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EVALUATION OF YIELD POTENTIAL, GENETIC VARIANCES AND CORRELATION FOR NINE CULTIVARS OF ALFALFA UNDER THE NEW VALLEY ENVIRONMENT

Abdel-Galil M.M. and N. M. Hamed
Forage Crops Res. Dept., Field Crops Res. Inst. ARC. Giza, Egypt.

ABSTRACT

In the period of 2004-2006, field trails were conducted at the New Valley Res. Station to evaluate the yield potential and genetic variances among alfalfa cultivas; a new Synthetic (Wady Syn.), four promising populations ($Serw_1$, $Serw_2$, Nitrogen fixation and salt tolerant), three commercial varieties (Siwa, $Ismailia_1$ and $Ismailia_{94}$) and a local cultivar (Wady). Twenty cuts were obtained during 2005 and 2006. The combined analysis of variance over two years indicated that Wady Syn. population ranked first for fresh and dry yields (72.3 t fed^{-1} and 18.9 t fed^{-1}) and other studied traits significantly different from other tested cultivars. The commercial variety $Ismailia_{94}$ ranked second (66.55 and 17.2 t fed^{-1}). Regarding plant height, tillers and leaf to stem ratio (LSR), WadySyn. recorded the highest values (48.2 cm, 416.7/m^2 and 47.6 %) significant from $Ismailia_{94}$ which recorded 45.6 cm, 362.3 m^2 and 43.3 %, respectively. Significant positive correlation among either fresh forage yield or dry forage yield and other traits. The values of genotypic coefficient of variation for fresh and dry forage yields revealed relative variations among the tested cultivars which were less influenced by environment. The environmental variation ranged from 4.4% to 33.3% and the genetic advance ranged from 3.9% to 14.5%.
Keywords: Alfalfa, Yield, Variability, correlation.

INTRODUCTION

Alfalfa (*Medicago sativa* L.) is recognized as high quality forage for all classes of livestock. It provides protein, minerals and vitamins requirements for dairy and meat cattle. Genetic variability of alfalfa promoted adaptability to many conditions of extreme heat, drought, and salinity. This flexibility and high productivity under both stress and optimum conditions are the reasons t hat alfalfa is widely known as *" The Queen of Forages"*. The New Valley region is one of the main regions for alfalfa cultivation for a long time ago, as the management, soil and climatic variables are more suitable for alfalfa cultivation and highly productive yield is expected in this region.

In Egypt, there is a gap between the demand and the consumption of green forages, especially in the summer seasons where the available forages are limited due to the competition of the strategic crops on limited arable land. Alfalfa synthetics proved adaptability to the New Valley environment and distinguished fresh and dry yields could be obtained compared to the commercial varieties, (Abdel-Galil 2007).

The local cultivars Ismailia-1 and Siwa expressed significant performance and wide range of genetic base for yield superiority and adaptability in comparison with the exotic cultivars. At the New Valley region, cultivars contributed the highest proportion (32.6%) of the total dry yield during spring season followed by autumn (25.3%) as mentioned by (Oushy *et al*., 2007).

Rumbough and Heichell (1984) indicated that looking for a genotype that could totally express its potential in the referred environments might support the approach about higher alfalfa yield. Evaluation of adaptability of genotypes to environments is very important to reach high yield and stand persistence.

This paper reports the results of experiment designed to compare the agronomy performance, correlation and genetic variation for new promising cultivars and a synthetic compared to commercial varieties and a local genotype of alfalfa.

MATERIALS AND METHODS

Four promising populations, three new varieties (Siwa, Ismailia-1 and Ismailia-94), Wady Synthetic and Wady local of alfalfa (*Medicago sativa* L.) were used in this investigation. The trial was conducted at the New Valley Res. Station during the period of 2004-2006. Planting date was November. $11^{th.}$, 2004. A randomized complete block design was used. The plot size was 6 m^2 and the seeds were drilled in 6 rows 20 cm apart at the rate of 20 kg fed^{-1}. Seeds were inoculated prior to sowing with *Rizobium melioloti* and all the cultural practices were applied at the optimum levels for maximum alfalfa productivity. The first cut was obtained at February $5^{th.}$, 2005 and the subsequent cuts were obtained at an interval of 30-35 days. Twenty cuts were obtained through the two growing years 2005 and 2006. The traits; fresh and forage dry yields (FY and DY) in ton per feddan, plant height (H) in centimeter, tillers number (T) in square meter and leaf to stem ratio (LSR) as percentage were studied. Data had been tested for homogeneity before pooling and as it was homogenous, the combined analysis of variance over two years was carried out. Statistical analysis was carried out using IRRISTAT (2002) and Mstat-C computer programs (1986).

Phenotypic correlation among the studied traits was calculated according to Snedecor and Chocran (1967), genotypic and phenotypic (σ^2g and σ^2p) variances were calculated according to Al-Jibouri *et al* (1958), phenotypic and genotypic coefficient of variability (PCV and GCV) according to Burton (1952) and heritability in broad sense (H^2b) as outlined by Johanson *et al* (1955).

RESULTS AND DISCUSSION

The combined analysis of variance over two years, (Table1) indicates that significant differences among the cultivars and between years for all studied traits. Cultivars X years interaction was significant indicating that environments, responded in different manner from year to year, had affected the tested cultivars and it is essential to evaluate these cultivars for more years in different conditions as mentioned by Bakheit (1986).

Table 1: Combined analysis of variance for the studied traits of nine alfalfa cultivars over two years.

S.O.V.	df		Mean Square					Expected MS.
			Fresh yield	Dry yield	Height	Tillers	LSR	
Rep	2		5.20*	0.323*	0.537*	1194.74*	1.601*	
Year	1		59.12*	4.80*	1.927*	135701.0*	0.031*	
Varieties	8	M3	176.8*	10.43*	6.997*	5790.46*	23.199*	$\sigma^2e + r\ \sigma^2_{an} + rn\ \sigma^2_a$
Var x Y	8	M2	7.78*	0.537*	0.308*	856.824*	7.690*	$\sigma^2e + r\ \sigma^2_{an}$
Error	34	M1	0.860	0.191	0.135	194.582	2.087	σ^2e

***significant at 0.05 level of probability.**

Means of total yield over two years (Table 2) show that Wady Syn. ranked first in fresh and dry forage yield traits (72.3 and 18.9 t fed^{-1}) significantly different from the other cultivars. The new variety (Ismailia-94) ranked second (66.55 and 17.15 t fed^{-1}) significantly different from the local cultivar (63.33 and 16.13 t fed-1) which ranked third, the two commercials Siwa (60.38 and 15.85 t fed^{-1}) and Ismailia-1 (60.51 and 16.08 t fed^{-1}) and other tested cultivars. The varietal differences in yield among the cultivars might be attributed to the differences in cultivars' characters as well as the interaction between the genetic materials and the environment, (Jung *et al*. 1969 and Ruggieri *et al* 2001). The results support those of Abdel-Galil *et al.* (2000) who reported greater variability and dry matter yield among seven alfalfa cultivars at the New Valley than at Ismailia region.

Significant differences were found among the tested cultivars regarding plant height, tillers and leaf to stem ratio (Table 2). For plant height, Wady Syn. ranked first (48.2) significantly different from Wady local (45.8) and Ismailia 94 (45.6). Regarding the number of tillers, Wady Syn. ranked first (416.7) followed by Wady local (373.8) and Ismailia 94 (362.3) with significant differences among each other. For leaf stem ratio, Wady Syn. ranked first (47.6%) followed by Nitrogen fixation (44.0%) and Salt tolerant (43.4%) indicating that these cultivars may be better in nutritive value the other tested entries. These results were expected as Frakes *et al* (1961) explained that the natural height and number of shoots accounted for over 90% of variation in dry matter yield in alfalfa. In addition, Volence *et al* (1987) reported that the herbage yield of alfalfa could be described by three yield components; plants/area, shoots/plant and shoot yield. Moreover, good quality and high protein yield could be expected as it recorded highly significant leaf to stem ratio.

Significant positive correlation between either fresh and or dry forage yields and other traits (Table 3).These results are on the line with those found by Bakheit (1986).

In addition, Abdel-Galil (2007) reported that plant height and tillers are determiners of fresh forage yield as these two characters revealed the most prominent direct effect on such trait.

Table 2: Means of total fresh and dry yield (t fed^{-1}), height (cm), tillers (m^2) and leaf stem ratio (LSR %) over two years.

Var./Char.	FY (t fed^{-1})	DY (t fed^{-1})	Height (cm)	Tillers (m^2)	LSR (%)
Siwa	60.38	15.85	45.48	324.17	41.38
Ismailia$_1$	60.51	16.08	45.50	335.83	40.98
Ismailia$_{94}$	66.55	17.15	45.6	362.33	43.33
Serw$_1$	54.70	14.48	44.28	311.33	42.5
Serw$_2$	56.43	15.48	45.13	338.00	41.98
Nitrogen fix.	57.48	14.75	45.10	343.50	43.95
Salt tolerant	61.58	15.78	45.25	354.16	43.42
Wady local	63.33	16.13	45.82	373.83	42.12
Wady Syn.	72.30	18.90	48.23	416.67	47.58
Mean	61.48	16.07	45.60	351.09	43.03
L.S.D. at 0.0 5%	1.088	0.051	0.431	16.367	1.683

Table 3. The correlation matrix for all variables over two years.

Char.	Fresh yield	Dry yield	Height	Tillers
Dry yield	0.997*			
Height	0.960*	0.956*		
Tillers	0.871*	0.877*	0.861*	
LSR	0.746*	0.763*	0.756*	0.842*

*** Significant at 0.05 level of probability.**

Genetic variances in terms of genotypic and phenotypic variance (∂^2g and ∂^2P), genotypic and phenotypic coefficient of variation (G.C.V and P.C.V), heritability in broad sense (H^2b), genetic advance as units (Ga) and as percentage of mean (Ga%) and environmental variation (En.V.) for the studied traits are presented in Table 4.

Table 4: Phenotypic and genotypic variance, phenotypic and genotypic coefficient of variation and genetic advance for various characters over all seasons.

Char.	X	σ^2g	σ^2p	G C.V.	P. C.V.	H^2b	Ga Unit	G.a %	En.V. %
Fresh yield	61.48	28.17	29.47	8.63	8.82	95.59	9.1	14.8	4.4
Dry yield	16.07	1.64	1.73	8.00	8.20	94.11	2.2	13.7	5.2
Height	45.60	1.11	1.17	2.31	2.37	94.87	1.8	3.9	5.1
Tillers	351.09	882.2	965.08	8.46	8.85	91.41	49.9	14.2	8.6
LSR	43.03	2.58	3.87	3.73	4.57	66.67	2.3	5.3	33.3

Genotypic variance (σ^2g) relative to environmental variation (En.V) was large in magnitude for all traits. The differences among G.C.V. and P.C.V. were narrow suggesting some effects of environments on these traits due to the confound by the cultivar X year interaction.

The estimates of expected genetic advance (Ga unit) Express that if plant breeder select within these cultivars for the studied characters, the average of selection would be increased by 9.1 t fed -1 (14.8%) for fresh yield over the general average of all entries. Likewise dry forage yield would be increased by 2.2 t fed-1 (13.7%) while height would be increased by 1.8 cm (3.9%) and tillers by 49.9 tillers per square meter (14.2%), respectively.

Heritability in broad sense expressed high values for the studied traits ranging from 66.7% to 95.6%. High heritability combined with high genetic advance for fresh and dry forage yield and tillers characters indicated that these characters were less affected by environment and largely influenced by the additive effect of genes and the improvement in these characters may be achieved through the phenotypic selection, as mentioned by Bakheit (1986). Johanson *et al* (1955) have also suggested that heritability estimates along with genetic advance would be helpful in predicting where the environmental effect ranged from 4.4 % to 33.3 %.

In conclusion, the synthetic population (WadySyn.) proved distinguished performance and adaptability under the New Valley environment. However, fresh and dry yields and tillers characters are largely influenced by the additive genes and less affected by the environment. Forage breeding programs should consider developing the productivity of the other cultivars used in this investigation.

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تقييم القدره المحصوليه والتباين والإرتباط في تسعة أصناف من البرسيم الحجـازي تحت ظروف الوادى الجديد

محيى الدين محمد عبد الجليل و ناصر محمد حامد

قسم بحوث محاصيل العلف- معهد بحوث المحاصيل الحقليه – مركز البحوث الزراعيه

أجريت هذه التجربة خلال الفترة من عام ٢٠٠٤ إلي عام ٢٠٠٦ بمحطة بحوث الوادي الجديد لتقييم القدرة الإنتاجية والتباين والارتباط في تسعة عشائر وأصناف من البرسيم الحجازي (تركيبي الوادي – سرو١ – سرو ٢ – مثبت الآزوت – متحمل الملوحة – سيوة – إسماعيلية١ – إسماعيلية٩٤ وعشيرة الوادي المحليه).

أوضح التحليل التجميعي لعدد ٢٠ حشة في عامي ٢٠٠٥، ٢٠٠٦ تفوق العشيرة (تركيبي الوادي) على كل العشائر والأصناف المختبرة في محصولي العلف الأخضر والجاف (٧٢,٣ ، ١٨,٩ طن/ فدان) متبوعاً بالصنف التجاري إسماعيلية٩٤ (٦٦,٥٥ ، ١٧,١٥طن/ فدان) .

بالنسبة لصفات ارتفاع النبات وعدد الأشطاء في المتر المربع ونسبة الأوراق الي السيقان أوضحت النتائج أيضاً تفوق العشيرة (تركيبي الوادي) معنوياً عن العشائر والأصناف الأخرى في كل الصفات متبوعاً بالصنف إسماعيلية ٩٤.

كما أظهرت النتائج وجود ارتباط موجب معنوي بين كل من المحصول الأخضر والجاف وباقي الصفات وأظهرت نتائج مكونات التباين وجود اختلافات وراثية بين الأصناف والعشائر تحت الدراسة وأن الصفات المدروسة تتأثر نسبياً بالظروف البيئية بما يشير إلي تحكم العوامل الجينية في الصفات تحت الدراسة وتراوح التباين البيئي بين ٤,٤% إلي ٣٣,٣% والتحسين الوراثي بين ٣,٩% إلي ١٤,٨% للصفات تحت الدرسة.