J. Agric. Chem. and Biotechn., Mansoura Univ. Vol. 9(12): 295 - 301, 2018

Genetic Variability and Path- Coefficient Analysis for Forage Yield and its Components in Egyptian Clover

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ABSTRACT

Thirteen populations of Egyptian clover had evaluated. Eight promising populations selected for high forage yield and five varieties were evaluated for forage yield and its components at Sakha Agricultural Research Station across two growing seasons 2015/2016 and 2016/2017. Genetic variance, phenotypic variance, heritability in broad sense, genotypic and phenotypic coefficient of variability were studied. The results from the combined analysis of two seasons showed that Helaly variety recorded the highest of total fresh yield, total dry yield, mean plant height and mean No. of stems ($0.25m^2$) whereas (107.39 kg/plot, 2.87 kg/plot, 74.2cm. and 251.56). Heritability was high for all traits studied. Fresh forage yield was highly significance (92.9%) followed by No. of stems (86.2%). Positive correlation was obtained between dry forage yield and No. of stems (0.956 and 0.992). Also, between dry forage yield and No. of stems (0.938) and fresh leaf/stem ratio with dry leaf stem ratio (0.996). Path-coefficient analysis revealed that No. of stems had the highest positive direct effect on fresh forage yield (dependent) (0.956), followed by dry leaf/stem ratio (0.867) and plant height (0.13) independents.

Keywords: Egyptian clover, Genotypic and Phenotypic variance, Heritability, Genotypic and Phenotypic coefficient of variability, Correlation and Path-coefficient analysis.

INTRODUCTION

Egyptian clover (*Trifolium alexandrinum,* l.) is an annual winter forage crop with good productivity, is well adapted to a wide range of environments Mediterranean basin, southern U S A, Pakistan and India for grassing and hay production Singh 1994. It is may be called " king" of fodder crops in Egypt due to its wider acceptance, multi-cuts nature, faster regrowth, higher fodder yield and better nutritional quality. The fodder is very succulent, palatable and is available for a fairly longer period during winter about 5-6 cuts per season. The fresh fodder can be utilized for making good quality hay Knight 1985.

Berseem clover improve significantly soil fertility by fixing atmospheric nitrogen, conservation crop, catch crop and minimize the use of in-organic nitrogen fertilizers contributing to a sustainable and environmentally friendly agriculture in the region Graves *et al*. 1987.

It is know that it is tolerant to annual precipitation between 380 mm and 1.660 mm, annual mean temperatures between 7.0 ºC and 26.7 ºC and soil pH ranging from 4.9 to 7.8 (Duke 1981).

A survey of Egyptian clover cultivation showed widespread use of the crop in the agriculture of middle – eastern countries, mainly Egypt (Martiniello and Ciola 1995). In Egypt berseem is grown through the winter season from (early October to May) for forage production and at the end of the season (late April and early May), seed crops sometimes taken (El- Nahrawy *et al*. 1997).

Large genetic variability has been found for morphological traits with forage (Bakheit 1985 and 1989, Martiniello 1992, Ahmed 2000, 2006, and Badawy 2013 and 2017).

Younis *et al*. (1986) showed that synthetic -79 was slightly higher than the evaluated populations of berseem for total green yield in several locations in two seasons. Chaudhary *et al* (1991) indicated that stimulation of any particular yield component was due to positive contribution of a combination of yield components like number of tillers and number of leaves per plant along with plant height. Avtar *et al*. (2007) evaluated ten different traits in berseem including; plant height, tillers per plant and leaves per plant to achieving higher yields.

Variability in multi-cut type of berseem has been studied for forage yield and plant traits (Radwan and Abou-El Fittoh 1970; Ali 1971 ; El-Nahrawy, 1980; Bakheit, 1985; Mahdy,1988; Rady,2008; Badawy, 2013 ; Abd El- Naby *et al*., 2014 and Ahmed *et al*., 2015).

Any progress in a breeding programme depends on the magnitude of genetic variability in the population and the extent of heritability of the desirable traits.. USHA, (2006) reported that High heritability coupled with high genetic advance indicates the expected effectiveness of selection for the traits under consideration.

Bakheit (1986), estimated heritability in broad – sense in Egyptian clover as high reached 78 and 81 % at Alexandria and Nubaria, respectively . Ahmed (2000) estimated heritability in broad sense as 92.56 % for total green forage yield in barseem. Abd El-Galil *et al* (2008) found that heritability in broad sense for seasonal fresh yield was high as 88.7% . Rajab (2010) estimated heritability in broad sense in Egyptian clover was 83.93% for fresh forage yield. Ahmed (1992) found heritability for fresh forage yield as 80% for most cutting. Badawy (2013) studied recurrent selection for seed yield in helaly berseem clover and found that fresh forage yield expressed that highest estimates of heritability among traits in both family types (0.64 and 0.75 for half – sib and s1 families, respectively). while, the obtained values for dry forage yield were of lower magnitude (0.62 and 0.65 for half - sib and s1 families, respectively). Abd El-Naby *et al* (2014) reported that broad sense heritability was highly significant for Hatour x Fahl with respect to plant height and total fresh weight plant -1 (0.9 and 0.84, respectively) Ahmed *et al* (2015) estimated broad sense heritability on berseem clover at first cutting in the first season where the highest values were obtained for fresh forage yield, dry forage yield and leaf/stem ratio(98.23 , 98.7 and 100). Badawy (2017) found that heritability for fresh forage yield reached 69.56 % which reflect a reseable genetic control. Badawy (2013) found that values of genotypic variances estimated from S1 families were of larger magnitude amounted to (1.28, 1.02, 2.32, 1.75 and 1.56 times the corresponding values for half – sib families in green forage yield, dry forage yield leaf/stem ratio (fresh weight), leaf \ stem ratio (dry weight) and plant height. El-Nahrawy *et al* (2006) estimated phenotypic variability of fresh forage yield of fresh forage yield in some cultivars of Egyptian clover under two locations. He showed that phenotypic coefficient of variation (P.C.V.) was low in all cuts for fresh forage yield of Egyptian clover. The recorded values for successive cuttings at Sakha location in 2003/2004 were 1.3, 1.9, 0.98 and 0.4 % for the four cuttings , respectively. At Sids location the obtained values were 0.9, 6.9, 0.98 and 0.45 % in 2003/2004 season, while in 2004 / 2005 were 0.69, 0.7, 0.79 and 1.6 % respectively. Rajab (2010), observed that the highest phenotypic coefficient of variation value (P.C.V.) was recorded for fresh forage yield as 5.075 % in 2001/2002, 9.036% in 2003/2004 and 6.792 % in 2004/2005 seasons. Badawy (2017) estimated genetic parameters for fresh yield, dry yield, plant height and dry leaf/stem ratio for P.C.V. (4.75, 4,65, 1.224 and 3.07) and for G.C.V. (3.21, 3.72, 0.774 and 2.24),respectively. Also he estimated phenotypic and genotypic variances (12.3, 0.211, 0.942 and 3.23) and (6.31, 0.135, 0.429 and 2.19), respectively.

Correlation analysis evaluate the relationship between variables. Relationship between traits of berseem clover was detected by several workers, (Radwan*, et al* 1983, Ahmed 2000, Abdel Gawad 2003, Ahmed 2006, Abdel Galil 2007, Abo El –Goud *et al.* 2015 and Abd El-Naby *et al.* 2015). However, this type of analysis does not drive conclusions about cause and effect relationships. The correlation studies give the amount of association between any pair of traits the direct and indirect effects of each of the components are not revealed by these correlation studies especially when more variables are included.

Path coefficient analysis provides estimates of direct and indirect effects of traits (one trait via other variables). Many workers gave results with forage crop evaluating forage yield components (Bakheit 1986, Iannucci and Martiniello 1998, Abd el Galil 2007, Abd El- Naby *et al*. 2015 and Rady 2008. So far , the influence of forage yield components on total fresh forage yield of Egyptian clover must be studied .

This study aimed to:

Estimate the heritability for forage yield and its components, study the genetic variability among different genotypes of berseem, select out the desirable traits for forage with the help of correlation and path-coefficient analysis studies for genetic improvement and identify the best genotypes (promising populations) and their use in further breeding programme.

MATERIALS AND METHODS

Plant Germplasm

This study was conducted at Sakha Agricultural Research Station farm of Forage Crops Research Department, FCRI, ARC, Egypt, during the two winter successive seasons of 2015/2016 and 2016/2017. Thirteen genotypes multi-cut gene pool of Egyptian clover. (Eight promising populations) namely pop.1, pop.2, pop.3, pop.4, pop. Serw3, pop.6, pop.10 and pop.46 and five populations were registered varieties (Helaly, Sakha 4, Gemmiza 1, Serw 1 and Giza 6). 1, 2, 3, and 4 populations selected from farmers seed lots at Giza Station. Serw 3 population selected under salinity condition from Serw 1 variety at Serw Agricultural Station. While 6, 10 and 46 populations selected from farmer̀s seed lots at Sakha Agricultural Station. All thirteen genotypes were provided by Forage Crops Research Department (FCRD), Field Crops Research Institute (FCRI), Agricultural Research Center (A. R. C.). It was supplemented with the recommended dose of super phosphate fertilizer, 15.5% P_2O_5 (150 kg/fed) at land preparation before sowing. In (2015/2016) winter season, seeds of populations were sown at the rate of 20 kg/faddan. Sowing dates were October 10th 2015 and October 9th 2016 in two seasons, respectively. Five cuts were taken from each seasons. In the 1st season five cuts were taken after 60 days, 110, 149, 179, 208 days, while in the 2nd season five cuts were taken after 58 days, 108 days, 147 days, 180 days and 210 days from sowing, respectively.

Experimental design and measured variables

The experimental layout was in a randomized complete block design with four replicates, plot size was (6 m^2). The traits studied were,

I- Forage yield

1- **Fresh forage yield kg/plot :** cut and weighted for each plot.
2- **Dry forage yield kg /plot :** samples about 250 gm had taken from each plot weighted immediately, then dried in an oven at 105ºc until weight constancy multiplied by dry matter percentage by fresh forage yield .

II- Plant traits

1- **Plant height (cm):** The average of five random plants from each plot from soil surface until the upper most tip of plant.
2- **Number of stems:** Counting the stems at (0.25m^2) from each plot
3- **Fresh leaf / stem ratio (fresh weight):** A sample of 200 gm plot for every fresh cutting was taken and separated to leaves and stems. Each component was weighted immediately to estimate the ratio
4- **Dry leaf/stem ratio (dry weight):** Reweighted samples from fresh leaf/stem after drying in an oven at 105ºc until the weight was constancy and calculated the ratio.

Statistical analysis

Data were subjected to the analysis of variance all according to Snedecor and Cochran (1989) using MSTAT computer program V.4 (1986).

The genotypic ($б^2g$) and phenotypic ($б^2p$) variance were calculated according to Al-Jibouri *et al* (1958). Heritability estimate in broad sense (H)=($б^2g$/$б^2p$)×100 was calculated as given by Hallauer and Miranda (1988).

Genotypic (G.C.V.%) and (P.C.V.%) coefficients of variability were calculated according to Burton (1952).

Homogeneity test was performed on mean squares of errors for all genotypes before analysis of variance and it was homogenous according to Barttlet (1937).

Correlation and path coefficient analysis:-

Simple correlation was calculated as described by Steel and Torries (1980). Path coefficient analysis was calculated according to Dewey and Lu (1959).

RESULTS AND DISCUSSION

The combined analysis of variance for the studied traits was presented in Table (1). Analysis of variance indicated that significant differences among genotypes for all traits, highly significant interaction between genotypes x years for fresh, as well as, dry forage yield and plant height indicated that the genotypes responded differently from year to year and it is necessary to evaluate as genotypes for a number of year (Bakheit 1986). Generally, if the variance of genotypes was higher than the interaction between genotypes x years, it is possible to possess great genetic variability about the amount of improvement through selecting superior genotypes. These results are in agreement with El- Nahrawy (1980), Radwan *et al.*(1983), Ahmed (2006), Abdel –Galil (2007), El Nahrawy (2007,Bakheit (2013), Radwan *et al*. (2015), Abo-El-Goud *et al*. (2015) and Badawy (2017).

Table 1. Mean squares of combined analysis of variance for the traits of thirteen genotypes in multi-cut over two years.

S.O.V.	D.f	Fresh forage yield	Dry forage yield	Plant height	No. of stems	Fresh leaf /stem ratio	Dry leaf /stem ratio	Expected M.S.	
Years	1	759.8**	2.4*	1228.2**	$44.2^{N.S}$	93.1**	96.2**		
Rep /years	6	5	0.2	0.5	11.6	0.5	0.9		
Genotypes	12	270.7**	4.3**	2.4**	262.4**	30**	30.9**	M3	$\sigma^2 e + r\sigma^2 gy + ry\sigma^2 g$
Gen. x years	12	67.3**	1.3**	1.1**	$52.2^{N.S}$	$0.6^{N.S}$	$0.5^{N.S}$	M2	$\sigma^2 e + r\sigma^2 gy$
Error	72	17.4	0.5	0.2	43.5	6.0	7	M1	$\sigma^2 e$

N.S. Insignificantly different.

*** and ** significance at 0.05 and 0.01 probability levels, respectively.**

Fresh forage yield

Data in Table (2) indicated that means of fresh and dry forage yield (kg/plot) for 13 genotypes of multi – cut clover over two years 2015/2016 and 2016/2017 were highly significant in five cuts. Helaly cultivar superiority over all genotypes in total fresh forage yield (107.39 kg/plot) followed by Serw 1 and population 4 (101.1 and 94.5 kg/plot). Populations 1, 2, 3, 4 and 10 were insignificant different for total fresh forage yield if compared with commercial varieties Giza 6, Sakha 4 and Gemmiza 1, which ranged from (91.3 kg/plot) for Giza 6 to pop.4 (94.5 kg/plot) while population 46 and Serw 3 were the lowest (82.6 and 85.2 kg/ plot), which ranged from 85.2 to 89.3 kg/plot, with insignificant different. These results are in agreement with Abd El- Naby *et al.* (2015) ,who evaluated 12 promising populations and indicated that new Khadrawy the highest yield for total fresh yield (72.50 ton/fed.) and exceeded significantly the highest variety Giza 6 (67.5 ton/fed.). Also, the results are agreement with Abd EL-Galil (2007). The results indicated that pop. 4 (94.5 kg), pop.10 (93.4 kg) and pop. 2 (93.1 kg/plot) can be used in suitable breeding programme for a good new genotypes.

Table 2. Means of fresh and dry forage yield for thirteen genotypes of multi-cut Egyptian clover over two seasons 2015/2016 and 2016/ 2017.

Genotypes	Fresh yield (kg/ plot)						Dry yield (kg / plot)					
	Cut1	Cut2	Cut3	Cut4	Cut5	Total	Cut1	Cut2	Cut3	Cut4	Cut5	Total
1- Pop.1	12.16	19.84	21.68	20.93	16.25	90.9	1.39	2.07	2.7	2.91	2.57	11.6
2- Pop.2	12.18	18.85	22.8	21.88	17.34	93.1	1.41	2.09	2.91	3.13	2.86	12.4
3- Pop.3	12.51	18.43	22.93	20.88	17.01	91.8	1.5	2.08	3.01	2.86	2.83	12.3
4- Pop.4	12.61	17.66	24.79	23.38	16.01	94.5	1.34	1.95	3.24	3.29	2.63	12.4
5- Serw3	10.6	16.28	21.75	19.63	16.96	85.2	1.21	1.89	2.83	2.76	2.72	11.4
6- Pop.6	13.3	14.93	21.38	21.49	18.19	89.3	1.47	1.68	2.93	3.2	2.93	12.2
7- Pop.10	12.25	18.98	23.21	21.68	17.3	93.4	1.39	2.1	3.01	3.06	2.8	12.4
8- Pop.46	12.19	15.54	21.7	19.9	16.84	86.2	1.38	1.68	2.89	2.85	2.76	11.6
9- Helaly	14.28	20.29	27.19	26.45	19.18	107.4	1.6	2.37	3.47	3.76	3.14	14.3
10- Sakha 4	12.29	19.63	24.54	20.74	16.58	93.8	1.51	2.17	3.31	3.0	2.67	12.7
11- Serw 1	13.13	20.94	26.75	21.63	18.64	101.1	1.45	2.29	3.33	2.91	2.92	12.9
12- Gemmiza 1	12.01	19.59	24.41	20.95	17.25	94.2	1.35	2.28	3.11	2.94	2.79	12.5
13- Giza 6	11.38	19.14	22.09	20.18	18.49	91.3	1.47	2.13	2.93	2.93	3.08	12.6
Mean	12.38	18.47	23.48	21.51	17.39	93.2	1.42	2.06	3.05	3.05	2.82	12.4
F-test	**	**	**	**	**	**	n.s	n.s	**	**	**	**
L.S.D.(0.05)	1	1.78	1.36	1.5	1.3	4.18	-	-	0.391	0.394	0.239	0.692

N.S. Insignificantly different. ** significance at 0.01 level of probability.

Dry forage yield (kg/plot)

Dry yield showed highly significant in the 3rd cut and 4th and 5th cut and total dry yield, while insignificant differences were obtained in 1st and 2nd cuts. helaly cultivar was the highest in dry forage yield (14.3 kg/plot) followed by Serw 1, Sakha 4, Giza 6, Gemmiza 1, population 4 and population 10 (12.9, 12.7, 12.6, 12.5, 12.4 and 12,4 kg/plot). Pop. 2, 3, 4 and 10 showed insignificant differences for total dry forage yield with commercial varieties Serw 1, Sakha 4, Giza 6 and Gemmiza 1 which ranged from 12.3 kg/plot for pop.3 to serw 1 12.9 kg/plot. These results are in agreement with Abd EL – Naby *et al.* (2015) and EL- Nahrawy (2007). while Serw 3 was the lowest(11.4 kg/plot). This are in harmony with Abd EL-Naby *et al.* (2015), who found that genotype Khadrawy gave the highest yield for total dry yield (9.79 ton/fed.) and exceeded significantly the highest variety Giza 6 (9.43 ton/fed.). The results indicated that promising populations 2 (12.4 kg/plot), 4 (12.4 kg/plot) can be used in suitable breeding program.

Plant height (cm.)

The means of plant height (cm.) across two seasons showed that highly significant differences among genotypes for all the five cuts (Table 3). Helaly was the tallest in average plant height and mean (74.2cm), followed by population 1(73.85cm.) respectively. Data showed that pop. 2, 3, 4 appeared insignificance differences with Sakha and Gemmiza 1, in plant height, which were (73.2, 73.2 and 73.1) and (73.5 and 73.2 cm.) respectively. The lowest plant height were the populations 10, 46, 6 and Serw 1 (72.8, 72,6 , 72.4 and 72.4 cm), respectively. Data indicated that plant heights were related to fresh forage yield as, Helaly was the tallest plant and the highest fresh yield, also pop. 46 was the shortest plant and the lowest fresh forage yield.

These results are in agreement with Abo EL-Goud *et al.* (2015) who studied selection within and between farmer seed lots of Egyptian clover to develop highly productive populations, which revealed that the genotype (3) recorded the tallest for plant height (103.16 cm.).

Table 3. Means of plant height and No. of stem for thirteen genotypes of multi-cut Egyptian clover over two seasons of 2015/2016 and 2016/ 2017.

Genotypes	Plant height (cm)						No. of stem ratio(0.25m^2)					
	Cut1	Cut2	Cut3	Cut4	Cut5	Mean	Cut1	Cut2	Cut3	Cut4	Cut5	Mean
1- Pop.1	66.25	69.13	78	77.5	78.38	73.9	176	214	271	286	225	234.4
2- Pop.2	65.63	68	78.25	76.63	77.38	73.2	178.5	216	281	292	228	239.1
3- Pop.3	66.25	67.75	77.75	76.38	77.75	73.2	179.5	211	278	288.5	225.5	236.5
4- Pop.4	65.25	67.5	76.75	76.5	79.25	73.1	180.5	208.4	289	295	224.6	239.5
5- Serw3	65.38	67.13	78	76.88	78.5	73.2	166	205	270.8	281.5	227	230.1
6- Pop.6	65.88	66.25	75.38	76.63	77.63	72.4	177	202.5	275.5	293.3	232	236.1
7- Pop.10	65.63	66.88	77.63	76.38	77.38	72.8	175	218	280	294	233	240
8- Pop.46	65.25	66.25	75.75	76.88	78.75	72.6	176	200	274	284	225	231.8
9- Helaly	67.13	68.38	78.00	77.88	79.63	74.2	187	232.3	295.5	306	237	251.6
10- Sakha 4	67.13	67.50	77.25	76.75	79.00	73.5	171.5	221	285	288	227.5	238.6
11- Serw 1	65.63	67.25	76.00	75.88	77.00	72.4	180	233	291	293	237	246.8
12- Gemmiza 1	65.63	67.13	77.13	75.88	78.50	72.9	175	219.5	284.4	288.5	233.5	240.2
13- Giza 6	66	67.38	76.38	76.63	79.5	73.2	168	213	279	287	234	236.2
Mean	65.92	67.42	77.1	76.67	78.36	73.1	176.19	214.9	281.1	290.5	229.9	238.5
F- test	**	**	**	*	**	**	**	**	**	**	**	**
L.S.D.(0.05)	1.04	1.12	1	1.09	0.89	0.46	5.7	6.2	8.2	7.6	7.1	6.6

*** and ** significance at 0.05 and 0.01 levels of probability, respectively.**

No. of stems

The combined analysis of variance for No. of stems appeared significance differences among the genotypes for the five cuts and over cuts (Table 3). Genotype Helaly followed by Serw 1 were the highest No. of stems (251.6 and 246.8, respectively). These data indicated that No. of stems related to fresh forage yield, whereas, Helaly followed by Serw 1 genotypes were the highest fresh forage yield (107.4 and 101.1 kg/plot). Data illustrated that Pop.1, 2, 3, 6 and 10 appeared insignificance differences with commercial varieties Gemmiza 1, Sakha 4 and Giza 6 for No. of stems which ranged from 236 to 240 stems. while the lowest No. of stems were population 46 and Serw 3 (231.8 and 230.1). Pop. of Serw 3 was he lowest total of fresh forage yield (85.2 kg/plot), the rest of populations and varieties were insignificant differences. The same results were obtained by Abo EL-Goud *et al.* (2015), who found that highly significant differences among genotypes, they evidenced that Giza composite was the highest (14.83), while Serw 1 variety was the lowest no. of stems 4.67.

Fresh leaf / stem ratio

Regarding to Table (4), the means of fresh leaf/stem ratio across two seasons showed highly significant differences among the genotypes for the five cuts and over cuts. Serw 1 and population 46 were the highest (59.3 and 58.9). Pop. 6, 10, and 46 showed insignificant differences means with commercial varieties Helaly, Sakha 4, Serw1 and Giza 6 for fresh leaf/stem ratio (ranged from 57 to 59.3). While the lowest genotypes for fresh leaf/stem ratio were populations 2, 1, and Gemmiza 1 (ranged from 53 to 55.2). This trait is very important for evaluate forage crops, which indicate that palatability and nutritional quality for fodder, also for breeding program. These results are in agreement with Abd EL-Galil (2007) and El Nahrawy (2007), who showed that in berseem clover highly significant differences were obtained among genotypes , seasons and locations, as well as, Helaly was the highest (60.80) followed by Sakha 4 (58.63).

Table 4. Means of fresh leaf /stem ratio and dry leaf /stem ratio for thirteen genotypes of multi-cut Egyptian clover over two seasons 2015/2016 and 2016/ 2017.

Genotypes	Fresh leaf / stem ratio						Dry leaf / stem ratio					
	Cut1	Cut2	Cut3	Cut4	Cut5	Mean	Cut1	Cut2	Cut3	Cut4	Cut5	Mean
1- Pop.1	41	45.5	51	61	66.5	53	55.5	58	59.5	66.5	70.5	62
2- Pop.2	42	47.4	53	64	69.5	55.2	56.5	60	61.5	70.9	73	64.4
3- Pop.3	42.5	48.5	55.1	63.5	68.5	55.6	57.5	61	62.5	70	73	64.8
4- Pop.4	43	49.5	56.5	65.5	65.5	56	59	62	65	72.5	70	65.7
5- Serw3	42.5	48.5	55.5	65	66.5	55.6	58	60.5	64	71.5	70.5	64.9
6- Pop.6	47	51	57.5	67	69.4	58.4	61.5	63.3	66	73.5	73.5	67.6
7- Pop.10	44	48	55.9	66	71.5	57.1	59.5	60	64	72.5	76	66.4
8- Pop.46	45.5	50.5	57	68	73.5	58.9	59.3	63.5	65.5	74	78.5	68.2
9- Helaly	48.5	52	58	69	66.5	58.8	63.5	65	67	75.5	70.5	68.3
10- Sakha 4	45	49	56	67.5	67.5	57	60.5	61.5	64.5	73	71.5	66.2
11- Serw 1	47	51	58.5	69.5	70.5	59.3	62	64	67	74.5	74.5	68.4
12- Gemmiza 1	41	45.5	52	63.5	72.5	54.9	56.5	58.5	61	69.5	76.5	64.4
13- Giza 6	48.5	51	56.5	67	70.5	58.7	61.9	64.5	65.5	73	75.5	68.1
Mean	44.4	49	55.6	65.9	69.1	56.8	59.3	61.7	64.1	72.1	73.3	66.1
F-test	**	**	**	**	**	**	**	**	**	**	**	**
L.S.D.(0.05)	2.6	3	2.9	3.1	5.4	2.46	3.5	3.1	3.1	3.2	3.4	2.7

**** significance at 0.01 level of probability**

Dry leaf/stem ratio

The results of Table (4) indicated that the means of dry leaf/stem ratio showed highly significant differences among genotypes for the five cuts and over cuts. Serw1, Helaly, pop. 46 and Giza 6 were the highest values (68.4, 68.3, 68.2 and 68.1), respectively. While population 1 was the lowest (62). Populations 46, 6, 10 and 4 were insignificant difference with commercial varieties Serw 1, Helaly, Giza 6 and Sakha 4 (ranged from 65.7 to 68.4) for dry leaf /stem ratio. This trait was very important for evaluate forage crop, which indicate that quality for forage yield, also for breeding program in Egyptian clover. These results are in agreement with those obtained by Abdalla and Abd EL- Naby (2013) and Badawy (2013).

Genetic parameters

The genetic parameters (σ2g, σ2p, GCV%, PCV% and H%), as well as, range and grand mean are presented in Table (5). Wide range of variability for fresh forage yield and dry forage yield traits. The maximum range of variation indicated that farmers seed lots vary in productivity as a consequence of genetic variability (Bakheit 1986). Data showed that the environmental effect was limited, while the genotypic variance relative to phenotypic variance for all traits, indicated that the environmental effect were limited.

The phenotypic coefficient of variance (P.C.V. %) varied 0.23 % for plant height to 2.2% for fresh forage yield and genotypic coefficient of variation (G.C.V.%) was varied from 0.22 % for plant height to 2.1% for fresh forage yield. The highest values of P.C.V. % and G.C.V. % for fresh forage yield evidence possibility of improving it by phenotypic selection for the development of new populations.

Narrow differences were obtained between (P.C.V.%) and (G.C.V.%) for all traits, suggesting some affects of environments on these traits due to its confounding by the genotypes $_x$ years interaction. Also this was reflected in higher estimates for heritability in broad-sense. These results are in agreement with Hill and Baylor (1983), Bakheit (1986 and 1989), Badawy (2013 and 2017), Abd EL-Galil (2007), Abd EL-Naby *et al.* (2015) and Abo El- Goud *et al.* (2015).

Heritability in broad sense was ranged from 83.3 for no. of stems and fresh/ leaf stem ratio to 92.9 % for fresh forage yield. These results indicated that these traits were less influenced by the environment and largely influenced by the additive effects of genes. This results are in agreement with Radwan and Abou El - Fittoh (1970).

Table 5. Range, grand mean, genotypic and phenotypic variances genotypic and phenotypic coefficient of variation and heritability in broad sense for various traits over two years in multi –cut Egyptian clover

Traits	Range	Mean	δ^2 g	δ^2 p	G.C.V. %	P.C.V. %	H%
Fresh forage yield	85.2 - 107.4	93.2	3.9	4.2	2.1	2.2	92.9
Dry forage yield	11.4-14.3	12.4	0.06	0.07	2	2.1	85.7
Plant height	72.4-74.2	73.1	0.025	0.029	022	0.23	86.2
No. of stems	230.1-251.6	238.5	4	4.8	08	0.9	83.3
Fresh leaf/stem ratio	53-59.3	56.8	0.5	0.6	1.3	1.4	83.3
Dry leaf /stem ratio	62.2-68.4	66.1	0.6	0.7	1.2	1.3	85.7

Correlation coefficient

Regarding to the simple correlation coefficients between fresh forage yield and other traits (dry forage yield, plant height, No. of stems, fresh/leaf stem ratio and dry leaf/stem ratio) Table (6) showed positive and highly significant correlation between fresh forage yield with (dry forage yield and No. of stems) (r=0.956** and r=0.992**), also dry forage yield with No. of stems (r=0.938**). Fresh leaf/stem ratio and dry leaf/stem ratio (r=0.996**). These results are in agreement with Jatsara *et al.* (1980), Bakheit (1986 and 1989) and Abd EL-Galil (2007), who reported the importance of selection for such traits to obtain high productive synthetic varieties.

Table 6. Simple correlation coefficient among six traits in multi-cut Egyptian clover over two years.

Traits	Fresh forage yield	Dry forage yield	Plant height	No. of stem	Fresh leaf /stem ratio	Dry leaf /stem ratio
Fresh forage yield	1.000	0.956**	0.302	0.992**	0.363	0.398
Dry forage yield		1.000	0.376	0.938**	0.435	0.467
Plant height			1.000	0.23	-0.353	-0.347
No. of stem				1.000	0.363	0.394
Fresh leaf/ stem ratio					1.000	0.996**
Dry leaf / stem ratio						1.000

**** significance at 0.01 level of probability.**

Path- coefficient analysis

Path- coefficient analysis was used to determine the direct and indirect effects and measures the relative importance of the causal factor individually (Dewey and Lue 1959). The total fresh forage yield, dry forage yield, plant height, No. of stems, fresh leaf/stem ratio and dry leaf/stem ratio for path coefficient were shown in Table (7) and figure (1) as a path diagram showing the direct and indirect influences of total fresh forage yield component traits across two years. In the present study, total fresh forage yield was independent trait and other traits (dry yield, plant height, No. of stems, fresh leaf/stem ratio and dry leaf/stem ratio) were taken as dependent traits. The highest positive direct effect on fresh forage yield was no. of stems (0.956), followed by dry leaf/stem ratio (0.867) and plant height (0.13). While the maximum indirect effects on fresh forage yield was no. of stems (0.897) followed by dry leaf/stem ratio (0.864). So, improvement of these traits would improve fresh forage yield because of correlated response of yield by applying strong, selection on these traits.

Table 7. Path coefficient analysis (direct) and indirect effects of the studied traits on fresh forage yield for 13 multi-cut Egyptian clover populations estimated over two years 2015/2016 and 2016/ 2017.

Traits	Dry forage yield	Plant height	No. of stems	Fresh leaf /stem ratio	Dry leaf /stem ratio	Total correlation
Dry forage yield	(-0.057)	0.049	0.897	-0.338	0.405	0.956
Plant height	-0.021	(0.13)	0.22	0.274	-0.301	0.302
No. of stems	-0.053	0.03	(0.956)	-0.282	0.341	0.992
Fresh leaf/ stem ratio	-0.025	-0.046	0.347	(-0.777)	0.864	0.363
Dry leaf / stem ratio	-0.026	-0.045	0.376	-0.774	(0.867)	0.398

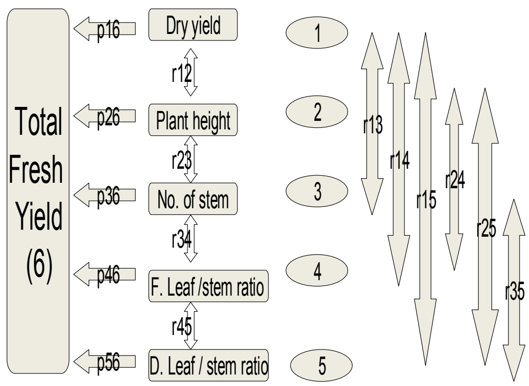

Fig. 1. Path diagram showing causal relationships of four predictor variables with the response variable total fresh yield one directional arrow (←) represent direct path (p) and two directional (↔) represent correlation (r) .

CONCLUSION

It can be conclusion that, Helaly cultivar was the best commercial in this study. the eight promising selected population produced height forage yield. Promising populations 4, 10 and 2 were insignificant than the check verities Gemmiza1, Sakha4, and Giza 6. Therefore it should be used these populations in Egyptian clover breeding programmers.

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تحليل التباينات الوراثية ومعامل المرور لمحصول العلف ومكوناته فى بعض عشائر البرسيم المصرى

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تم تقييم ثلاثة عشر تركيب وراثى تشمل ثمانية عشائر مبشرة منتخبة لمحصول العلف العالى مقارنة بخمس اصناف تجارية ،أجريت تلك الدراسة فى محطة البحوث الزراعيه بسخا خلال موسمى 2016/2015 ، 2017/2016 لتقدير المكافئ الوراثى، ودراسة التباينات الوراثية وإنتخاب الصفات المرغوبة لمحصول العلف باستخدام الارتباط ومعامل المرور للتحسين الوراثى، وللتعرف على أفضل العشائر المبشرة التى يمكنإدخالها فى برنامج التربية. أظهرت نتائج التحليل المشترك للموسمين الآتى:-* تفوق الصنف هلالى على باقى التراكيب الوراثيه فى محصول العلف الأخضر والجاف وطول النبات وعدد السيقان فى مساحة (0,25م2) حيث أعطى 107,4 كجم/قطعه ، 14,3كجم/قطعه ، 74,2سم ، 251,6ساق على التوالى.* كان المكافئ الوراثى لكل الصفات المدروسه عالى وكانت صفة محصول العلف الأخضر أعلى من 92,9% يليها صفة عدد السيقان فى مساحة (0,25م2) 86,2%.*وجود إرتباط عالى وموجب بين محصول العلف الأخضر وكلا من محصول العلف الجاف وعدد السيقان (956,. و 996,.). * أعلى قيمه لمعامل المرور بالنسبة للتأثير المباشر على صفة محصول العلف الأخضر (العامل غير مستقل) من العوامل المستقله صفة عدد السيقان، نسبة ورق/سوق جاف وطول النبات (956,. ، 867,. ، 13,.).* عكست نتائج هذه الدراسة أن ارقام العشائر (2، 4، 10) لم تختلف معنويا عن الأصناف التجاريه جميزة 1 ، سخا4 ، جيزة 6 ولذلك نوصى باكثارهم واستخدامهم فى برنامج التربيه لتحسين انتاجية البرسيم المصرى .