1}$, respectively).

Malengier and Baer (2007) estimated heritability of seed yield in red clover. Estimates were high amounted to 82% in the first season. Bakheit (1989a) estimated broad sense heritability for seed yield of berseem clover from variance components as 63.03%. Ahmed (1992) reached an estimate of 97% for seed yield of berseem. Rajab (2010) estimated heritability in broad-sense for seed yield as 96%.

Genetic gain from selection of the top 20% of half-sib families in all studied populations was parallel to what noticed with 10% selection intensity with the advantage of keeping larger variability that enable successive cycles of selection. Abou-El-Shawareb (1971) obtained a gain from selection reached 19.9 to 29.0% in seed yield of Meskawi berseem clover. Bakheit (1989a) recorded a realized gain in seed yield from selection amounted to 17.47%. Ahmed (2000), obtained a realized gain in seed yield of berseem of 8.55% from index selection. Ahmed (2006a) obtained a lowest gain from selection in seed yield when half-sib families were evaluated. Bakheit *et al* (2007) recorded a realized gain in seed yield of berseem ranging between 13.59 and 18.45%. Commonly, the genetic coefficient of variability is a measure of relative genetic variation. Breeders can't rely on such measure alone, because it is a function of both genetic variation and population mean.

**Table (6) Phenotypic (σ2Ph) and genotypic variance (σ2G), phenotypic (PCV%) and genotypic coefficients of variability (GCV%), Heritability(H%) , for various traits of berseem genotypes.**

| Genetic parameter | Plant height (cm) | Leaf/ stem ratio | No. of branches/ plant | Fresh forage yield | Dry forage yield | Seed No. /head | 1000 Seed weight | Seed yield kg/fad |
|---|---|---|---|---|---|---|---|---|
| $\sigma^2_G$ | 6.191 | 0.0013 | 0.0705 | 2.565 | 0.249 | 15.548 | 0.151 | 7281.099 |
| $\sigma^2_{Ph}$ | 8.293 | 0.0031 | 0.0734 | 3.123 | 0.284 | 15.601 | 0.159 | 7286.59 |
| GCV (%) | 3.74 | 6.281 | 8.38 | 15.39 | 27.02 | 11.02 | 8.52 | 24.81 |
| PCV (%) | 4.33 | 9.81 | 8.08 | 16.98 | 28.85 | 11.04 | 8.73 | 24.83 |
| H (%) | 74.65 | 41.92 | 96.04 | 82.13 | 87.77 | 99.66 | 95.40 | 99.92 |

Table (7) showed significant correlation coefficients among studies traits. Positive correlations between all studied traits suggested the possibility of developing new improved cultivars of berseem that means inherent relationship between all the traits. This is in agreement with Schaaf *et al* (1962), El-hattab *et al* (1969), Bakheit(1989a), and Ahmed (2006b). Bakheit (1985) applied mass and family selection for improving seed-yield of single-cut berseem. He reported a weak correlation between seed and both of fresh and dry forage yields. Martiniello and Lannucci (1998a) recorded that half-sib selection for seed yield was correlated with an improvement in dry matter. Ahmed (2006 a) postulated a correlated response in fresh and dry forage yield and leaves/stem ratio when practiced recurrent selection for protein yield. Bakheit *et al* (2007) recorded positive responses to selection in seed yield, fresh and dry forage yield. They added that all traits were positively correlated. Abdalla *et al* (2009) concluded that seed yield improvement was correlated with an improvement in vegetative growth and forage yield. Abdalla and Abd El-Naby (2012) through discussion to the relation between seed setting potentiality and pollination pattern, they suggested the possibility of developing new improved cultivars of berseem that have high seed and forage yield. Ahmed and Rady (2016) reported that green and dry forage yields in berseem were positively and strongly correlated.

**Table 7. Correlation coefficients among different forage yield traits.**

| | Plant height (cm) | Leaf/ stem ratio | No of branches/ plant | Fresh forage yield (kg/m2) | Dry forage yield (kgm2) | Seed No/ head | 1000-Seed weight (g) | Seed yield kg/fad |
|---|---|---|---|---|---|---|---|---|
| **Plant height** | **1.000** | **0.816**** | **0.903**** | **0.846**** | **0.757**** | **0.786**** | **0.511*** | **0.415** |
| **Leaf/stem ratio** | | **1.000** | **0.742**** | **0.843**** | **0.736**** | **0.608**** | **0.497** | **0.407** |
| **No of branches /plant** | | | **1.000** | **0.843**** | **0.774**** | **0.765**** | **0.620**** | **0.586**** |
| **fresh forage yield** | | | | **1.000** | **0.936**** | **0.626**** | **0.747**** | **0.532**** |
| **Dry forage Yield** | | | | | **1.000** | **0.612**** | **0.617**** | **0.476** |
| **Seed no. /head** | | | | | | **1.000** | **0.467** | **0.683**** |
| **1000 Seed weight** | | | | | | | **1.000** | **0.831**** |
| **Seed yield** | | | | | | | | **1.000** |

***, **: significant at $p \leq 0.05$ and $p \leq 0.01$, respectively.**

## REFERENCES

**Abdalla, M.M.F and Z.M. Abd EL- Naby (2012).** Inbreeding and fertility in Egyption clover, (*Trifolium alexandrinum*, L.). J. Phamacognosy phytotherpay, 4: 16-25.

**Abdalla, M.M.F., A. A. Moballah, M. S. Radwan, A. M. Soliman, A. R. Rammah and Z.M. Abd El- Naby (2009).** Inbreeding and fertility in Egyptian clover, (*Trifolium alexandrinum*, L.). 2. Proceedings of the forage yield of high self- fertility selection 9th international plant breeding conference, May 3- 5, 2009, Ismailia, Egypt, PP: 484-513.

**Abdel-Galil, M.M., A. Helmy and N.M. Hamed (2008).** Developing a synthetic Population through selection in Egyptian clover genotypes (*Triflium alexandrinum*, L.). J. Agric. Sci., Mansoura Univ., 33:983-989.

**Abd El-Naby, Zeinab. M, Shafie, W. M. Wafaa and M. A. El- Nahrawy (2014).** Genetic analysis and maternal effects in barseem clover. Life. Sci. J.11: 407-418.

**Abou El-Shawareb, O. (1971).** Comparative efficiency of mass and recurrent selection breeding methods in the improvement of Egyptian "Berseem" (*Trifolium alexandrinum* , L.) Ph.D., Faculty of Agric, Cairo Univ., Egypt.

**Ahmed, M. Abd El-Sattar(1992).** Improvement of berseem clover (Trifolium *alexandrinum* , L.) by different methods of selection. Ph.D. Dissertation, Faculty of Agriculture, Alexandria University, Egypt.

**Ahmed, M. Abd El-Sattar (2000).** Comparison of single trait with multiple trait selection in berseem clover (*Trifolium alexandrinum*, L.). J. Agric, Sci. 25(8):4601-4613.

**Ahmed, M. Abd El-Sattar (2006a).** Response to three methods of recurrent selection in a Khadarawi berseem (*Trifolium alexandrinum*, L.) population. Alex. J. Agric. Res. 51(3):1323.

**Ahmed, M. Abd El-Sattar (2006b).** Variability, correlations and path-coefficient analysis in two populations of multi-cut Barseem clover. Alex. J. Agric. Res., 51 (2): 63-72.

**Ahmed ,M. Abd EL-Sattar and Asmaa M. S. Rady (2016).** Response to one cycle of half- sib family selection for crown size in barseem clover "*Trifolium alexandrinum*, L". Egypt. J. Plant Breed. 20 (4):222 -236.

**Ahmed, M. Abd El-Sattar, M. N. Barakat, and A. M. S. Rady (2015)**. Genotypic variation in Egyptian gene pool of berseem clover (*Trifolium aexandrinum*,L.). Egypt .J. Plant. Breed. 19 (3): 307-326.

**Ali, F.M. (1971).**The effect of mass selection on forage yield and related traits in barseem clover (*Trifolium alexandrinum*, L.). M.Sc. Thesis,Cairo Univ., Giza, Egypt.

**Al-Jibouri, H.A., P.A. Miller & H.F. Robinson. (1958).** Genotypic and environmental variances and covariance in an upland cotton cross of interspecific origin. Agron. J. 50: 633-636.

**Badawy, A. S. M. (2013)**.Recurrent selection for seed yield in barseem clover. Ph.D. Helaly Thesis. Fac .Agric. Alex. Univ., Egypt.

**Badawy, A. S. M., (2017).** Variability and potentiality of selection among farmers seed lots of barseem clover "*Trifolium alexandrinum*, L.". Alex. J. Agric Sci., 62(6): 469-476.

**Bakheit, B. R. (1985).** Effect of mass and family selection on productivity of Egyptian clover (*Trifolium alexandrinum*, L.). Assuit J. Agric. Sci. 16, 35-46.

**Bakheit, B.R. (1989a).** The effect of recurrent selection and performance of seed synthetics in berseem clover (*Trifolium alexandrinum* L.). Assiut J. Agric. Sci., 20 (1): 189-198.

**Bakheit, B.R. (1989b).** Selection for seed yield production of Egyptian clover (*Trifolium alexandrinum* L.) C.V. Fahl. Plant Breeding, 103: 278-285.

**Bakheit, B.R. (2013).** Egyptian clover (*Trifolium alexandrinum* L.) Breeding inEgypt: A Review. Asian J. of Crop Sci., 5: 325-337.

**Bakheit, B.R.; M.A. Ali and A.M. Abo El-Wafa (2007).** The efficiency of selection for seed yield in Fahl variety of Egyptian (berseem) clover, *Trifolium alexandrinum,* L. J. Agric. Sci., Mansoura Univ., 32(1):1-19

**Burton, G.W. (1952).** Quantitative inheritance in grasses. Proc. 6th Int. Grassland congr.1: 277283.

**El-Hattab, H., M.S. Radwan and A.M. Rammah (1969)**. Phenotypic variability and interrelations among characters of berseem (*Trifolium alexandrinum* L.). Proceedings of the 6th Arab Science Congress, (ASC'69), Damascus, pp: 209- 219.

**El-Nahrawy, S.M.A. (2007).** Estimates of phenotypic and genotypic variances for forage and seed yields in some cultivars of berseem clover (*Trifolium alexandrinum,* L.) under two locations. M.Sc. Thesis, Dept. Agronomy, Fac. Agric. Kafr El-Sheikh Univ., Egypt.

**El-Nakhlawy, F.S. (2010).** Experimental Design and Analysis in the Scientific Research. Sci. Pub. Center, King Abdulaziz University, Jeddah, Saudi Arabia.

**Falconer, D.S., (1989).** Introduction to Quantitative Genetics. 3rd Edn., Longman Scientific and Technical, New York, USA Pages: 438.

**Falconer, D. S., and T. F. C. Mackay (1996).** Introduction to Quantita-tive Genetics, Ed 4. Longmans Green, Harlow, Essex, UK. essentially defined the subject. He will be greatly missed. Falconer, D. S., I. K. Gauld, R. C. Roberts and D. A. Wil

**Falconer, D. S., and T. F. C. Mackay (1996).** Introduction to Quantitative Genetics, Ed 4. Longmans Green, Harlow, Essex, UK. essentially defined the subject. He will be greatly missed. Falconer, D. S., I. K. Gauld, R. C. Roberts and D. A. Wil

**Falconer, D. S., and T. F. C. Mackay (1996).** Introduction to Quantitative Genetics, Ed 4. Longmans Green, Harlow, Essex, UK.

**Farid, N.I.; L.F. Tanash and A.M. Moustafa (1972).** Comparative study of some imported varieties of "*Trifolium alexandrinum*, L.", compared with the local variety Giza-1 and the effect of number of cuttings on their seed yield. Agric. Res .Rev. 50: 89-106.

**Graves, W.L., W.A. Williams and C.D. Thomsen (1996)**. Berseem clover: A Winter annual forage for California agriculture. University of California Division of Agriculture and Natural Resources, Publication No. 21536, pp: 12.

**Koraiem, Y.S., M.M. Habib, M.M. El-Rouby and M.T.H. Hassan (1980).** Selection in berseem clover (*Trifolium alexandrinum* L.). Alex. J. Agric. Res., 28: 455-462.

**Malengier, M.and J. Baer (2007).** Heritability of seed yielding capacity in tetraploid red clover (*Trifolium pratense*,L.). 27th EUCARPIA Symposium on Improvement of Fodder Crops and Amenity Grasses Kopenhagen.Denmark, P21 (Abstract).

**Martiniello, P. and A. Lannucci (1998a)**. Genetic variability in herbage and seed yield in selected half–sib families of berseem clover (*Trifolium alexandrinum*, L.). Plant Breeding 117:559-562.

**Martiniello, P. and A. Lannucci (1998b).** Analysis of seed yield components in four Mediterranean annual clovers. Field Crops Research, 55 (3): 235-243.

**Martiniello, P., G. de Santis and A. Iannucci (1992**). Phenotypic variability for bio-agronomical traits in berseem (*Trifolium alexandrinum* L.) populations of the Meskawi botanical group. Plant Breed., 108: 338-341.

**Mikhiel, G.S., (1987).** Studies on forage crops imrpovements. Ph.D. Thesis, Faculty of Agriculture, Alexandria University, Egypt.

**Omara, M.K. and M.Y. Hussein (1982).** Selection for productivity of green material in berseem clover (*Trifolum alexandrinum* L.). Assiut J. Agric. Sci., 13: 105-116.

**Rady, A.M.S. (2008).** Estimation of morphological and genetic variations in barseem clover gene pool. M.Sc. Thesis in Crop Sci, Fac. Agric.Alex. Univ. Egypt.

**Radwan, M.S.and H.A. Abou-El-Fittoh (1970).** Evaluation of berseem clover varieties in field versus nursery plots. Contemporary Agriculture 6: 515-519.

**Radwan, M.S., R. Shabana, A.M. Rammah and M.A. El-Nehrawy (1983)**. Variability and combining ability estimates in farmers seed lots of Egyptian clover (*Trifolium alexandrinum* L.). Proceedings of the 1st Conference on Agriculture Botany Science, April 27-28, 1983, Mansoura University, Egypt, 86-105.

**Rajab, M.N. (2010).** Studies on breeding of Egyptian clover (*Trifolium alexandrinum*, L.). Ph.D. Dissertation, Fac. Agric. Minia Univ., Egypt.

**SAS (2014).** SAS: Business analytics and business intelligence software. SAS Inst. http://www.sas.com/en_us/home.html (accessed 30 Sept. 2014).

**Schaaf, H.M., G.A. Rogler and R.J. Lorenz (1962)**. Importance of variations in forage yield, seed yield and seed weight to the improvement of crested wheatgrass. Crop Sci., 2: 67-71.

**Younis, A.A., A.M. Rammah and F.M. Ali (1986).** Efficiency of visual selection under competition conditions in five populations of berseem clover (*Trifolium alexandrinum* L.) on forage yield. Proceedings of the 2nd Egyptian Conference of Agronomy, (ECA`86), Alexandria, 773-788.

# أنتخاب عائلات أنصاف الأشقاء لبعض عشائر البرسيم المصرى لتحسين المحصول و بعض مكوناتة

**مفيدة عبد القادر صيام, شيرين محمد ابو زيد النحراوى و ماجده نادي رجب**

قسم بحوث العلف –معهد المحاصيل الحقلية – مركز البحوث الزراعية

***الهدف من الدراسة هو حساب العائد من الأنتخاب والمقارنة بين العشيرة الاصلية و العائلات أنصاف الأشقاء لأفضل خمس عائلات (5٪ كثافة الأنتخاب). تم تقييم دورات الانتخاب الاجمالى C1 و C2 لمحصول العلف الاخضر ومكوناته. تفوقت العشيرة C2 على العشيرة C1 التى تفوقت بشكل كبير على العشيرةالأصلية C0. كان العائد المحقق بعد دورتي من الانتخاب الكلى 25.11، 24.42، 48.41، 72.72، 81.17 ، 27.46 ، 21.84 و 73.72٪ لارتفاع النبات، نسبة الأوراق/الساق، عدد الفروع/النبات، محصول العلف، محصول العلف الجاف، عدد البذور/رأس، وزن 1000 بذرة ومحصول البذور كجم/فدان على التوالي بالنسبة للعشيرة الأصليه، تشير النتائج إلى أن الأنتخاب الأجمالى أدى إلى تحسين ارتفاع محصول العلف الطازج، وحاصل العلف الجاف وحاصل البذور، ولكن بالنسبة لأرتفاع النبات، ونسبة الأوراق/الساق، وعدد الأفرع/نبات، ووزن 1000 بذرة و عدد البذور/رأس كان التحسين منخفض و بشكل عام كانت قيم كل من معامل التباين الوراثي ومعامل التباين المظهرى منخفضة في جميع الصفات المدروسة .كانت قيم معامل التباين الوراثي ومعامل التباين المظهرى 3.74٪ و 4.33٪ لارتفاع النبات، و 6.28 و9.81 ٪ لنسبة الأوراق/الساق ، و8.08 ٪ و8.38 ٪ لعدد الأفرع/النبات ، 15.39و 16.98 ٪ لحاصل العلف الطازج ، 27.02 و28.85 ٪ لمحصول العلف الجاف، 11.02 و11.04٪ لعدد ا لبذور/رأس، 8.52. و8.73 ٪ لوزن 1000 بذرة و 24.81 ،24.83٪ لمحصول البذور/ فدان . زاد تقدير كفاءة التوريث عندما كانت الفروق بين GCV و PCV أقل القيم التقديرية العالية للتوريث بالمعنى الواسع لارتفاع النبات، عدد الأفرع/نبات، عدد البذور االرأس، وزن 1000 بذرة ومحصول البذرة كجم/فدان بقيم 74.65 ٪، 96.04٪، 99.66٪، 95.40٪ و 99.92٪ على التوالي. بينما كانت لصفة المحصول العلف الطازج و محصول العلف الجاف 82.13٪ و 87.77٪ على التوالي. ومتوسطة لصفة نسبة الأوراق/الساق (41.92٪).***

***المجلة المصرية لتربية النبات ٢٥(١): ١ - ١٤ (٢٠٢١)***