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PREDICTING THE PERFORMANCE OF BARSEEM CLOVER "*TRIFOLIUM ALEXANDRINUM* , L" FAMILIES IN MIXTURES WITH ITALIAN RYE-GRASS CULTIVARS *VIA* MIXING ABILITY ANALYSIS

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ABSTRACT: *Italian rye- grass had proposed as a compatible component to barseem- grass mixture. A method for estimating the performance of barseem families (genotypes) in mixtures would be beneficial to breeders interested in selecting genotypes that perform well in mixtures. The objective of this study was to identity a rye-grass cultivar that would be more suitable for selecting competitive barseem families for the formation of mixtures through two- factor analysis. Sixty half – sib barseem families three Italian rue- grass cultivars and 180 binary mixtures had evaluated using dry forage yield of the third cutting. Overall mixtures, dry forage yield increased by 0.735 Mg ha^{-1} or about 31.69 % compare with the average of both barseem families and rye- grass cultivars. Two factor analyses for mixing ability had successfully identified Liflona rye- grass cultivar that had the highest contribution in increasing dry forage yield of mixtures, as the most competitive cultivar, since; it expressed the highest negative competitive effect, the least general mixing ability (GMA) values and the most frequent negative specific mixing ability (SMA) effects with barseem families. Consequently, Liflona rye-grass is the most suitable cultivar for testing selecting barseem genotypes with high compatibility to form barseem – rye grass mixtures. Also, the 60 tested barseem half sib families had separated depending on GMA effects to; a very good combiners that expressed the highest positive GMA values (Families coded 6, 14, 23, 25, 50 and 55); good combiners (families coded 2, 2, 5, 10, 36 and 44); a compatible combiners (families coded 5, 31, 32, 43, 48, 52 and 53) and wear combiners (families coded 38 and 57). SMA effects had usefully separated the most competitive barseem half – sib families, that had the highest positive SMA values with the most competitive rye- grass cultivar "Liflona" (families coded 1, 12, 18, 23, 30, 31, and 37).*

***Key words**: Barseem clover, mixture, two- factor analysis, mixing ability, rye- grass Cultivars.*

INTRODUCTION

Barseem clover "*Trifolium alexandrinum* , L."is the most adapted forage legume to Egypt. This legume is most often grown alone. Barseem forage has high protein and low energy along with high moisture, especially at early cuttings (Radwan *et al.,*1977). Growing barseem with grass in mixtures had proposed as a technique to improve quality , productivity and botanical composition (Abou-Raya *et al*., 1965;Abou-Raya and Shehab,1971; Abou-Raya and Ibrahim,1975; Ibrahim *et al.*,1978, Ahmed and Nour,1996 and Ahmed, 1999). However, physiological growth requirements and regrowth potentiality among components of an interspecific mixture, often preclude the effective use of management practices to maintain components in the mixture (Casler, 1988). Even, if both components can be maintained in a binary mixture, it may be difficult to maintain each component at specific level (Smith *et al.,*1986).This becomes an even more difficult proposition when management of the mixture is based on factors related to only one component of the mixture (Smith,1968).

A botanically stable and productive barseem-grass mixture is often difficult to maintain because of a high degree of competition between its components through the successive cuttings. Though, barseem often has deeper root system than grass, it also exhibit lower water-use efficiency. The fibrous nature and low cation-exchange capacity of grass roots give grasses an advantage over legumes in extracting monovalent cations from the soil. On the other hand, nitrogen relationship may be largely non-competitive (Haynes, 1980).However, Farmers are unlikely to adopt the increased cost and complexity of managing mixtures without demonstrated evidence of potential advantage over monocultures.

Italian rye-grass "*Lolium multifloium*,Lam."had proposed as a compatible component to barseem-grass mixtures (Ahmed and Nour,1996). The stability of mixture components through cuttings had largely related to the genetic nature of mixed species (Ahmed,1999).Mixtures may perform equal to, better or worse than the mean of the components grown in monocultures (Ahmed,2007). Thus, a method for estimating the performance of barseem genotypes in mixtures would be beneficial to breeders interested in selecting genotypes that perform well in mixtures.

One method of estimating the compatibility of a genotype in a mixture is to use two-factor analysis similar to combining ability procedure. Jensen and federer (1965) used model I, method I of a combining ability analysis developed by Griffing (1956) on wheat cultivar mixtures. They found a significant general combining effect, which they termed general competing (combining) effect (GME),but no specific competing (combining) effect (SME).General competing ability was calculated as the average performance of a cultivar in mixtures . Specific competing ability, was considered an indication of how well certain combinations performed, compared to that expected from their average abilities over all mixtures.Gizlice *et al*., (1989), adapted methodIII ,model I of Griffing (1956), to estimate general blending ability (GBA) and an interaction term analogous to specific combining ability (SCA) of Soybean "Glycin max,L.", cultivars. These terms are analogous to those developed by Federer *et al.,* (1982) for use in mixtures . Ahmed (2007), adapted line x tester analysis (Kemthorne,1957) for estimating general and specific mixing abilities, which had referred to as general mixing ability (GMA) and specific mixing ability (SMA), when applied to the performance of forage mixtures.

The main objectives of this study were to identify a rye grass cultivar that would be more suitable for selecting barseem genotypes for the formation of mixtures and to examine two-factor analysis to study mixing abilities (or compatibilities) of barseem clover families.

MATERIALS AND METHODS

Barseem Families formulation:

The base population of barseem clover under study was an improved population of multi-cut barseem (Ahmed, 2006). In 2008-2009 seasons, seeds of the base population had sown in 400 rows, 20 cm apart and 4.0 m. long at the rate of 31.4 kg ha^{-1}. The Agricultural Experimental Farm of Alexandria University (ten kilometers south of Alexandria) was the test site. Cultural practices were applied as recommended for optimum barseem productivity in the region. Five cutting were taken before adjusting spacing within row to 10 cm among plants, through uprooting small-tagged plants. 200 plants were visually selected before flowering , depending on crown size and general performance .Those selected plants were marked by wood Sticks tagged "OP" to indicate the collection of their open pollinated seeds .Other unselected plants were uprooted. The highest seed producing 60 plants (seed yield ≥ 15.09 g) had saved as half-sib families.

Families' evaluation:

In 2009-2010 season, the 60 half-sib barseem families were evaluated in four sets, each with fifteen families. Each set was treated as a randomized complete block experiment in two blocks. The families were mixed with each of Liberla, Ligrande and Liflona, Italian rye-grass "*Lolium multiflorium westerwoldicum*, lam" cultivars, in two-way combinations, so that ,45 mixtures were developed. Mixtures components were represented by two thirds of barseem and one third of rye-grass monoculture seeding rates. Mixtures and monocultures (45+15+three) had represented the tested treatments.

One-row plots of one meter length and 20 cm apart were used. Seeding rate was 31.4 kg ha $^{-1}$ for barseem and rye-grass monocultures. Data had determined from the middle half meter of each plot (0.1 m^2). Green forage yield, had determined for three cuttings, where, only the third cut had used in mixing ability analysis. The harvested forage had hand-separated to grass and barseem to determine barseem percentage by weight. Dry matter samples had randomly taken at the time of harvest for plot component(s), weighed immediately, and then dried at 70 ^{0}c until weight constancy. Dry matter percentage of mixtures was determined by weighing dry matter of components times' components percentage in mixture. These figures were used for determining dry forage yield.

Statistical analysis:

Analysis of variance had performed on dry forage yield and barseem percentage using MSTAT-c package (Michigan State university, 1996). Two factor analyses, provides a method for estimating general and specific combining ability, which will be referred to as general mixing ability (GMA) and specific mixing ability (SMA), when applied to the performance of barseem families and mixtures (Ahmed ,2007). General mixing ability is the average performance of a family in a mixture, and is calculated according to the following model

$$\bar{X}_{ij} = \mu + g_i + g_j + S_{ij}$$

And, consequently, the gi, gj, and Sij were calculated as:

$$g_i = \bar{X}_{i.} - \bar{X}_{..}$$

$$g_j = \bar{X}_{.j} - \bar{X}_{..}$$

$$S_{ij} = \bar{X}_{ij} - \bar{X}_{i.} - \bar{X}_{.j} + \bar{X}_{..}$$

Where:

$\bar{X}_{ij}$ =mean of a mixture ij,

$\bar{X}_{i.}$= mean of all mixtures having barseem family i.

$\bar{X}_{.j}$ = mean of all mixtures having a rye grass cultivar j.

$\bar{X}_{..}$ = overall mean of all the mixtures

The competitive effect for each mixtures combination was calculated as the different between the mean of the mixture ($\bar{X}_{ij}$) and expected mean as an average of its two Component monocultures components monoculture as follows:

Competitive effect $= \bar{X}_{ij} - \left(\bar{X}_{mi} * 0.67 + \bar{X}_{mj} * 0.33\right)$

Where:

$\bar{X}_{mi}$: mean of barseem family monoculture

$\bar{X}_{mj}$; mean of Italian rye- grass cultivar monoculture

RESULTS AND DISCUSSION

Combined analysis of variance over sets for the third cutting dry forage yield of sixty half- sib families of barseem clover, three Italian rye- grass cultivars and 180 binary mixtures grown in 2009 -2010 winter season were presented in Table 1. Differences among the studied forages (sixty barseem monocultures, three Italian rye- grass monocultures and 180 barseem – rye grass binary mixtures) were highly significant (P≥ 0.01). Orthogonal partioning of variation among forages resulted in highly significant (P≥ 0.01) three components; monocultures, monocultures *vs*. Mixtures and among mixtures. The variations among mixtures were analyzed, using two- factor analysis, showing general mixing ability (GMA) barseem, GMA rye-grass and specific mixing ability (SMA). The three aforementioned components were highly significant (P≥ 0.01).

Means of third cutting dry forage yield of three Italian rye- grass cultivars and sixty barseem half- sib families monocultures, had presented in Table2. Rye- grass cultivars, gave significantly similar dry forage yield, amounted to about 2.008 Mg ha^{-1} in average. Barseem half– sib families, significantly yielded variable dry forage ranged between 3.672 and 0.722 Mg ha^{-1}. This indicates that significant variations among the studied forages monocultures (Table 1) were basically due significant variations among barseem families. Only one barseem family had significantly yielded over 175% of the families over all mean (family 14 with 3.672 Mg ha^{-1}). Meanwhile, six half sib Families had significantly yielded about 150% of families over all mean (family number 10 (3.051 Mg ha^{-1}), family number 20 (3.139 Mg ha^{-1}), family number 24 (2.969 Mg ha^{-1}), family number 28 (2.990 Mg ha^{-1}), family number 36 (3.142 Mg ha^{-1}), and family number 41 (3.189 Mg ha^{-1}). In the meantime, significantly superior four families had produced 125% of the over all families dry forage mean yield (family number 6 (2.629 Mg ha^{-1}), family number16 (2.693 Mg ha^{-1}), family number32 (2.669 Mg ha^{-1}), and family number 40 (2.622 Mg ha^{-1})). While, twenty two barseem half- sib families had significantly yielded less dry forage yield than the overall average. The least significant dry forage yield had recorded by family number 79 (0.722 Mg ha^{-1})).

Table (1): Combined analysis of variance for third cutting dry forage yield of sixty barseem half-sib families and three Italian rye – grass varieties and 180 binary mixtures grown in 2009/2010 winter season .

Source of variation	d.f.	Mean squares
Sets	3	3.42
Reps/Sets	4	2.698
Forages/Sets	248	0.5320**
Monocultures	68	0.7564**
Mono. *vs*. Mix.	1	10.20**
Mixtures	176	0.5154**
GMA(barseem)	14	48.90**
GMA(rye-grass)	2	69.5**
SMA (barseem **x** rye-grass)	28	8.007**
Combined error	248	0.434

**** Highly significant at 0.01 level.**

Table (2): Means of third cutting dry forage yield for sixty barseem half- sib families and three Italian rye – grass cultivars.

Barseem families monoculture	Dry forage yield ($Mgha^{-1}$)	Barseem families monoculture	Dry forage yield ($Mgha^{-1}$)	Barseem families monoculture	Dry forage yield ($Mgha^{-1}$)	Barseem families monoculture	Dry forage yield ($Mgha^{-1}$)
1	2.218	16	2.693	31	1.639	46	1.724
2	2.296	17	1.757	32	2.669	47	1.749
3	1.470	18	2.105	33	2.163	48	2.220
4	1.118	19	1.363	34	1.776	49	0.722
5	2.337	20	3.139	35	2.382	50	1.748
6	2.629	21	1.876	36	3.142	51	1.899
7	1.767	22	1.576	37	2.295	52	1.939
8	2.245	23	2.221	38	2.208	53	1.286
9	2.124	24	2.969	39	1.360	54	1.862
10	3.051	25	2.503	40	2.622	55	1.339
11	2.369	26	1.813	41	3.189	56	1.704
12	1.139	27	1.921	42	2.086	57	1.039
13	1.927	28	2.990	43	2.094	58	1.826
14	3.627	29	1.838	44	2.380	59	1.447
15	1.852	30	1.851	45	2.540	60	1.817
Italian rye-grass monocultures							
Liberla	2.400						
Ligrande	2.313						
Liflona	2.302						
Average	2.338						
$L.S.D_{(0.01)}$	**0.217**						

Mixtures of barseem half- sib families cultivars with Italian rye- grass cultivars, had presented in Table 3. Significantly (P≥ 0.01) superior mixtures in dry forage yield had expressed by barseem family number 18 with both ligranda and Liflona rye- grass varieties (2.867 and 2.960 Mg ha^{-1}, respectively), family number 19 with both Liberla and ligranda rye- grass cultivars (2.891 and 2.954 Mg ha^{-1}, respectively), family number 23 with both ligranda and Liflona rye- grass cultivars (2.642 and 3.035 Mg ha^{-1}, respectively), family number 32 with Liberla and Liflona rye- grass cultivars (3.116 and 2.513 Mg ha^{-1}, respectively), family number34 with ligranda and Liflona rye - grass cultivars (2.884 and 2.519 Mg ha^{-1}, respectively), families number 41 , 42 and 43 with Liberla and ligranda rye- grass cultivars (2.947, 2.629; 3.226, 3.069; 3.058, 2.659 Mg ha^{-1} for the two successive rye- grass cultivars, respectively), family number 50 with Liberla and Liflona rye- grass cultivars (3.180 and 3.162 Mg ha^{-1}, respectively), families number 53, 54 and 56 with librela and Liflona rye- grass cultivars (3.014 , 2.978; 2.796, 2.927; 2.796, 2.927 Mg ha^{-1} for the two successive rye- grass cultivars, respectively), and family number 55 with Liberla and Liflona rye- grass varieties (2.991 and 3.549 Mg ha^{-1}, respectively). In the mean time, barseem families number 3, 6, 25, 46 and 44 gave Significantly (P≥ 0.01) superior dry matter yields when mixed with Liberla rye- grass cultivars(3.007, 3.383, 3.103, 3.416 and 3.021 Mg ha^{-1}, respectively). While, barseem family number 18, significantly yielded superior dry matter yield, when mixed with Ligrande rye- grass cultivar (3.034 Mg ha^{-1}). Also, barseem families number 2, 3, and 37 significantly (P≥ 0.01) yielded superior dry matter yield, when mixed with Liflona rye – grass variety (3.3, 3, 3.316 and 3.116 Mg ha^{-1}, respectively). Light, water and nutrients my be completely absorbed and converted to dry forage biomass by mixtures rather than monocultures. This might be the result of differences in competitive ability for growth factors between mixtures components (Anil *et al*. 1998; Ofori and Stern 1987; Willey 1979). In terms of competition this means that the components are not competing for the same ecological niches, and that interspecies competition is weaker than intraspecific competition for a given factor (vandermeer, 1989). This might explain the superiority of barseem families-rye grass mixtures over the monoculture (Zarea *et al* 2010).

Table 3: Mean of third cutting dry forage yield for 180 barseem half – sib families x Italian rye- grass cultivar mixture.

Barseem family code	Italian rye- grass variety			Barseem family code	Italian rye- grass variety		
	Liberla	Ligrande	Liflona		Liberla	Ligrande	Liflona
1	2.454	1.563	3.037	31	2.491	2.833	3.316
2	2.307	1.212	3.313	32	2.101	3.116	2.513
3	3.007	1.065	2.334	33	2.219	2.326	2.224
4	2.588	1.632	1.664	34	2.884	2.219	2.519
5	2.876	2.157	1.806	35	2.972	2.505	1.876
6	3.383	1.597	2.523	36	2.258	2.914	2.532
7	1.060	1.672	1.502	37	2.342	2.263	3.116
8	1.610	1.065	1.948	38	2.093	2.396	1.493
9	1.923	1.831	1.371	39	2.739	1.755	2.722
10	2.369	2.200	1.554	40	1.782	2.836	2.148
11	1.008	1.760	1.709	41	2.629	2.947	2.139
12	2.354	1.670	2.765	42	3.096	3.226	2.465
13	1.601	1.831	1.898	43	2.659	3.058	2.408
14	2.062	2.806	1.346	44	2.467	2.295	2.333
15	2.482	2.482	2.046	45	1.889	1.889	2.601
16	2.183	2.048	1.514	46	3.416	2.512	1.989
17	2.877	2.416	1.428	47	2.913	1.975	2.482
18	2.867	1.723	2.960	48	2.521	3.034	1.996
19	2.954	2.891	1.623	49	3.021	2.218	2.045
20	1.884	2.008	1.883	50	2.537	3.180	3.162
21	2.569	2.848	1.641	51	2.326	2.627	1.785
22	2.547	2.223	2.075	52	2.596	2.922	2.231
23	2.642	2.340	3.035	53	3.014	2.373	2.978
24	2.600	1.713	1.872	54	2.796	1.919	2.927
25	3.105	2.736	2.368	55	2.443	2.991	3.549
26	2.670	2.808	2.011	56	2.679	2.500	2.698
27	2.335	2.478	2.309	57	1.986	1.999	2.230
28	0.726	2.959	1.834	58	2.094	2.608	2.414
29	1.535	2.641	2.025	59	2.185	2.446	2.718
30	1.667	1.667	2.413	60	2.569	2.569	1.713

Average	
Barseem – Liberla	2.399
Barseem- Ligrande	2.308
Barseem- Liflona	2.252
Over all mixtures	2.319
$L.S.D_{(0.01)}$	0.217

Over all barseem families, mixtures with both of Liberla and ligranda had significantly yield higher dry matter relative to Liflona rye-grass cultivar (2.399 or 2.308 vs. 2.252 Mg ha^{-1}, respectively). The average of all barseem half- sib families monocultures was significantly (P≥ 0.01) lower than the average of any of the studied rye- grass cultivar monocultures. The over all average of all studied 180 mixtures was significantly higher (P≥ 0.01) than the over all average of barseem families monocultures (2.319 vs. 2.062 Mg ha^{-1}). In the mean time, the average over all the 180 mixtures was insignificantly different from the average over any of the studied rye- grass cultivars (2.319 vs. 2.399 or 2.308 or 2.252 for the four aforementioned averages, respectively). The tendency of binary mixtures between barseem half-sib families and rye-grass cultivars, to perform different than their component monocultures was obvious, as mixtures vs. monocultures was significant (Table 1). Generally, mixtures performed differently depending on its barseem family and rye-grass variety components (Table 4). However although, the average dry forage yield of mixtures were2.160, 2.012 and 2.188 Mg ha $^{-1}$ for rye-grass cultivars; Liberla, Ligrande and Liflona, respectively, the average of difference between dry forage yield of mixtures and the mean yield of both component monocultures were descending as 0.255, 0.107 and – 0.003 Mg ha^{-1}, respectively. Thus, it is unrealistic to expect that binary mixtures of barseem families with any Italian rye-grass cultivar would yield equal or higher than the highest yielding component monoculture. In the mean time, Liflona rye-grass, that had the highest contribution in increasing dry forage yield of mixture, seemed to be the most competitive rye- grass cultivar.

Twenty barseem half – sib families had showed positive competitive effects irrespective of the mixed rye- grass variety. These were families coded 4, 12, 22, 23, 27, 31, 34, 39, 42, 43, 46, 47, 49, 50, 52, 53, 55, 56, 57, 58, and 59. Mean while, barseem half- sib families coded 5, 44 and 60 had expressed positive competitive effects only with Liberla rye- grass cultivars. Also, half-sib families coded 28, 29, 38, 40 and 41 were only compatible with Ligrande rye-grass (expressed positive competitive effects). A confined compatibility to Liflona rye- grass had shown by barseem families coded 11, 30, 37, and 45. In the means time, the least competitive barseem half- sib families were those coded 7, 8, 9, 10, 11, 13, 14, 16, 20 and 24, since, a negative values for competitive effects had recorded, irrespective of the mixed rye-grass variety. Commonly, over the three studied rye- grass varieties, six half-sib families had recorded the highest positive average competitive effect. Those families were coded 12(0.952 Mg ha^{-1}), 31 (1.030 Mg ha^{-1}), 49 (1.159 Mg ha^{-1}), 50 (1.012 Mg ha^{-1}), 53 (1.480 Mg ha^{-1}) and 55 (1.317 Mg ha^{-1}). The aforementioned six families had proven high positive competitive effects with Liflona, the most competitive rye- grass cultivar.

Rye- grass cultivars , as well as barseem half- sib families, participated differently to mixtures dry forage yield (significant GMA for barseem families and rye- grass cultivars). Meanwhile, the differences in dry forage yield among mixtures were due to both GMA and SMA (Table 1). Barseem half sib families coded 6, 14, 23, 25,50 and 5, had the highest GMA for dry forage yield (Table 5) and were significantly superior to the rest of families, as a component in mixtures. Barseem half- sib families coded 1, 2, 5, 10, 36, and 41, could be considered as good combiners with Italian rye – grass cultivars, since , they had positive significant GMA values. Compatible combiners had represented by barseem families coded 15, 31, 32, 43, 46, 48, 52, and 53. The least significant GMA had expressed by barseem families coded 38 and 57. Rye- grass cultivar Liberla had the highest GMA, whereas, Liflona expressed the least GMA value.

SMA effects were, generally, larger relative to GMA effects, although several exceptions were observed (Table 6). The largest significant SMA effects were the interaction between Liberla rye- grass and barseem families coded 3, 4, 6, 17, 19, 46 and 49, the interaction between ligranda rye-grass and families coded 14, 19, and 28 and the interaction between Liflona rye- grass and half- sibs coded 1, 12, 18, 23, 30, 31, and 37. Liflona rye- grass, that expressed the least positive GMA, had the most frequent negative SMA with barseem families.

Table (4): Average of the two component monocultures and competitive effects of barseem half-sib families in mixtures with Italian rye- grass cultivars for dry forage yield (Mg ha $^{-1}$) of the third cutting .

Barseem family code	Average of the two			*competitive effects		
	Liberla	*Ligrande*	*Liflona*	*Liberla*	*Ligrande*	*Liflona*
1	2.256	2.227	2.224	+0.198	- 0.664	+0.813
2	2.305	2.276	2.273	+0.002	- 1.064	+1.04
3	1.762	1.733	1.73	+1.245	- 0.668	+0.604
4	1.53	1.501	1.498	+1.058	+0.131	+0.166
5	2.334	2.305	2.366	+0.542	- 0.148	- 0.56
6	2.527	1.537	2.559	+0.856	+0.06	- 0.036
7	1.958	1.929	1.99	- 0.898	- 0.257	- 0.488
8	2.274	2.245	2.306	- 0.673	- 1.18	- 0.358
9	2.194	2.165	2.226	- 0.271	- 0.334	- 0.855
10	2.806	2.777	2.838	- 0.437	- 0.577	- 1.284
11	2.356	2.327	2.388	- 1.348	- 0.567	- 0.679
12	1.544	1.515	1.576	+0.81	+0.155	+1.189
13	2.064	2.035	2.096	- 0.463	- 0.204	- 0.198
14	3.186	3.157	3.218	- 1.124	- 0.351	- 1.872
15	2.014	1.985	2.046	+0.468	+0.497	- 0.573
16	2.569	2.54	2.601	- 0.386	- 0.492	- 1.087
17	1.952	1.923	1.984	+0.925	+0.493	- 0.556
18	2.681	2.652	2.713	+0.186	- 0.929	+0.247
19	1.691	1.662	1.723	+1.263	+1.229	- 0.1
20	2.864	2.835	2.896	- 0.98	- 0.827	- 1.013
21	2.03	2.001	2.062	+0.539	+0.847	- 0.421
22	1.832	1.803	1.864	+0.715	+0.42	+0.211
23	2.258	2.229	2.29	+0.384	+0.111	+0.745
24	2.752	2.723	2.784	- 0.152	- 1.01	- 0.912
25	2.444	2.415	2.476	+0.661	+0.321	- 0.108
26	1.989	1.96	2.021	+0.681	+0.848	- 0.01
27	2.06	2.031	2.092	+0.275	+0.447	+0.217
28	2.765	2.736	2.797	- 2.039	+0.223	- 0.963
29	2.005	1.976	2.037	- 0.47	+0.665	- 0.012
30	2.014	1.985	2.046	- 0.347	- 0.318	+0.367
31	1.874	1.845	1.906	+0.617	+0.988	+1.41
32	2.554	2.525	2.586	- 0.453	+0.591	- 0.073
33	2.22	2.191	2.252	- 0.001	+0.135	- 0.028
34	1.964	1.935	1.996	+0.92	+0.284	+0.523
35	2.364	2.335	2.396	+0.608	+0.17	- 0.52
36	2.866	2.837	2.898	- 0.608	+0.077	- 0.366
37	2.307	2.278	2.339	+0.035	- 0.015	+0.777
38	2.249	2.22	2.281	- 0.156	+0.176	- 0.788
39	1.69	1.661	1.722	+1.049	+0.094	+1
40	2.523	2.494	2.555	- 0.741	+0.342	- 0.407
41	2.897	2.868	2.929	- 0.268	+0.079	- 0.79
42	2.169	2.14	2.201	+0.927	+1.086	+0.264
43	2.174	2.145	2.206	+0.485	+0.913	+0.202
44	2.363	2.334	2.395	+0.104	- 0.039	- 0.062
45	2.468	2.439	2.5	- 0.579	- 0.55	+0.101
46	1.93	1.901	1.962	+1.486	+0.611	+0.027
47	1.946	1.917	1.978	+0.967	+0.058	+0.504
48	2.257	2.228	2.289	+0.264	+0.806	- 0.293
49	1.268	1.239	1.3	+1.753	+0.979	+0.745
50	1.946	1.917	1.978	+0.591	+1.263	+1.184
51	2.045	2.016	2.077	+0.281	+0.611	- 0.292
52	2.072	2.043	2.104	+0.524	+0.879	+0.127
53	1.641	1.612	1.673	+2.373	+0.761	+1.305
54	2.021	1.992	2.053	+0.775	- 0.073	+0.874
55	1.676	1.647	1.708	+0.767	+1.344	+1.841
56	1.917	1.888	1.949	+0.762	+0.612	+0.749
57	1.478	1.449	1.51	+0.508	+0.55	+0.72
58	1.997	1.968	2.029	+0.097	+0.64	+0.385
59	1.747	1.718	1.779	+0.438	+0.728	+0.939
60	1.991	1.962	2.023	+0.578	- 4.531	- 3.736
average	2.1605	2.115483	2.188233	0.255383	0.1071	-0.00273

*****Competitive effect = $\overline{X}_{ij} - \left(\overline{X}_{mi} * 0.67 + \overline{X}_{mj} * 0.33\right)$

Table (5) : General mixing ability for third cutting dry forage yield of 60 barseem half– sib families and three Italian rye- grass cultivars.

Barseem families code	Dry forage yield (Mg ha^{-1})	Barseem families code	Dry forage yield (Mg ha^{-1})	Barseem families code	Dry forage yield (Mg ha^{-1})	Barseem families code	Dry forage yield (Mg ha^{-1})
1	+2.777**	16	-1.303**	31	+1.222**	46	+1.102**
2	+2.416**	17	-1.204**	32	+1.522**	47	-0.202 n.s
3	-0.707**	18	+1.741**	33	-1.966**	48	+1.428**
4	-2.897**	19	-0.322 n.s	34	-0.979**	49	-2.985**
5	+2.538**	20	-0.109 n.s	35	-0.136**	50	+3.567**
6	+4.925**	21	-0.062 n.s	36	+2.640**	51	-1.433**
7	-5.395**	22	-1.313**	37	+0.556*	52	+1.233**
8	-3.229**	23	+3.158**	38	-3.999**	53	+1.127**
9	-2.279**	24	+0.485 n.s	39	-3.033**	54	+0.761*
10	+2.538**	25	+4.381**	40	-1.007**	55	+2.804**
11	-3.282**	26	+0.856**	41	+2.787**	56	+0.949**
12	-0.581*	27	+0.213 n.s	42	+2.706**	57	-4.863**
13	-2.256**	28	-1.120**	43	+1.072**	58	-0.642*
14	+4.315**	29	-2.298**	44	-0.788**	59	-1.005**
15	+1.116**	30	-3.102**	45	-0.614*	60	-1.863**
Italian rye-grass monocultures							
Liberla	24.004 **						
Ligrande	23.131 **						
Liflona	23.002 **						
Average							

L.S.D$_{(0.01)}$ for Barseem 0.985
L.S.D$_{(0.01)}$ for Italian rye- grass 0.440

Table (6): Specific mixing ability for third cutting dry forage yield of 180 barseem half – sib families x Italian rye- grass cultivars.

Barseem family code	Italian rye- grass variety			Barseem family code	Italian rye- grass variety		
	Liberla	Ligrande	Liflona		Liberla	Ligrande	Liflona
1	-0.295 **	-4.672 **	+7.044 **	31	-0.78 n.s	+0.977 *	+7.669 **
2	-1.404 **	-7.824 **	+1.016 **	32	-4.975 **	+3.500 **	-0.662 n.s
3	+8.722 **	-6.169 **	+3.508 **	33	+0.412 n.s	-0.914 n.s	-0.061 n.s
4	+6.717 **	+1.688 **	-1.007 **	34	+5.360 **	-2.968 **	+1.901 **
5	+4.169 **	+1.502 **	-5.025 **	35	+5.394 **	-0.967 **	-5.371 **
6	+6.836 **	-6.481 **	-0.243 **	36	-4.521 **	+0.363 n.s	-1.590 **
7	-6.051 **	+4.588 **	-0.126 **	37	-1.606 **	-4.071 **	+6.322 **
8	-2.724 **	-3.645 **	+2.165 **	38	+0.499 n.s	+1.851 **	-5.307 **
9	-0.548 n.s	+3.062 **	-4.552 **	39	+5.968 **	-5.553 **	+5.984 **
10	-0.900 n.s	+1.945 **	-7.542 **	40	-5.635 **	+3.227 **	-1.788 **
11	-8.694 **	+3.358 **	-0.164 **	41	-0.962 *	+0.551 n.s	-5.667 **
12	+2.061 **	-0.236 **	+7.682 **	42	+3.785 **	+3.426 **	-2.331 **
13	-3.783 **	+3.042 **	+0.689 **	43	+1.052 *	+3.376 **	-1.262 **
14	-5.754 **	+6.214 **	-1.139 **	44	+0.997 *	-2.398 **	+0.152 n.s
15	+1.645 **	+3.632 **	-1.198 **	45	-4.956 **	-0.386 n.s	+2.357 **
16	-0.299 n.s	-1.972 **	-4.217 **	46	+6.991 **	-1.093 *	-7.824 **
17	+6.539 **	+1.610 **	-5.176 **	47	+3.265 **	-5.155 **	-1.589 **
18	+3.502 **	-8.269 **	+7.202 **	48	-2.282 **	+3.802 **	-8.078 **
19	+6.432 **	+5.477 **	-4.133 **	49	+7.133 **	+0.055 n.s	-3.175 **
20	-4.473 **	-3.563 **	-1.723 **	50	-4.259 **	+3.127 *	+1.437 **
21	+2.303 **	+4.764 **	-4.207 **	51	-1.378 **	+2.596 **	-7.323 **
22	+3.356 **	-0.091 n.s	+1.40 **	52	-1.320 **	+2.888 **	-5.523 **
23	-0.345 **	-3.503 **	+6.532 **	53	+2.947 **	-2.505 **	+2.042 **
24	+2.084 **	-7.112 **	-2.43 **	54	+1.135 **	-6.647 **	+1.899 **
25	+3.239 **	-0.778 **	-1.361 **	55	-4.441 **	+1.992 **	+6.076 **
26	+2.440 **	+3.470 **	-1.407 **	56	-0.229 n.s	-1.058 *	-0.587 n.s
27	-0.293 n.s	+0.821 n.s	+2.215 **	57	-1.338 **	-0.254 n.s	+0.550 n.s
28	-1.505 **	+6.965 **	-1.203 **	58	-4.476 **	+1.615 **	-1.831 **
29	-5.782 **	+4.950 **	+1.892 **	59	-3.209 **	+0.372 n.s	+1.578 **
30	-3.656 **	-2.783 **	+6.576 **	60	+1.493 **	+0.316 n.s	-7.626 **

(L.S.D$_{(0.01)}$) 1.706

Summary and conclusion

The present results showed on overall dry forage yield increase of 0.735 Mg ha^{-1} (about 31.69% of mixtures), compared with the average of both barseem families and rye-grass cultivars monocultures. Mixing ability analysis by two-factor analysis had successfully identified *Liflona* rye-grass cultivar , that had the highest contribution in increasing dry forage yield of mixtures , as the most competitive cultivar , since , it expressed the highest negative competitive effect, the least general mixing ability (GMA) values and the most frequent negative specific mixing ability (SMA) effects with barseem families . Consequently *Liflona* rye-grass is the most suitable cultivar for selecting barseem genotype with high compatibility to form barseem rye-grass mixtures. Also the 60 tested half-sib families had separated depending on GMA values to a very good combiners that expressed the highest positive GMA values (Families coded 6,14,23,25,50and55), a good combiners (Families coded 1,2,5,10,36and 41) a compatible combiners (Families coded 15, 31, 32, 43, 46, 48, 52 and 53) and weak combiners (Families coded 38 and 58), SMA effects had usefully separated the most competitive barseem half-sib families that had the highest positive SMA values with the most competitive rye-grass cultivar " *Liflona"(Families coded 1, 12, 18, 23, 30, 31 and 37).*

REFERENCES

Abou-Raya, A.K. and S.S.A. Ibrahim (1975). Some studies on interseeding clover with Italian rye-grass (IRG) and its relation to yield, nutritive value and botanical analysis: 3- Effect on the nutritive analysis and feeding value. Agric. Res. Rev. 53(6): 85-95.

Abou-Raya, A.K. and E.Z. Shehab (1971). The effect of interseeding barley with clover on the yield and nutritive analysis. J. Anim. Prod. 11(2): 297-298.

Abou-Raya, A.K. EL-Moursi and A.A. Ibrahim (1965). The effect of interseeding rye-grass with Egyptian clover on the chemical and botanical analysis of the herbage. Agric. Res. Rev. 43: 108-121.

Ahmed, M. Abd EL-Sattar (1999). Berseem clover "*Trifolium alexandrium* L." grass binary mixtures in comparison to monocultures. Alex. J. Agric. Res. 44(1): 37-59.

Ahmed, M. Abd EL-Sattar (2006). Response to three methods of recurrent selection in a khadarawi barseem "*Trifolium alexandrium*, L.". Population. Alex. J. Agric. Res. 51(3): 13-22.

Ahmed, M. Abd EL-Sattar (2007). Compatibility among mixtures components of cowpea and summer forage grasses. Alex. J. Agric. Res. 52(1): 41-48.

Ahmed, M. Abd EL-Sattar and A.A. Nour (1996). Productivity, quality and cost of nutrient production of some Egyptian green forage crops and their mixtures with barseem. Alex. J. Agric. Res. 41(2): 141-157.

Anil, L., R.H.P. Park and F.A. Miller (1998). Temperate intercropping of cereals for forage; a review of potential for growth and utilization with particular reference to the UK. Grass forage SU. 53: 301-317.

Claser, M.D. (1988). Performance of orchard grass, smooth brome grass and ryegrass in binary mixtures with alfalfa. Agron. J. 80: 509- 514.

Federer, W.T., J.C. Connigale, J.N. Rutger and A. Wijesinha (1982). Statistical analyses of yields from uniblends and biblends of eight dry bean cultivars. Crop Sci., 22: 111-115.

Gizlice, Z.T.E. Carter, Jr.J.W., Butrton and J.H. Emigh (1989). Partitioning of blending ability, using two-way blends and component lines of soybean.Crop-Sci.29:885-889.

Griffing, B. (1956). Concepts of general and specific combing ability in relation to diallel crossing system. Aust. J. Biol. Sci., 9: 463-493.

Haynes, R.J. (1980). Competitive aspects of the grass-legume association. Adv. Agron. 33: 227-261.

Ibrahim, S.A.A., A.K. Abou-Raya, A.M. Makky and S.EL. Samman (1978). The effect of interseeding Italian rye-grass with clover on the composition, digestibility and feeding value of the green herbage with reference to nitrogen balance. Agric. Res. Rev. 56 (6): 135.

Jensen, N.F. and W.T. Federer (1965). Competing ability in wheat. Crop Sci., 5: 449- 452.

Kempthorne, O. (1957). An introduction to genetic statistics. New York: John Wielly and Sons, Inc; London: Chapman and Hall, Ltd.

Ofori, F. and W.R. Stern (1987). Cereal ± legume intercropping systems. Adv. Agron. 41: 41-90.

Radwan, M.S., A.L. Saffar, S.M. and H.E. AL.Hattao (1977). The influence of the method of seeding on performance of berseem grass mixtures. Res. Bull. No. 713 Ain Shams Univ.

Smith, D. (1968). The establishment and management of alfalfa. Wisconsin Agric. Exp. Stn. Bull. 542.

Smith, D., R.J. Bula and R.P. Walgenbach (1986). Forage management. Kendall/Hunt, Dubuque, IA.

Vandermeer, J. (1989). The Ecology of Intercropping. Cambridge University Press, Cambridge, UK, 237pp.

Willey, R. W. (1979). Intercropping; Its importance and research needs. Part 1. Competition and yield advantages. Field Crop Abstr. 32(1): 1-10.

Zarea, M. J., Ghalav and A., Mohammadi Gottapeh, Rejali, F. (2010). Effect of clovers intercropping and earthworm activity on weed growth. J. Plant Protection Research 50(4): 463-469.

تقدير سلوك عائلات البرسيم المصري عند زراعتها في مخاليط مع أصناف حشيشه الراى الايطالية من خلال تحليل القدرة على الخلط

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الملخص العربي

اقترحت حشيشة الراى الايطالية كمكون متوافق عند زراعة مخاليط البرسيم المصري مع النجيليات . ويعتبر الوصول إلى طريقة لتقدير سلوك عائلات البرسيم (التراكيب الوراثية) عند زراعتها في مخاليط مفيد لمربى النباتات المهتمين بانتخاب تراكيب جيدة الاداء عند زراعتها في مخاليط . الهدف من الدراسة الحالية كان تمييز صنف من حشيشة الراى الايطالية أكثر ملائمة عند إجراء انتخاب لعائلات البرسيم النافسة لتدخل في زراعة المخاليط من خلال تطبيق تحليل عاملين two-factor analysis . وقد تم تقييم ستون عائلة نصف شقيقة من البرسيم المصري وثلاثة أصناف من حشيشة الراى الايطالية و ١٨٠ مخلوط ثنائي بين البرسيم وحشيشة الراى بقياس محصول العلف الجاف للحشة الثالثة .وقد زاد محصول العلف الجاف للمخاليط بمقدار ٠.٧٣٥ طن للهكتار أو ما يعادل ٣١.٦٩% مقارنة بمتوسط إنتاجية كل من عائلات البرسيم وأصناف الراى . وقد نجح تحليل القابلية للخلط من خلال تطبيق تحليل عاملين في تمييز صنف الراى *Liflona* والذي اتسم بأعلى زيادة في محصول العلف الجاف لمخاليطه مع عائلات البرسيم المصري بأنه أشد أصناف حشيشة الراى الايطالية المختبرة في المنافسة. حيث أعطى أعلى قيم سالبة لتأثيرات المنافسة competitive effect واقل قيم للقابلية العامة للخلط GMA وأعلى تكرار للتأثيرات السالبة للقابلية الخاصة للخلط SMA مع عائلات البرسيم ألمختبره .وبناء على ذلك فقدتم اختيار صنف حشيشة الراى الايطالية Liflona كأفضل صنف مناسب لاختبار واختيار التراكيب الوراثية من البرسيم المصري عالية التوافق لتزرع في مخاليط مع حشيشة الراى. أيضا فقد تم تقسيم الستون عائلة نصف الشقيقة المختبرة من البرسيم اعتمادا على تقديرات GMA إلى :عائلات متوافقة بدرجة جيدة جدا للمخاليط وهى تلك العائلات التي أظهرت أعلى قيم موجبة لتأثيرات GMA (العائلات أرقام ٦و١٤و٢٣و٢٥و٥٠و٥٥) ، وعائلات جيدة التوافق (العائلات أرقام ١و٢و٥و١٠و٣٦و٤١) ، وعائلات متوافقة للخلط ويمثلها (العائلات أرقام ١٥و٣١و٣٢و٤٣و٤٨و٥٢و٥٣)، وعائلات ضعيفة التوافق ويمثلها (العائلات أرقام ٣٨و٥٧). كما نجحت تقديرات القابلية الخاصة للخلط SMA في عزل العائلات النصف شقيقة الأعلى منافسة وهى تلك العائلات التي أظهرت تقديرات مرتفعة وموجبة للقدرة الخاصةSMA مع اعلي أصناف حشيشة الراى الايطالية منافسة " الصنف *Liflona* " وهى العائلات المرقمة ١و١٢و١٨و٢٣و٣٠و٣١و٣٧ .