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EVALUATION AND SELECTION OF SOME ALFALFA GENOTYPES FOR HIGH FORAGE YIELD AND PROTEIN

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ABSTRACT

Twenty five genotypes of alfalfa were evaluated for forage and dry yields and protein content at Nubaria Research Station. Planting was carried out at October, 5th 2011, and data were taken during the three years 2012, 2013 and 2014. Data of green and dry forage yields and protein content were collected for four seasons in each year during the three years. Results indicated highly significant differences among genotypes for all traits. Dry forage yield and protein content of the studied genotypes had a highly significant reliance on years and seasons. The values of genotypic coefficient of variation (GCV%) and phenotypic coefficient of variation (PCV%) were 6.48 and 6.89% for green forage yield, 5.72 and 7.53% for dry forage yield and 1.43 and 1.73 % for protein percentage, respectively. Broad-sense heritability for green forage yield was 88.38% which was higher than that for dry forage yields and protein content (57.58% and 68.81%), respectively. The average of expected genetic advance value for total green forage yield, total dry yield and protein content were 8.52, 6.06 and 1.65%, respectively. The population G.15 showed common superiority over other populations (46.163, 48.163 and 55.939 t/ha, in the first, second and third year, respectively) in the summer season. In the context, G.5 showed common superiority in the autumn (24.233 and 26.233 t/ha in the first and the second years, respectively) While, G.3 was the best for previous trait (35.135 t/ha) in the third year in autumn season. It could be concluded that, the genotypes G.15, G.3, G.9 and G.14 are promising to improve green and dry forage yield and protein content and could be used to produce as available a new variety via further breeding programs.

Key words: ***Alfalfa, Medicago sativa L., Green forage yield, Dry forage yield, Protein content.***

INTRODUCTION

Alfalfa is a high quality persistent forage crop sometimes intercropped with grasses or grown solely for the purpose of green forage production, hay or silage (Jung *et al* 1997). Alfalfa is the major forage legume worldwide and the main forage crop in the semi-arid and arid land countries (El-Nakhlawy *et al* 2012). Alfalfa has specific characteristics due to its high productivity and persistence (Michaud *et al* 1988).

In practice, the need for fodder often obliges local alfalfa growers to frequently harvest alfalfa earlier than recommended for maintaining high production and stand viability. In Europe, alfalfa is also harvested early to obtain high-protein, low-fiber forage for industrial or nutritional uses (Verondeso *et al* 1986 and Lioveras *et al* 1998). However, frequent harvesting of immature alfalfa, increases the number of harvests, reduces forage yield per harvest (Rammah and Hamza 1980) and accelerates stand, decline and reduces total yield (Sheafer *et al* 1988). There were indications that, in non-dormant alfalfa, survival and production under frequent harvesting could be improved by selection. Marbel (1989) noted that local alfalfa ecotypes in the Near East might be more adapted to frequent harvesting than introduced varieties. In addition, El-Doss (2001) in Egypt, pointed out that, non-dormant Hejaz and African alfalfa were adapted to frequent harvesting which does not seem to affect ability to generate new stems and recovery after harvest. Differences in regrowth rate under frequent harvests were also reported among18 alfalfa varieties (Bosca *et al* 1983).

Variability analysis was found useful for getting information about the characters that are expected to respond to selection and influence the yield potential (Bakheit 1988). Besides, Bakheit and El-Nahrawy (1997) found that, realized gains over the base population were 17.7 and 25.2% in fresh forage yield, 18.7 and 24.8% in dry forage yield and 18.4 and 25.4% in protein content in the 1st and 2nd cycle of recurrent selection, respectively. Abdel- Galil (2007) indicated that the environmental variation of alfalfa ranged from 2.4 to 30.5% and the genetic advance of selection for the studied traits ranged from 3.3 to 20.3%.

Progress in breeding programs depends on the magnitude of genetic variability in the population and the extent of heritability of the desirable character. Radwan *et al* (2015) reported low to medium heritability estimates in Egyptian clover. While, Bakheit (1986) reported high heritability estimates in Egyptian clover for seasonal fresh and dry yields (89.0 and 91%) indicating less influence by environment. In addition Bakheit (1985) reported that effectiveness of mass selection for fresh forage yield was detected for two generations in Egyptian berseem, where he also declared that the gain of the 1st and 2nd cycles of mass selection for the fresh forage yield were 8.4 and 10.7% of the original population. Besides the realized heritability and expected selection advance for first and second cycles of mass selection were (0.38 and 0.04) and (31.8 and 3.94%), respectively. Younis *et al* (1986) subjected five populations of berseem clover to three cycles of visual selection. They reported that, visual selection was more effective in increasing green and dry yield which were increased by 17.7 and 23.9%, respectively over their initial populations. In addition, Abdel-Galil and Hamid (2008) reported that enormous improvement was achieved through selection in seven Egyptian clover varieties. They added that heritability in broad-sense was high for seasonal fresh and dry yields (88.7 and 82.3%). Also, Bakheit and Ali (2013) reported that influences were detected by 4.94% and 14.38% in fresh forage yield 5.3% and 13.22% in dry yield as a result of two cycles of selection in berseem clover.

The current investigation was conducted aiming to (i) evaluate forage yield of promising alfalfa genotypes for three years with four seasons per year (ii) estimate the heritability for green and dry forage yield and quality, (iii) study the genetic variability among selection genotypes of alfalfa (iv) identify the best genotypes (promising populations) to be used in further breeding programs.

MATERIALS AND METHODS

Farmer's seed lots of five hundred and twenty five alfalfa populations were collected from Dakhla, Kharga, Elbhareia and Siwa Oasis and one French population (non- winter dormant) and planted during the two years 2009 and 2010. Then, twenty-five populations were selected (Table 1) which recorded the highest yields of whole seed lots under the environment of Nubaria region. Seed of the twenty-five selected populations was planted during three successive years from 2011 to 2014 to evaluate them for forage and dry yield and protein percentage for four seasons per year. The experiment was conducted in Nubaria Agricultural Research Station (North West of Nile delta), Egypt starting from October 5th, 2011. A randomized complete blocks design with four replicates was used. Plot size was 3.0 x3.0 m with rows 20 cm apart. The seeding rate was 48 kg ha^{-1}. Seeds were inoculated with *Rhizobium melolitii* prior to seeding. Starter dose of nitrogen (48 kg N ha^{-1}) was applied after the full establishment. A base dose of Super phosphate (15.5% P_2O_5) at the rate of 360 kg ha-^{1} was applied at land preparation. 120 kg ha^{-1} of Potassium sulphate (46%K_2O) was applied at three equal doses, yearly.

Table 1. Designation and pedigree of the twenty-five alfalfa populations.

populations designation	Number of selected populations	Pedigree
G. 1 – G. 2 – G.3 – G.13	4	Land races farm Dahkla oasis (El Kasr in New valley)
G. 4 – G. 5 – G.14	3	Land races farm Dahkla oasis (Palat in New valley)
G. 6 – G. 7- G.15	3	Land races farm Dahkla oasis (Moot in New valley)
G. 8 – G.16 – G.17	3	Land races farm Kharga oasis (El Farafra in New valley)
G. 9 – G.18 – G.19	3	Land races farm Kharga oasis
G. 10 – G.20 – G.21	3	Land races farm Siwa oasis (Marsa Matroh)
G. 11 – G.22 – G.23	3	Land races farm Elbharei oasis (Giza)
G. 12 – G.24 – G.25	3	French populations

Data were recorded for green forage yield (t ha^{-1}). A representative sample was taken at each cut to determine dry matter percentage using the oven drying at 105˚C till constant weight. The obtained percentage was used to estimate dry forage yield (t ha^{-1}). Crude protein (g/100g dry matter) was determined using standard methods (A.O.A.C. 1990).

Cutting date was determined when the based shoots reach 4- 5 cm length. Nine cuts were obtained per growth year. Cuttings covered four growth seasons as follows: Winter (December, and February cuts), Spring (April, and may cuts), Summer (June, July, and August cuts) and Autumn season (September, and November cuts) as shown in Table (2) and meteorological data is presented in Fig (1). The obtained results of 2011/2012, 2012/2013, 2013/2014 years of alfalfa growth were used in this study.

Table 2. Number and date of cuts at the experimental site.

Season	Cutting	Year	Date of cutting	Year	Date of cutting	Year	Date of cutting
Winter	1	First year	20/12/2011	Second year	29/12/2012	Third year	28/12/2013
	2		16/2/2012		15/2/2013		17/2/2014
Spring	1		15/3/2012		13/3/2013		18/3/2014
	2		17/5/2012		14/5/2013		16/5/2014
Summer	1		18/6/2012		15/6/2013		13/6/2014
	2		22/7/2012		20/7/2013		24/7/2014
	3		4/8/2012		1/8/2013		5/8/2014
Autumn	1		25/9/2012		23/9/2013		20/9/2014
	2		20/11/2012		15/11/2013		11/11/2014

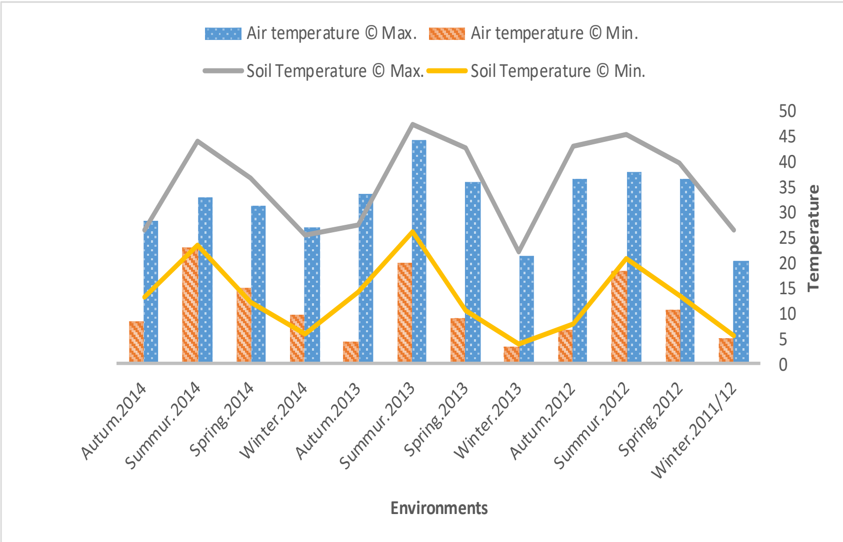

Fig. 1. Meteorological data of Nubaria region in 2011, 2012, 2013 and 2014

Data were subjected to the analysis of variance according to Steel *et al* (1997) using SAS program (2014). The genotypic (σ^2_G) and phenotypic (σ^2_p) variance were calculated according to Al-Jibouri *et al* (1958). Heritability in broad sense (h^2_b%) = σ^2_G/σ^2_P x 100, where σ^2_G is genotypic variance and σ^2_p is phenotypic variance.

Genotypic (G.C.V.%) and (P.C.V.%) coefficients of variability were calculated according to Burton (1952). Genetic advance under selection (ΔGS) was estimated using a selection intensity of 20% according to the formula, GS%=ΔGS in units/grand mean x100 where ΔGS is the genetic advance in units which is calculated as = σ_{Ph} x h^2_p/100 x 1.40 (Flaconer 1981).

RESULTS AND DISCUSSION

Results from ANOVA for the studied traits of the 25 alfalfa genotypes tested across 12 seasons (three years with four seasons) showed that 81.04%, 83.59% and 77.99% of the total sum of squares was attributed to season's effects for green and dry forage yield and protein content respectively, whereas genotypes and genotypes x seasons interaction effects explained 2.80% and 3.30%, respectively for green forage yield, 1.86% and 5.31% for dry forage yield and 6.81% and 10.28% for protein content. The large season's sum of squares indicated that seasons were diverse, with large differences among season's means causing most of the variation in green and dry forage yields. The magnitude of the genotypes x seasons interaction sum of squares was 1.18, 2.85 and 1.51 times larger than genotypes for green and dry forage yield and protein content respectively, indicating that there were substantial differences in genotypic response across the 12 seasons (3 years x 4 seasons) (Table 3).

Mean squares due to seasons were highly significant for the three studied traits, indicating that the twelve seasons were different in their climatic conditions. Highly significant differences among genotypes were detected for green and dry forage yields and protein content.

Table 3. **Sum of squares, % from total sum of squares and mean squares of green and dry Forage yields and protein content of twenty five alfalfa genotypes under twelve seasons.**

SOV	df	Green forage yield (t ha^{-1})			Dry forage yield(t ha^{-1})			Protein content (g/100g dry matter)		
		Sum of squares	% from total	Mean squares	Sum of squares	% from total	Mean squares	Sum of squares	% from total	Mean squares
Seasons (Seas.)	11	141692.1	81.04	12881.10**	13025.98	83.59	1184.18**	989219	77.99	89.929**
Rep/seasons	36	4529.484	2.59	125.819	234.144	1.50	6.504	32.184	2.54	0.894
Genotype (Gen.)	24	4889.16	2.80	203.715**	290.328	1.86	12.097**	86.328	6.81	3.597**
Gen. x Seas	264	5765.76	3.30	21.84	827.112	5.31	3.133**	130.416	10.28	0.494**
Pooled error	864	17962.56	10.27	20.79	1206.144	7.74	1.396	30.24	2.38	0.035
Total	1199	174839.06			15583.708			1268.387		

**Significant at $p \leq 0.01$.

Highly significant mean squares due to genotypes x seasons interactions were detected for dry forage yield and protein content which indicated that genotypes performed differently at different seasons and it is worthwhile to evaluate genotypes at a wide range of different seasons in different years, especially for dry forage yield and protein content which could be considered as the most important traits.

These results agree with those reported by Mousa *et al* (1996), who evaluated six alfalfa varieties and found significant differences for total fresh and dry forage yields with individual cuttings in the first and second year. Also, all studied traits were significantly affected by seasonal growth in both years. Oushy *et al* (1999) studied the seasonal variation in performance of alfalfa genotypes under sandy soil conditions. Abdel-Galil *et al* (2000) studied the productivity of dry yield for five alfalfa cultivars from Egypt and two varieties from U.S.A. at Ismailia and New Valley locations. The productivity of alfalfa was significantly different between and within seasons in Ismailia location and *vice versa* in the New Valley location. Oushy *et al* (2007) studied the variability of forage yield and quality in three exotic alfalfa cultivars imported from U.S.A and two local cultivars, Ismailia and Siwa, at two different environmental conditions, Ismailia and New Valley Agric. Res. Stations. Results showed that the local cultivars (Ismailia-1 and Siwa) were superior in yielding capacity at the two locations. Abdel-Galil and Hamed (2008) evaluated nine cultivars of alfalfa under New Valley environment. Significant differences were reported among the cultivars and between years for fresh and dry forage yield traits. Moreover, Avci *et al* (2010) reported that significant differences were found among alfalfa lines and cultivars in dry matter yield, plant height and quality traits in three respective years.

Mean performance

Green forage yield

The full data of the 12 seasons for alfalfa (green and dry forage yield and protein content) are presented in Tables (4, 5 and 6). Pooled data of each year for each studied trait are presented in Table 7.

Total green forage yield for alfalfa genotypes under different environments are presented in Table (4). G.4 in the first year, G.20 in the second year and G.10 in the third year recorded the highest green forage yield in winter environments (16.208, 19.223 and 22.711 t/ha, respectively). In spring, G.14, recorded the highest green forage yield (32.163 and 34.058 t/ha) in the first and the second year, respectively. In the third year, G.15 and G.20 gave the highest green forage yield (53.533 and 53.532 t/ha, respectively). In the first, second and third year, G.15 gave the highest green forage (46.163, 48.163 and 55.939 t/ha, respectively) in the summer season. Thus, the population G.15 showed common superiority over other populations in the summer season. In the context, G.5 showed common superiority in the autumn (24.233 and 26.233 t/ha in the first and the second years, respectively) While, G.3 was the best for previous trait (35.135 t/ha) in the third year in autumn season.

In general, the highest green forage yield was in summer seasons followed by spring seasons, while winter seasons gave the lowest productivity.

Table 4. Means of green forage yield (t ha^{-1}) of alfalfa genotypes across three years and 12 seasons.

Genotype	2012				2013				2014			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
G. 1	11.742	30.626	34.081	17.992	17.753	31.126	36.081	19.492	27.159	47.533	41.879	26.847
G. 2	13.313	26.603	34.838	18.477	16.298	28.603	37.088	20.477	28.877	44.946	52.946	29.772
G. 3	15.014	32.122	43.142	21.089	14.846	34.058	47.640	23.089	29.880	48.572	51.384	35.135
G. 4	16.208	31.850	41.357	22.238	18.014	33.850	43.357	24.238	22.711	50.867	52.959	28.411
G. 5	15.985	26.219	40.103	24.223	19.017	28.219	42.103	26.223	31.593	53.276	55.001	31.855
G. 6	13.492	24.328	37.178	20.671	16.925	26.328	39.178	22.671	27.934	46.745	49.883	30.709
G. 7	9.701	21.745	35.745	14.850	12.567	23.745	37.567	16.850	23.943	35.735	41.395	22.223
G. 8	13.343	29.655	44.066	20.984	18.178	31.655	46.066	22.984	26.095	48.315	52.804	30.757
G. 9	15.137	30.491	43.446	22.551	18.701	32.491	45.446	24.551	29.247	48.657	53.539	31.073
G. 10	14.283	26.103	44.334	18.790	17.029	28.103	46.334	20.790	30.023	46.739	54.270	28.130
G. 11	15.029	28.402	39.849	20.462	17.447	30.402	40.849	22.462	27.408	48.052	46.172	31.073
G. 12	11.880	28.405	37.636	17.934	15.447	30.406	39.386	19.954	27.933	38.124	42.008	27.474
G.13	12.790	29.529	36.223	18.342	15.880	31.029	38.223	20.342	25.959	40.476	43.187	28.202
G.14	16.014	32.163	44.386	21.925	17.969	34.163	46.386	23.925	26.996	46.219	51.779	32.796
G.15	14.074	28.297	46.163	20.984	17.759	30.297	48.163	22.984	29.503	53.533	55.939	31.587
G.16	14.193	29.687	38.223	17.223	17.559	31.656	40.223	19.224	26.214	44.918	47.321	27.993
G.17	10.223	24.577	38.118	16.596	14.731	26.327	39.941	18.596	26.476	33.791	43.252	25.116
G.18	8.745	22.999	29.581	14.639	14.372	24.999	30.581	16.641	27.292	35.124	36.675	24.157
G.19	16.447	28.055	38.640	20.358	18.074	32.805	40.467	22.358	26.948	43.702	48.362	25.116
G.20	13.596	26.835	42.297	22.321	19.223	28.835	44.297	23.820	29.247	53.532	54.894	33.217
G.21	14.328	29.447	38.223	18.540	17.343	31.447	40.224	20.790	27.941	42.040	50.698	25.897
G.22	13.745	27.335	38.333	18.245	17.969	28.835	40.154	19.745	27.157	39.169	47.437	26.476
G.23	13.179	26.312	39.059	17.044	16.193	28.312	41.059	19.044	29.503	41.676	47.206	27.578
G.24	12.746	28.779	41.670	19.522	15.671	30.529	43.670	21.522	25.844	42.309	41.784	30.137
G.25	12.787	28.611	37.909	20.044	17.552	30.611	39.909	22.044	28.597	47.507	46.728	30.028
Mean	13.519	27.967	39.384	19.441	16.901	29.953	41.375	21.392	27.619	44.862	48.380	28.870
L.S.D(G*S) P=0.05 P=0.01	1.369 1.808											

Concerning green forage yield t/ha (Table 7), data showed that, yield of genotypes across environments ranged from 42.931 (G.5/2014) to 18.991 t/ha (G.18/2012).In 2014 year, the highest yielding genotypes were, G.5 (42.931 t/ha), G.20 (42.722 t/ha), G.15 (42.64 t/ha), G.3 (41.242 t/ha), G.9 (40.629 t/ha) and G.14 (39.447 t/ha).

Dry forage yield

Total dry forage yield for of alfalfa genotypes across the three years (four seasons per year) are presented in Table (5). The population G.14 in the first and the second year and G.23 in the third year recorded the highest dry forage yield in winter seasons (3.856, 5.757 and 8.007 t/ha, respectively). In spring, G.14 in the first and the second year and G.5 in the third year recorded the highest dry forage yield (9.112, 9.732 and 15.906 t/ha, respectively). In addition, the genotype G.15 achieved the highest dry forage yield in the first year, but in the second and third year, the genotype G.14 gave the highest dry forage (11.262, 13.194 and 16.981 t/ha, respectively) in the summer season. While, in the autumn, G.5 in the first year gave the highest dry forage yield (5.669 t/ha). This changed in the second and the third years, where G.14 gave the highest dry forage yield (6.654 and 9.825 t/ha, respectively). In general high forage dry yield was obtained in the summer season in the three years followed by spring season, while winter season gave the lowest productivity.

Mean values of dry forage yield of genotypes (Table7) ranged from 12.328 t/ha (G.14/2014) to 3.860 t/ha (G.7/2012). Dry forage yield/ha responded to the years in a similar pattern to green forage yield, where the highest green forage yielding genotypes were the highest dry forage yielding.

The performance of dry forage yield of the alfalfa is different due to the different seasons and years depending on the cutting time. Results in our study are similar to previous reports of Abdel-Galil and Hamed (2008), Avci *et al* (2010), El-Nakhlawy *et al* (2012), Nascimento *et al* (2013) and Seiam and Farag (2019).

Table 5. Means of dry forage yield (t ha^{-1}) of alfalfa genotypes across three years and 12 seasons.

Genotype	2012				2013				2014			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
G. 1	2.277	7.929	8.286	4.013	3.850	8.711	7.902	4.314	6.135	14.389	13.123	5.838
G. 2	2.374	5.935	7.424	3.841	4.288	6.727	8.809	4.368	6.544	12.719	13.572	6.380
G. 3	2.836	7.680	9.685	4.121	3.334	8.579	12.024	4.463	6.666	11.705	14.148	6.908
G. 4	3.148	7.042	9.363	4.872	5.411	8.388	9.456	5.212	5.864	14.741	15.240	7.295
G. 5	3.320	6.722	9.619	5.669	5.671	7.639	9.844	5.625	7.838	15.906	15.628	8.659
G. 6	2.648	4.654	7.436	4.041	4.780	5.611	9.461	5.009	6.797	11.684	14.063	7.928
G. 7	1.353	4.392	7.152	2.545	3.563	5.412	9.397	3.486	5.429	8.806	12.104	5.810
G. 8	2.072	6.919	9.852	4.499	4.362	8.018	12.413	4.558	6.065	13.218	13.699	6.323
G. 9	3.219	6.312	8.641	4.274	4.105	7.170	10.653	5.397	6.597	10.508	15.835	7.024
G. 10	3.031	6.588	10.782	3.799	5.200	7.987	10.844	4.540	6.523	15.487	14.043	6.936
G. 11	2.703	6.314	8.767	4.060	4.110	6.170	10.095	5.343	6.011	11.610	12.043	7.671
G. 12	2.864	4.829	6.569	2.411	3.553	4.934	8.336	3.251	4.678	7.792	11.692	5.415
G.13	2.413	7.447	8.828	4.085	4.077	8.986	10.192	4.190	6.285	10.455	12.179	6.804
G.14	3.856	9.112	11.049	5.304	5.757	9.732	13.194	6.654	7.274	15.235	16.981	9.825
G.15	3.680	7.667	11.262	5.123	4.864	8.695	12.372	5.903	8.312	15.187	16.594	7.967
G.16	3.019	7.122	8.153	3.386	4.612	8.213	11.153	5.009	5.782	12.348	14.560	7.812
G.17	2.194	5.633	9.305	3.117	3.835	7.157	10.789	3.789	6.449	10.542	13.155	6.690
G.18	1.689	5.547	6.106	2.337	3.731	5.714	9.077	3.309	6.980	8.582	11.198	6.467
G.19	2.711	6.679	7.983	3.730	5.136	8.425	11.871	4.562	5.159	12.646	13.827	6.509
G.20	2.674	6.087	9.775	4.282	4.426	7.516	10.242	4.836	6.651	14.718	16.384	7.017
G.21	2.827	7.247	8.495	3.645	4.572	7.940	10.144	4.256	6.990	11.975	14.386	6.446
G.22	3.655	6.287	7.674	4.123	4.740	7.662	11.213	4.643	5.651	9.896	14.421	7.316
G.23	3.220	6.394	7.851	3.281	4.489	6.453	11.020	4.412	8.007	14.292	13.754	7.380
G.24	3.433	5.989	8.984	3.418	3.672	6.544	11.325	5.344	6.192	12.652	12.049	7.101
G.25	3.129	6.420	8.886	4.057	4.613	8.805	9.775	4.959	6.750	12.170	12.733	7.674
Mean	2.813	6.517	8.717	3.921	4.430	7.487	10.464	4.697	6.465	12.370	13.896	7.087
L.S.D (G*S) P=0.05 P=0.01	1.628 2.150											

Protein content

Means of protein content of alfalfa genotypes under three years and four seasons each year are presented in Table (6). The population G.15 recorded the highest protein content in the winter season and the second year. Populations G.14, G.16 and G.18 in winter season gave the highest protein content. In the spring, G.14, G.16 and G.18 in the first and the second years and G.16, G.12 and G.16 in the third year recorded the highest protein content.

In the first and third year, G. 18 and in the second year, G.9 gave the highest protein content in the summer season. While in the autumn season, G. 16 in the first year gave the highest protein content. G.18 in the second year and the G. 20 in the third year gave the highest protein content.

High protein contents were obtained under winter season conditions in the three years followed by the autumn seasons in the first and the second years while the summer seasons gave the lowest protein content in the three years. Protein content results revealed a negative relationship with forage yield. Protein content of alfalfa during the studied seasons ranged from 22.262 (g/100g) for G.8/2013 to 14.036 (g/100g) for G. 4/2012. The highest protein content overall the three years was 20.647 (g/100g) for G.17 genotype that produced 26.478 t/ha green forage yield and 6.887 t/ha dry forage yield (Table 7). The protein content of alfalfa was different according to the cutting time due to different seasons and years.

In the first year of the experiment (Table 7) a lower protein content was obtained compared to the second year for the different harvest stages. Similar conclusion was reported by Decruyenaere *et al* (2008), Stanacev *et al* (2010) and Seiam and Farag (2019). According to the harvest stage, it was observed a reduction in crude protein (CP) and an increase in crude fiber (CF) in the latest harvest which could be explained by the evolution of stems and leaves containing more CP and less CF than stems.

Table 6. Means of protein content (g/100 g) of alfalfa genotypes across three years and 12 seasons.

Genotype	2012				2013				2014			
	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
G. 1	17.895	17.502	15.545	16.747	19.770	18.575	18.155	19.367	17.362	18.205	16.062	17.280
G. 2	16.470	16.410	14.940	15.335	17.987	17.372	17.177	17.792	16.387	16.282	15.547	16.295
G. 3	19.595	19.252	18.190	17.152	19.810	20.285	18.722	20.315	19.470	19.707	18.297	19.870
G. 4	14.035	13.840	13.990	14.280	17.055	16.130	16.717	16.430	15.507	15.307	14.407	15.390
G. 5	17.550	17.465	16.325	16.237	19.130	18.340	18.137	18.515	17.777	17.555	16.707	17.610
G. 6	17.500	17.355	16.405	16.515	18.070	17.235	17.195	17.502	16.485	16.405	15.517	16.500
G. 7	16.605	16.422	15.377	15.392	18.085	17.265	17.217	17.427	16.500	16.597	15.437	16.685
G. 8	18.672	18.532	17.505	17.605	20.335	19.490	19.322	19.902	18.407	18.347	17.702	18.482
G. 9	19.040	18.922	17.595	17.177	20.512	20.152	19.662	20.095	18.432	18.552	17.917	18.582
G. 10	19.405	19.197	17.635	17.262	20.700	20.215	19.420	20.472	18.445	18.320	18.007	18.317
G. 11	17.597	17.467	16.345	16.495	19.265	18.442	18.065	18.512	17.465	16.720	16.527	17.680
G. 12	19.045	18.737	17.307	17.122	20.790	20.000	19.502	20.327	18.747	18.617	17.107	18.590
G.13	17.455	17.467	16.312	16.482	19.125	18.447	18.015	18.417	17.532	17.630	16.537	17.700
G.14	19.665	19.250	17.165	17.285	20.790	20.367	18.755	20.325	18.602	18.520	17.107	18.490
G.15	18.747	18.572	17.305	17.522	21.300	19.517	19.122	19.655	18.280	18.527	17.597	18.540
G.16	14.747	14.552	13.767	14.387	17.260	15.317	16.232	15.687	14.492	14.515	13.600	14.710
G.17	19.287	18.752	17.592	17.160	20.635	19.590	19.425	19.770	19.572	18.435	18.045	18.872
G.18	19.560	19.310	18.222	17.542	20.090	20.297	19.085	20.505	18.705	18.435	18.482	18.520
G.19	17.085	16.690	15.277	15.292	17.922	17.107	16.750	17.290	16.682	16.092	15.280	16.340
G.20	18.945	18.405	17.625	17.747	20.415	19.595	19.347	19.752	18.565	18.595	17.830	18.690
G.21	18.802	18.355	17.427	17.542	20.360	19.445	19.147	19.612	18.370	18.547	17.707	18.600
G.22	18.852	18.482	17.535	17.297	20.730	19.547	19.262	19.785	18.690	18.605	18.005	18.760
G.23	16.507	16.255	15.445	15.660	18.235	17.127	16.740	17.515	16.415	16.395	15.617	16.340
G.24	14.592	14.320	13.675	14.060	17.357	16.217	16.110	16.170	15.355	14.677	13.957	15.120
G.25	16.620	16.180	13.535	14.225	16.745	16.475	16.485	16.795	15.052	14.610	13.507	14.760
L.S.D (G* S) P=0.05 P=0.01	0.265 0.350											

Table 7. Means of alfalfa genotypes for green forage yield (t ha^{-1}), dry forage yield (t ha^{-1}) and protein content (g /100 g) across three years.

Genotype	Green forage yield (t ha^{-1})				Dry forage yield (t ha^{-1})				Protein content (g /100 g)			
	2012	2013	2014	Mean	2012	2013	2014	Mean	2012	2013	2014	Mean
G. 1	23.610	26.113	35.854	28.525	5.626	6.219	9.757	7.200	16.922	18.966	17.227	17.705
G. 2	23.307	25.616	39.135	29.352	4.893	6.048	9.803	6.914	15.788	17.582	16.127	16.491
G. 3	27.841	29.908	41.242	32.997	6.080	7.100	9.856	7.678	18.547	19.783	19.336	19.222
G. 4	27.913	29.864	38.737	32.171	6.106	7.116	10.785	8.002	14.036	16.583	15.152	15.257
G. 5	26.632	28.890	42.931	32.817	6.345	7.194	11.894	8.477	16.894	18.530	17.412	17.612
G. 6	23.917	26.275	38.817	29.669	4.694	6.215	10.109	7.006	16.943	17.500	16.226	16.889
G. 7	20.510	22.682	30.824	24.672	3.860	5.464	7.622	7.982	15.949	17.498	16.304	16.583
G. 8	27.012	29.720	39.492	31.074	5.835	7.337	9.826	7.666	18.078	22.262	18.234	19.524
G. 9	27.906	30.297	40.629	32.944	5.611	6.831	12.267	8.903	18.183	20.107	18.370	18.886
G. 10	25.877	28.064	39.790	31.243	6.050	7.142	10.747	7.979	18.374	20.198	18.272	18.948
G. 11	25.935	27.790	38.176	30.633	5.461	6.429	9.333	7.074	16.976	18.571	17.098	19.014
G. 12	23.963	26.297	33.884	28.048	3.668	5.018	7.394	5.360	18.052	20.154	18.265	18.823
G.13	24.221	26.368	34.456	28.348	5.693	6.861	8.930	7.161	16.929	18.501	17.349	17.593
G.14	28.622	30.610	39.447	32.893	7.330	8.834	12.328	9.497	18.341	20.059	18.179	18.859
G.15	27.379	29.800	42.640	33.273	6.933	7.958	12.015	8.968	18.036	19.898	18.236	18.723
G.16	24.834	27.165	36.611	29.536	5.420	7.246	10.125	7.597	14.363	16.124	14.329	14.938
G.17	22.378	24.898	32.158	26.478	5.062	6.392	9.209	6.887	19.497	22.313	19.931	20.580
G.18	18.991	21.648	37.635	26.091	3.919	5.457	8.306	5.894	18.658	19.994	18.535	19.062
G.19	25.875	28.426	36.032	30.111	5.275	7.498	9.535	7.375	16.086	17.267	16.098	16.483
G.20	26.262	29.043	42.722	32.675	5.704	6.755	11.192	7.883	18.180	19.777	18.42	18.792
G.21	25.134	27.450	36.644	29.742	5.553	6.728	9.949	7.410	18.031	19.641	18.306	18.659
G.22	24.413	26.675	35.059	28.715	5.434	7.064	9.321	7.273	18.041	19.831	18.515	18.765
G.23	23.898	26.152	36.490	28.846	5.186	6.593	10.858	7.545	15.966	17.404	16.191	16.520
G.24	25.679	27.848	35.018	29.515	5.456	6.721	9.498	7.225	14.161	16.463	14.777	15.133
G.25	24.837	27.529	38.215	30.193	5.623	7.038	9.831	7.497	15.140	16.625	14.482	15.415
Mean	25.077	27.405	37.705	30.022	5.472	6.770	10.019	7.538	17.003	18.609	17.266	17.626
L.S.D $_{(0.05)}$ Years	3.503				0.815				0.286			
L.S.D $_{(0.05)}$ genotypes	1.823				0.471				0.385			
L.S.D $_{(0.05)}$ genotypes x years	6.260				1.596				0.292			

Moreover, Heinriches (1970) and Babinec *et al* (2001) pointed out that losses of leaves are important because the protein concentration was higher in leaves than in stems. The crude protein content and the crude fiber contents vary between very wide limits depending largely on the development stage of alfalfa (Dale 2011). Protein content varied in response to the growing season. Winter and autumn growth showed higher protein content than spring and summer (Abd El-Halim *et al* 1992 and Seiam and Farag 2019).

Genetic parameters

The variances in terms of genotypic ($\boldsymbol{\sigma^2_G}$) and phenotypic ($\boldsymbol{\sigma^2_{Ph}}$) as well as, genotypic (G.C.V.) and phenotypic (P.C.V.) coefficient of variability, heritability in broad sense (h^2_b), and genetic advance under selection using 20% selection intensity are presented in Table (8). A wide range of variability was observed for fresh forage yield and dry forage yield traits. The maximum range of variation indicated that genotypes vary in productivity as a consequence of genetic variability (Bakheit 1986). Data showed that the years and seasons effect was limited, while the genotypic variance relative to phenotypic variance for all traits, indicated that the environmental effect was limited. The phenotypic coefficient of variance (P.C.V.%) varied from 1.73 % for protein content to 6.89% for fresh forage yield. On the other hand, genotypic coefficient of variation (G.C.V. %) varied from 1.43 % for protein content to 6.48% for fresh forage yield. The highest values of P.C.V. % and G.C.V. % for fresh forage yield are evidence for 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 limited effects of environments on these traits due to its confounding by the genotypes x years interaction. Also, this was reflected in higher estimates of heritability in broad-sense.

Table 8. Mean, range, genetic variance (σ^2_G), environmental variance (σ^2_E), and genetic x Environment variance (σ^2_{GE}), phenotypic variance (σ^2_{Ph}), heritability estimates (h^2_b), expected genetic advance (ΔGs), and percent of advance to the mean (Gs%) for studied characters across 12 seasons(4 seasons for 3 years).

Genetic parameter	Green forage yield	Dry forage yield	Protein content
Range	33.974-23.817	9.497-5.360	19.222-14.938
Mean	30.022	7.538	17.626
σ^2_G	3.789	0.186	0.064
σ^2_E	20.790	1.396	0.035
σ^2_{GE}	0.262	0.434	0.114
σ^2_{Ph}	4.287	0.323	0.093
GCV%	6.48	5.72	1.43
PCV%	6.89	7.53	1.73
h^2_b%	88.38	57.58	68.81
ΔGs	2.56	0.457	0.292
Gs%	8.52	6.06	1.65

σ^2_E: environment variance, σ^2_G: genotypic variance. σ^2_{GxE} genotypic x environment variance, σ^2_{Ph}: phenotypic variance, P.C.V.: phenotypic coefficient of variability, G.C.V.: genotypic coefficient of variability.
$h^2_{b:}$ heritability estimates, ΔGs: expected genetic advance and Gs%: percent of advance to the mean.

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), Abo El- Goud *et al* (2015) and Badawy *et al* (2018).

Heritability in broad sense ranged from 88.38% for fresh forage yield to 57.58% for dry forage yield. These results indicated that these traits were less influenced by the environment. These results are in agreement with those reported by Abo El- Goud *et al* (2015), Radwan *et al* (2015) and Badawy *et al* (2018).

The expected genetic advance (ΔGs) for total green forage yield, total dry yield, and protein content was 8.52, 6.06 and 1.65% respectively. The success of selection programs for forage yield and its components depend mainly on large genetic variability that has been found for morphological traits along with forage yield. The heritability of the selected traits, the nature of correlations between different characters and the intensity of selection applied are also important for the success of selection (Abdel Galil 2007, Veronesi *et al* 2010, Bakheit *et al* 2011, Hamd Alla *et al* 2012, Annicchiarico 2015 and Badawy 2017). The results are in harmony with those of Martiniello and Iannucci (1998), Abo El- Goud *et al* (2015) and Badawy (2017).

Thus, from the previous results, it could be concluded that, selection in this populations is good to improve these traits and also the genotypes G.15, G.3, G.9 and G.14 available a new promising to produce as a variety and their use in further breeding programs

REFERENCES

Abd El-Galil, M.M. (2007). Yield potential, genetic variation, correlation and path coefficient for two newly developed synthetics and three commercial varieties of alfalfa. Egyptian, J. Plant Breeding, 11 (3):45-54.

Abd El-Galil, M.M. and N.M. Hamed (2008). Evaluation of yield potential, genetic variances and correlation for nine cultivars of alfalfa under the New Valley environment. J. Agric. Sci. Mansoura Univ., 33(7): 4681-4686.

Abd El-Galil, M. M, M. A. S. Abdel-Gawad and I. A. Hanna (2000). Evaluation of dry matter productivity of seven alfalfa cultivars and stability performance under different environments. Egypt. J. Sci., 15(8): 37:48.

Abd El-Halim, A.Z., I. A. Hanna and T.A. Mahmoud (1992). Productivity and forage quality of some alfalfa cultivars on newly reclaimed sandy soils. Egypt .J. Appl. Sci., 7 (9): 407-427.

Abo EL-Goud, Sh. A., H. O. Sakr, S. S. M. Abo-Feteieh and M. M. Abd El- Galil (2015). Selection within and between farmer seed lots of Egyptian Clover to develop highly productive populations tolerant to high level of salinity. J. Plant Prod. Mansoura Univ., 6 (12): 2163-2176.

Abd EL-Naby, M. Zeinab, R. N. Magda, and I. M. Ahmed (2015). Evaluation of some promising berseem clover populations for yield, quality, genetic variability and path-coefficient analysis. Egypt. J. Plant Breed. 19(1): 215-227.

A. O. A. C. (1990). Official Methods of Analysis of the Association official Analysis Chemist. 15 ed. Washington. D. C. USA

Annicchiarico P. (2015). Alfalfa forage yield and leaf/stem ratio: narrow-sense heritability, genetic correlation, and parent selection procedures. Euphytica, 205:409–420

Avci, M., S, Cinar, C. Yucel and I. Inal (2010). Evaluation of some selected alfalfa (*Medicago sativa* L.). lines for herbage yield and forage quality. Journal of Food, Agriculture & Environment., 8: 545-549.

Babinec, J., Z. Kozova, E. Strakova, P. Suchy (2001). The variance of the amino acids in some Lucerne (*Medicago sativa* L.) populations. In I. Delgado, & J. Lloveras, Quality in Lucerne and medics for anomal production (pp. 235-239). Zaragoza (Spain): CIHEAM.

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

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

Badawy, A. S. M.; S. M. EL-Nahrawy and A. T. Bondok (2018). Genetic variability and path- coefficient analysis for forage yield and its components in Egyptian clover. J. Agric. Chem. and Biotechn., Mansoura Univ., 12: 295 – 301.

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. (1986). Genetic variability, genotypic and phenotypic correlations and path-coefficient analysis in Egyptian clover (*Trifolium alexandrinum*, L.). J. of Agron. and Crop Sci., 157(1): 58-66.

Bekhit, B.R. (1988). Variation, correlation and path-coefficient analysis in some world varieties of alfalfa (*Medicago sativa* L.). Assiut J. of Agric. Sci., 19(5): 149-163.

Bakheit, B.R., and M.A. Ali (2013). Improvement of single cut Egyptian clover (*Trifolium alexandrinum* L.) by mass and family selection methods. Asian Journal of Crop Science, 5: 304-311.

Bakheit, B.R., M.A. Ali and A.A. Helmy (2011). Effect of Selection for Crown Diameter on Forage Yield and Quality Components in Alfalfa (*Medicago sativa*, L.). Asian Journal of Crop Science, 3: 68-76.

Bakheit, B.R. and M.A. El-Nahrawy (1997). Altenative approaches to alfalfa population improvement. Egypt. J. Plant Breeding, 1:27-34.

Bosca, I., J. Buglos and I. Sziraki (1983). Breeding Lucerne for tolerance to frequent cutting and physiological aspects of tolerance. Plant Breed. Abst., 53 (8): 6526.

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

Dale, L. M. (2011). Determination of forage quality by destructive and non-destructive methods. PhD thesis. USAMV Cluj, 330p.

Decruyenaere, V., P. Lecomte, C. Demarquilly, J. Aufrere, P. Dardenne and D. Stilmant (2008). Evaluation of green forage intake and digestibility in ruminants using near infrared reflectance spectroscopy (NIRS): Developing a global calibration. Animal Feed Science and Technology, 148: 138-156.

El-Doss, A. (2001). Effect of cutting frequency on forage yield and regrowth characteristics of non-dormant alfalfa. Alexandria J. Agric. Res., 46 (2): 63-71.

El-Nakhlawy, F.S., M.A. Shaheen and A.R. Al-Shareef, (2012). Response of Forage Yield, Protein and Proline Contents of Alfalfa Genotypes to Irrigation Water Salinity and Phosphorus Fertilizer. International Journal of Food, Agriculture & Environment 10(1): 551 – 557.

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

Hamd Alla, W. A., B. R. Bakheit, A. Abo- Elwafa and M. A. El-Nahrawy (2012). Effect of mass selection for root characteristics on forage yield and some of its components in alfalfa. Egypt. J. Plant Breed. 3:1 – 18.

Heinriches, D. (1970). Variation of chemical constituents within and between alfalfa populations. In M. Norman, 11th Proc. Int. Grassl. Congr. (pp. 267-270). St. Lucia, Queensland: University of Queensland Press.

Hill, Jr. R. R. and J. E. Baylor (1983). Genotypic x environment interaction analysis for yield in alfalfa. Crop Sci., 23: 811-815.

Jung, H. G., C. C. Sheaffer, D. K. Barnes and J. L. Halgerson (1997). Forage quality variation in the U.S. alfalfa core collection. Crop Sci., 37: 1361-1366.

Lioveras, J., A. J. Ferran, A. Alvarez and L. Torres (1998). Harvest management effects on alfalfa (*Medicago sativa* L.) production and quality in Mediterranean areas. Grass and Forage Science J., 533: 88-92.

Marbel, V. L. (1989). Fodders for the Near East: Alfalfa. FAO. Plant Production and Protection Paper 97/1, pp. 207.

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

Michaud, R, W.F. Lehman and M.D. Rumbauch (1988). World distribution and historical development. In: Hanson A.A., D.K. Barnes, R.R. Hill, Alfalfa and Alfalfa Improvement. Agronomy Monograph 29: 25-91.

Mousa, M.E., I.A. Hanna and Z.M. Marei (1996). Evaluation of some alfalfa (*Medicago sativa* L.) cultivars for growth and yield in sandy soil at North East of Egypt. Zagazig J. Agric. Res., 23: 29-49.

Nascimento, M., Peternelli L. A., Cruz C. D., Nascimento A. C. C., Ferreira R. P., Bhering L. L. and Stalgado C. C. (2013). Artificial neural networks for adaptability and stability evaluation in alfalfa genotypes. Crop Breeding and Applied biotechnology 13: 152-156.

Oushy, H.S., M.M. AbdEl-Galil and N.M. Hamd (2007), Performance of local and exotic alfalfa cultivars under different environmental conditions in Egypt. Egypt. J. Agric. Res., 85: 2201-2217.

Oushy, H.S., O. Niemelainen, M.A. El-Nahrawy and I.A. Hanna (1999). Seasonal variation in performance of alfalfa genotypes under sandy soil condition. I- Yield and yield components. Egypt. J. Plant Breeding, 3: 281-296.

Radwan, M. S., K. I. A. Gawad, M. Th. Hassan, Hoda I. M. Ibrahim and W. M. EL-Debeiky (2015). The effect of planting density on estimates of genetic variance, heritability and correlation between traits of berseem clover. Egypt. J. Plant Breeding, 18 (3): 389-403.

Rammah, A.M. and A.S. Hamza (1980). Cutting schedules and seasonal effect on yield and quality of alfalfa. Annals of Agric. Sci. Moshtohor, 14: 61-74.

SAS Institute (2014). SAS System for Windows version 9.31. SAS Inst., Cary, NC.

Seiam, A. Mofeeda and Sahar A. Farag (2019). Balanced Parameters for Genotype X Environment Interaction in Some Alfalfa Genotypes. Alex. J. Agric. Sci. Vol. 64, No.6: 385-397.

Sheafer, C. C., G. D. Lacefield and V. L. Marvle (1988). Cutting schedules and stands .P. 411-438. In A.A. Hanson, (ed.) Alfalfa and Alfalfa Improvement. Agron. Monogr. 29 ASA, CSSA. SSSA, Madison. WI.

Stanacev, V., D. Dukic, S. Kovcin, M. Drinic, N. Puva, V. Stanacev (2010). Nutritive value of the genetically divergent genotypes of Lucerne (*Medicago sativa* L.). Africa Journal of Agricultural Research, 5 (11): 1284-187.

Steel, R. F., J. H. Torrie and D.A. Dickey (1997). Principles and Procedures of Statistical 3rd ed. McGraw- Hill Book Co. Inc. NEW York.

Younis, A. A., A. 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. Proc. of the 2nd Egyptian Conf. of Agron. (ECA'86), Alex.: 773-788.

Verondeso, F., A. Mariani, M. Falciivelli and S. Arcioni (1986). Selection for tolerance to frequent cutting regimes in Lucerne. Cop Sci., 26: 58-61.

Veronesi, F., E.C. Brummer and C. Huyghe (2010). Alfalfa. In:” B. Boller *et al.* (eds.), Fodder crops and Amenity Grasses, Handbook of Plant Breeding, Springer Science + Business Media, P: 395-437.

تقييم وأنتخاب بعض التراكيب الوراثيه من البرسيم الحجازى لمحصول العلف العالي و البروتين

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٢. قسم بحوث فسيولوجيا المحاصيل – معهد المحاصيل الحقليه – مركز البحوث الزراعية

اجريت هذه الدراسة خلال أربع فصول لكل من السنوات الثلاث ٢٠١٢، ٢٠١٣، ٢٠١٤ .وذلك لانتخاب افضل التراكيب الوراثية والمستديمة الانتاجية وتم تقييم كل من صفة المحصول الاخضر الطازج والمحصول الجاف

والمحتوى البروتينى خلال أربعة فصول x ثلاث سنوات. اجريت هذه الدراسة فى محطة البحوث الزراعية بالنوبارية على خمسة وعشرين تركيب وراثى من البرسيم الحجازى, حيث تمت الزراعة في الخامس من اكتوبر٢٠١١. و قد اوضحت النتائج ان صفة المحصول الاخضر الطازج للتراكيب الوراثية الخمس والعشرون قد تاثرت كثيرا بالمواسم خلال الثلاث سنوات. أظهر التركيب لاوراثى رقم ١٥ تفوقا حيث أعطى أعلى متوسط محصول أخضر ٤٦,١٦٣ و ٤٨,١٦٣ و ٥٥,٩٣٩ . فى السنة الأولى و السنة الثانية والسنة الثالثة على التوالى خلال فصل الصيف. بينما اعطى التركيب الوراثى رقم ٥ أعلى متوسط محصول أخضر خلال فصل الخريف فى السنة الأولى و السنة الثانية حيث كان ٢٤,٢٣٣ و ٢٦,٢٣٣ طن/هكتار, بينما فى السنة الثالثة أعطى التركيب الوراثى رقم ٣ أعلى متوسط محصول أخضرحيث كان ٣٥,١٣٥ طن/هكتار. اعطى التركيب الوراثى رقم ١٥و ٣و ٩و ١٤ متوسط محصول اخضر ٣٣,٢٧٣ و ٣٢,٩٩٧ و ٣٢,٩٤٤ و ٣٢,٨٩٣ طن/هكتار علي التوالي وقد كانت قيم متوسطات محتوى البروتين لتلك التراكيب الوراثية ١٨,٧٢٣ و ١٩,٢٢٢ و ١٨,٨٨٦ و ١٨,٨٥٩ (جم/١٠٠جم) على التوالى. أظهرت النتائج ان الفرق بين معامل الأختلاف الوراثى والمظهرى كانت ضيقه حيث كانت ٦,٤٨ و ٦,٨٩% للمحصول الأخضر و٥,٧٢ و ٧,٥٣% للمحصول الجاف و١,٤٣ و ١,٧٣ و % على التوالى. كانت كفاءة التوريث بمفهومها الواسع لصفة المحصول الأخضر ٨٨,٣٨% أعلى من صفة المحصول الجاف و محتوى البروتين حيث كانت ٥٧,٥٨ و ٦٨,٨١% على التوالى. العائد المتوقع من الأنتخاب للمحصول الأخضر والجاف والبروتين كان ٨,٥٢ و ٦,٠٦ و ١,٦٥% على التوالى. يتضح من ذلك ان الأنتخاب بين التراكيب الوراثيه جيد لتحسين صفة المحصول الأخضر الجاف والمحتوى البروتينى وان التراكيب الوراثيه رقم ١٥ و٣ و ٩ و ١٤ مبشرة لأنتاج صنف جديد و أستخدامهم فى برامج التربيه.

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