PERFORMANCE OF LOCAL AND EXOTIC ALFALFA CULTIVARS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS IN EGYPT

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Abstract

Finding high yielding alfalfa (*Medicago sativa L.*) cultivars adapted for the new reclaimed land conditions is considered an important task for alfalfa breeders and growers as well. The objective of this study was to evaluate three exotic alfalfa cultivars imported from USA (109/01, 109/02 and 109/03) in comparison with two local alfalfa cultivars; Ismailia-1 and Siwa for annual and seasonal yield distribution and quality. Experiments were carried out at two different environmental conditions; Ismailia and the New Valley Agricultural Research Stations, ARC, Egypt. Annual and seasonal dry forage yields over 29 successive cuts were determined. Results showed that the local cultivars Ismailia-1 and Siwa were superior in yielding capacity and distribution to the exotic cultivars. The highest total dry forage yield of 29 cuts was obtained from Isamilia-1 (49.0 t h^{-1}), followed by Siwa (48.8 t h^{-1}) at Ismailia. Similar trend occurred in the New Valley, where Siwa expressed the highest total dry forage yield (118.7 t h^{-1}) from 27 cuts, followed by Ismailia-1 (117.8 t h^{-1}). The total dry forage yield combined over the two locations declared the superiority of Siwa and Ismailia-1 to the exotic genotypes. Similar trends were obtained for plant height. However, chemical analysis expressed slight superiority in CP%, Ash % and EE% in favor of exotic group. Accordingly, Ismailia-1 and Siwa could be recommended as alfalfa cultivars for the new reclaimed land at Ismailia and New Valley governorates. The genotypic cluster of these two cultivars indicated that both are genetically related, descending from Egyptian alfalfa landraces which have been subjected to severe biotic and abiotic stresses in the New Valley area for a long period.

Key words: Alfalfa, Cultivars, Yield distribution, Genetic cluster.

INTRODUCTION

Alfalfa (*Medicago sativa L.*) is an important forage crop for newly reclaimed soils of Egypt because of its high quality and high productivity in addition to soil fertility. Alfalfa shows high tolerance to drought and heat stress which makes adapted to the harsh environment of the Egyptian desert areas. Alfalfa is recognized as high quality forage for all classes of livestock and alone can provide energy, protein, minerals, and vitamin requirements for dairy cattle. Genetic variability of alfalfa promoted adaptability to many conditions of extreme heat, cold, drought, salinity, and pests. This flexibility and high productivity under both stress and optimum conditions are the reasons that alfalfa is so widely known as "The queen of forages".

Rammah *et al* (1995) reported that alfalfa is grown on newly developed land and old oases in Egypt. Alfalfa is grown in large areas located in the New Valley, Nubaria, North and South Tahrer, Upper Egypt and Ismailia. Alfalfa in these areas is mainly used for land reclamation and providing forage for livestock as pasture, green feed and hay. From eight to ten cuttings can be obtained per year. Oushy *et al.* (1999) reported that alfalfa varietal comparison and yield distribution across the four seasons of the year is an important selective trait in alfalfa breeding programs and is considered of great importance to forage breeders. Ghobrial (1978) concluded that the local alfalfa strains in the New Valley yield higher green forage than introduced varieties.

Abd El-Halim *et al.* (1992) reported that dry winter yield of eight alfalfa varieties was lower than that of the spring growth.. Rammah *et al.* (1995) stated that summer yield of the tested alfalfa entries contributed the highest proportion of the total yield followed by Spring, Winter and Autumn and the highest average yield obtained in the second year.

Brune *et al.* (1989) investigated the variation in alfalfa yield distribution and observed the variation in the performance of cultivars among periods and seasons. Rammah *et al.* (1995) concluded that none of the tested alfalfa landraces were active in the same manner in all growing seasons, but all of them were active in only one season and that variation in seasonal growth should be taken into consideration in the breeding program. In alfalfa varietal comparison Mousa *et al.* (1996) reported significant differences in yield among alfalfa cultivars within and over two successive years. The highest dry forage yields were obtained from Nubaria-92 and Ismailia-1 cultivars where, they recorded significant higher fresh and dry forage yields than other cultivars in spring , winter, summer and autumn in both years.

Oushy *et al.* (1999) found that alfalfa landraces from the New Valley are superior to the introduced genotypes in yield and yield components. They concluded that this genetic variation can be used to reconstruct elite synthetic varieties of alfalfa. In addition, they reported that the highest dry forage yield was obtained in Autumn followed by Summer, Spring, and Winter seasons. The exotic alfalfa cultivars fell into two significantly different yield groups. Moreover, the tallest plants were in Spring of the second year, followed by summer in the seedling year. Marble *et al.* (1985) and Rumbough *et al.* (1988) reported that long period of agriculture in the vast region has apparently led to the evolution of many unique local ecotypes of the alfalfa from Morocco, where, there was variation among the geographic groups for 22 of the 28 traits and 5 of 146 populations could be selected for quantitatively inherited adaptive traits. Moreover, Smith *et al.* (1991) concluded that there is a high degree of

similarity between ecotypes within clusters. These ecotypes may be excellent candidates for breeding non dormant varieties adapted to desert conditions using the extent of variation they contain. Alfalfa quality is affected by the stage of maturity. Matches *et al.* (1970) reported that crude protein and ash content decreased with increasing alfalfa maturity. El-Silimy (1980) found that crude protein, crude fiber and ash differed among the four seasons of the year. Oushy *et al.* (1999) reported that noticeable variation among six cultivars of alfalfa in crude protein percentage were observed within each individual cut and between seasons. They added that the highest average of CP% was reached during Winter and Autumn growth while Spring was lowest. They added that slight differences were observed in CF%. In addition, noticeable variability was observed among cultivars in % ether extract within cuts and seasons as well as remarkable differences in % ash among seasons of the year. This paper reports results of experiments designed to compare the performance of forage yield and chemical composition of three introduced exotic alfalfa cultivars in comparison with two local cultivars under two different locations in Egypt.

MATERIALS AND METHODS

Three exotic alfalfa cultivars imported from USA (109/01, 109/02 and 109/03) in addition to two local cultivars Ismalia-1 and Siwa were grown to evaluate growth and productivity during the course of the study. The experiment continued from 2003 through 2006 at two locations; Ismailia and New Valley Agricultural Research Stations. The meteorological data of the experimental sites are summarized (Table.1). Plots were 1.0 x 6.0 m with five rows 20 cm apart in a randomized complete block design with four replicates. Planting took place on 6 and 7 Sep, 2003 at Ismailia and the New Valley respectively. Seeding rate was 20 kg/fed.

Preplant fertilizer applications of 60 kg/fed of P_2O_5 and 96 kg/fed of K_2O. Seeds were inoculated prior to seeding with *Rhizobium melitoti*. Starter dose of nitrogen fertilizer of 20 kg/fed, was applied directly after emergence.

Table 1. Seasonal climatological data of the experimental sites at Ismailia and New Valley during 2004 to 2006.

Sites	Ismailia				New Valley			
Items:	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn
Air temperature (°C):								
Mean maximum	20.9	27.9	35.3	30.8	25.2	36.3	42.6	36.15
Mean minimum	9.2	14.2	22.3	17.0	8.3	16.5	23.3	18.3
Relative humidity (%):								
Mean maximum	83.2	80.8	83.7	83.8	69.4	51.7	49.8	70.3
Mean minimum	33.8	26.1	28.9	32.3	38.3	27.9	29.7	36.9
Soil temperature(°C):								
Mean maximum	16.0	22.8	30.7	25.2	21.0	33.0	39.4	32.2
Mean minimum	13.6	19.4	27.4	23.0	18.1	29.0	36.2	29.1

Irrigation was applied through fixed sprinkler system in the two experimental sites with a daily water application of 20, 30 and 40 m^3fed^{-1} during Autumn and winter, Spring and Summer, respectively. The four seasons of the year have included the following months of the year; Winter (December, January, and February); Spring (March, April, and May); Summer (June, July and August) and Autumn (September, October, and November). Plots were harvested leaving around 7cm stubble when most entries were at the flowering stage and not exceeding 10% bloom. However, in winter plants were harvested on average at 40-45cm height to determine fresh yield.

Plant height was measured, from the crown region to the top leaves, before each cut. Fresh samples from each cut were oven dried at 105 °C up to constant weight to determine the DM %, then fresh yield was transformed into dry forage yield (t/fed). Chemical analysis as crude protein (CP %), crude fiber (CF %) ether extract (EE %) and ash % were determined for the tested cultivars in the winter season of the second year at Ismailia location only. Fresh samples (1.0 kg each) were taken from the two cuts of winter season of the second year and samples were oven dried at 75 °C up to constant weight, then, ground and used to determine the chemical composition, according to the conventional methods recommended by AOAC (1980).

By November, 2006 twenty nine and 27 cuts were obtained from Ismailia and the New Valley experimental site, respectively. The seasonal, yearly and the proportion of total yield in each of the four seasons were determined for each plot throughout the three successive experimental years. The obtained data for seasonal, yearly yield for each location and the combined over years and locations were statistically analyzed according to procedures outlined by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Seasonal Performance:

Seasonal forage dry yield of the tested cultivars were varied significantly among and within seasons, throughout the three growing years at Ismailia and New Valley (Table2 and 3). The local cultivars, Ismailia-1 and Siwa were significantly higher than the exotic cultivars; 109/01, 109/02 and 109/03, in total forage dry yield in all seasons and years at Ismailia (Table 2). There were insignificant differences among the local cultivars and the exotic cultivar; 109/03 in the first year at the New Valley (Table 3).

Table 2. Total forage dry yield (t h^{-1}) per season in three successive years for the tested alfalfa cultivars at Ismailia Research Station.

Cultivars	First year (2004)					Second year (2005)					Third year (2006)				
	Win. 2 cuts	Spr. 2 cuts	Sum 3 cuts	Aut. 3 cuts	mean	Win. 2 cuts	Spr. 3 cuts	Sum 3 cuts	Aut. 2 cuts	mean	Win. 2 cuts	Spr. 2 cuts	Sum 3 cuts	Aut. 2 cuts	mean
109/01	2.2	2.0	2.8	2.3	2.3	2.2	2.9	2.0	1.5	2.2	1.3	1.3	2.9	2.0	1.9
109/02	2.4	2.0	2.6	2.5	2.4	2.0	3.2	2.3	1.5	2.3	1.4	1.3	3.0	1.8	1.9
109/03	2.7	2.0	2.9	2.3	2.6	2.3	3.3	2.4	1.5	2.4	1.3	1.1	3.0	1.8	1.8
Ismailia-1	3.9	4.3	5.4	4.5	4.5	3.5	5.4	5.1	3.1	4.3	3.2	2.6	5.0	3.2	3.4
Siwa	3.8	3.8	5.5	4.8	4.5	3.8	6.0	5.1	3.2	4.5	3.1	2.6	4.6	2.7	3.3
Average:	3.0	2.8	3.8	3.3	3.3	2.8	4.2	3.4	2.2	3.1	2.0	1.7	3.7	2.3	2.5
CV. % :	4.5	4.4	6.4	6.9	3.9	8.5	5.7	7.7	9.6	5.4	9.7	12.1	4.8	8.9	6.8
LSD (0.05)															
Cultivars:	0.09	0.08	0.16	0.15	0.13	0.15	0.15	0.17	0.14	0.12	0.13	0.14	0.11	0.13	0.09
LSD (0.05)															
Cul x Seas:	---------- 0.11 ---------					---------- 0.14 ---------					---------- 0.12 ---------				

Significant differences were observed in Spring, Summer and Autumn of the same year (2004). Furthermore, significant differences were obtained among cultivars and seasons in the second (2005) and third year (2006) respectively, at both Ismailia and New Valley locations (Tables 2 & 3). The tested cultivars fell in two distinguished groups, based on their production. These results were in agreement with Oushy *et al.* (1999) who concluded that both local and exotic alfalfa cultivars fell in two significantly different groups. In the seedling year, Siwa and Ismailia-1 were the highest yielding cultivars. Both cultivars performed similarly in the four growing seasons during the three years over locations.

These results could be due to the fact that Ismailia-1 and Siwa cultivars originated from the same cluster (New Valley Oasis). These results are in agreement with Oushy *et al* (1999) who reported that the alfalfa cultivars which developed and originated from the New Valley germplasm have a lot of similarity in genetic constitution.

Table 3. Total forage dry yield (t h^{-1}) per season in three successive years for the tested alfalfa cultivars at the New Valley Research Station.

Cultivars	First year (2004)					Second year (2005)					Third year (2006)				
	Win.	Spr.	Sum	Aut.		Win.	Spr.	Sum	Aut.		Win.	Spr.	Sum	Aut.	
	1 cuts	2 cuts	3 cuts	2 cuts	mean	2 cuts	3 cuts	2 cuts	3 cuts	mean	2 cuts	3 cuts	2 cuts	2 cuts	mean
109/01	3.1	8.9	10.1	8.1	7.6	9.3	17.2	9.0	10.6	11.5	5.9	8.6	6.4	6.4	6.8
109/02	3.5	8.4	9.9	6.9	7.2	6.6	14.6	7.9	10.6	9.9	5.6	8.9	6.0	6.0	6.6
109/03	4.0	7.2	9.4	6.9	6.9	7.3	13.9	10.0	12.1	10.8	5.6	9.2	5.8	5.3	6.5
Ismailia-1	4.3	10.1	11.8	9.6	9.0	8.8	17.2	10.2	13.0	12.3	6.9	10.6	7.3	8.1	8.2
Siwa	3.8	10.2	11.7	9.8	8.9	8.6	16.9	10.4	13.2	12.3	7.1	11.3	7.8	8.1	8.6
Average:	3.7	8.9	10.6	8.3	7.9	8.1	15.9	9.5	11.9	11.4	6.3	9.7	6.7	6.8	7.3
CV. % :	2.5	17.9	14.7	11.8	10.2	6.50	5.20	2.10	1.80	4.2	2.3	3.2	3.5	3.9	2.1
LSD (0.05)															
Cultivars:	0.59	1.04	1.00	0.63	0.42	0.34	0.54	0.13	0.14	0.27	0.09	0.20	0.15	0.17	0.12
LSD (0.05)															
Cut x Seas:	---------- 0.78 ----------					---------- 0.30 ----------					---------- 0.15 ----------				

Moreover, the exotic cultivars have shown similar yielding behavior, within and between seasons, throughout the three growing years over locations (Table 2 & 3). It seems that they have originated from the same gene pool. These results are in agreement with those obtained by Oushy *et al.* (1999) and Ramah *et al.* (1995). The exotic cultivars have shown insignificant differences regarding forage yield in Spring, Summer and Autumn of the seedling year as well as in winter, summer and Autumn of the second year at Ismailia. While, in the third year, no significant differences were shown for forage yield overall seasons (Table 2). While, the local group expressed higher yielding capacity over the exotic group cultivars in Spring, Summer and Autumn during the three years at the New Valley (Table 3). However, 109/01 cultivar had the highest yield in winter of the second year (Table 3).Neither of the tested cultivars was top yielding in all seasons nor in the same year over locations (Table 2 & 3).

2. Distribution of dry forage yield:

The local and exotic cultivars were categorized in two distinguished groups based on their total dry forage yield of all cuts, over locations (Table 4&5). Ismailia-1 was the highest yielding cultivars in total yield over 29 cuts, followed by Siwa in Ismailia (Table 4)

However, there was very little difference (0.119 t h^{-1}) between local cultivars. Siwa ranked first highest in yielding capacity in winter and spring followed by Ismailia-1 over all growing years.Ismailia-1 ranked first in yielding capacity in Summer and Autumn followed by Siwa overall the three-year study (Table 4).

Table 4. Total forage dry yield (t h^{-1}) in four seasons of the tested alfalfa cultivars and as a percentage of the total accumulated yield obtained from 29 cuts at Ismailia Agricultural Research Station.

Cultivars	Winter		Spring		Summer		Autumn		Total
	total 6 cuts	% of total	total 7 cuts	% of total	total 9 cuts	% of total	total 7 cuts	% of total	yield of 29 cuts
109/01	5.6	22.30	6.1	24.29	7.6	30.46	5.8	23.06	25.1
109/02	6.0	22.96	6.4	24.61	7.7	29.75	5.9	22.77	25.9
109/03	6.2	23.45	6.5	24.62	8.2	30.91	5.7	21.02	26.5
Ismailia-1	10.6	21.63	12.1	24.65	15.5	31.65	10.8	22.12	49.0
Siwa	10.6	21.78	12.4	25.49	15.1	30.90	10.7	21.88	48.8
Average:	7.5	22.42	8.7	24.73	10.8	30.73	7.8	22.17	35.1
CV. % :	5.6		4.2		4.7		3.6		2.7
LSD (0.05) Cultivars:	0.28		0.24		0.33		0.18		0.61
LSD (0.05) Cul x Seas:	---------- 0.24 ----------								

Similar results were obtained at the New Valley, where the local cultivars Isamailia-1 and Siwa were superior to the exotic cultivars in total dry forage yield as a percentage of the total accumulated yield obtained from 27 cuts (Table 5). Ismailia-1 had the highest yielding capacity in 5 cuts in winter seasons; whereas, Siwa had the highest yielding capacity in Spring, Summer, and Autumn seasons during the three years (Table 5). It seems that none of the tested cultivars performed similarly in all seasons and years (Table 4 & 5).

The average of total forage dry yield (t h^{-1}) of the exotic cultivars over the 29 cuts at Ismailia, represents 52.8% of the local cultivars. It could be stated that the local cultivars Ismailia-1 and Siwa have surpassed the exotic cultivars. The local cultivars yielded as double (49.0 t h^{-1}) as the exotic cultivars (25.9 t h^{-1}) overall the 29 cuts at Ismailia (Table 4).

At the New Valley, the average dry forage yield (t h^{-1}) of the exotic cultivars over the 27 cuts represents 83.25% of the local cultivars.

A similar trend was obtained for the local group over the exotic group at the New Valley (Table 5). The superiority of the local cultivars could be due to their adaptability for the abiotic and biotic environmental conditions compared with the exotic cultivars that originated under different environmental conditions, in addition to the genetic constitution differences of both groups. The accumulation of dry matter yield as average during the successive years of production at the New Valley location

was three times (106.4 t h^{-1}) than at Ismailia location (35.1 t h^{-1}). This might be due to the existing environment at the New Valley such as the relative high temperature, low humidity and high soil temperature in comparison with those at Ismailia (Table 1) where more suitable conditions are existing for plant growth (Table 6 and 7). Moreover, such variables cause definable and distinct differences in yield and yield components. In addition, the fact that alfalfa originated and trace back to the New Valley specifically and Oases generally is true and these areas may be one of the centers of origin of the non-dormant alfalfa germplasm. It is worth to mention that the remarkable differences between the highest and lowest yielding environment may indicate that the cultivars were subjected to a wide range of environmental changes which affected their yielding abilities. These results are in line with the findings of Abdel-Galil *et al* (2000) who reported that, at the New Valley location, the varieties of alfalfa performed much better than at Ismailia location, where, the total dry yields over two years ranged from 33.8 to 38.3 t h^{-1} at the New Valley and from 17.1 to 22.1 t h^{-1} at Ismailia. Also, Smith *et al* (1968) stated that the varieties which gave the highest yield under one set of field condition, not necessarily give the highest yield under all conditions. Moreover, the results were in agreement with Marble *et al.* (1985) who concluded that Middle East ecotypes were superior to other varieties or ecotypes in Summer and grow more during Winter. Also, these results were supported by Smith *et al.* (1991) who reported that there is a highly degree of similarity between ecotypes within a cluster.

Table 5. Total forage dry yield (t h^{-1}) in four seasons for the tested alfalfa cultivars and as a percentage of the total accumulated yield obtained from 27 cuts at the New Valley Agricultural Research Station.

Cultivars	Winter		Spring		Summer		Autumn		Total
	total 5 cuts	% of total	total 8 cuts	% of total	total 7 cuts	% of total	total 7 cuts	% of total	yield of 27 cuts
109/01	18.3	17.69	34.6	33.47	25.4	24.57	25.1	24.27	103.5
109/02	15.8	16.64	31.8	33.51	23.8	25.05	23.6	24.81	95.0
109/03	17.3	17.17	30.2	31.14	25.1	25.89	24.4	25.13	97.0
Ismailia-1	20.0	16.59	37.9	32.26	29.3	24.82	30.7	26.10	117.8
Siwa	19.3	16.24	38.4	32.36	29.9	25.20	31.1	26.21	118.7
Average:	18.1	16.95	34.6	32.63	26.7	25.11	27.0	25.31	106.4
CV. % :									
LSD (0.05)									
Cultivars:	0.64		1.31		1.10		0.60		2.16
LSD (0.05) Cul x Seas:	---------- 0.88 ----------								

The yield distribution over the four seasons over the 29 cuts as a percentage from the total yield indicated that Ismailia-1 and Siwa were the highest contributors to Winter, Spring, Summer, and Autumn dry forage yield. However, the lowest contributors in all seasons were the exotic cultivars (Table 4&5). These results could indicate that the exotic cultivars have some sort of winter dormancy compared with local cultivars that are winter active. These results are in agreement with Oushy *et al.* (1999), Smith *et al.* (1991), Rumbaugh *et al.* (1998) and Marble *et al* .(1985) who stated that cultivation in the arid regions had led to evolution of many unique local ecotypes which may be excellent candidates for breeding non dormant varieties adapted to desert conditions.

The genetic potential performance of the five tested cultivars differed significantly during the four growing seasons overall the three growing years. The seasonal proportion of the total yield over the 29 cuts, expressed upward trend from winter to summer overall cultivars, then sharply dropped in Autumn (Table 4). Summer yield contributed the highest proportion of the total yield (30.73 %) followed by Spring (24.73%), Winter (22.42%), and Autumn (22.17%). In contrast, a different trend was observed in the New Valley, where spring season contributed the highest proportion (32.63%) followed by autumn (25..31%), summer (25.11%) and the lowest season was winter (16.95%) over 27 cuts. These results are in agreement with those obtained by Rammah *et al.* (1995) who reported that summer average dry yield of thirteen Egyptian landraces and three local cultivars, contributed the highest proportion of the total yield followed by Spring, Winter and Autumn. In addition, these results are supported by Brune *et al.* (1989) who found variation in the performance of cultivars among periods and seasons. Also, similar results were reported by Oushy *et al.* (1999) who stated that Autumn contributed the highest proportion (32.41%) followed by Summer (30.94%), Spring (23.88%) and then Winter (12.77%) at Ismailia.

3. Productivity distribution among years:

The accumulated dry forage yield in the three growing years and the total yield of all cuts over locations divided the tested cultivars into two groups (Tables 6&7). At Ismailia the highest group was the local cultivars with no significant difference in yielding capacity, between Ismailia-1and Siwa, except in the third year (Table 6). The first year contributed with 36.84% to the total yield followed by the second year which contributed with 35.23% and then followed by the third year with contribution of 27.95% to the total yield, at Ismailia. The contributed trend from the total was downward from the first to the third year (Table 6).

Table 6. The accumulated forage dry yield (t h^{-1}) during three successive years as a percentage from the total yield of the 29 cuts at Ismailia Research Station.

Cultivars	First year (2004)		Second year (2005)		Third year (2006)		Total
	total 10 cuts	% of total	total 10 cuts	% of total	total 9 cuts	% of total	yield of 29 cuts
109/01	9.2	36.81	8.5	34.06	7.3	29.13	25.1
109/02	9.5	36.64	9.0	34.62	7.4	28.74	25.9
109/03	9.9	37.56	9.4	35.49	7.2	27.04	26.5
Ismailia-1	17.9	36.66	17.1	34.91	13.9	28.44	49.0
Siwa	17.9	36.55	18.1	37.09	12.9	26.41	48.9
Average:	12.9	36.84	12.4	35.23	9.8	27.95	35.1
CV. % :	2.9		5.8		2.9		2.7
LSD (0.05) Cultivars:	0.24		0.5		0.2		0.61

A different trend was obtained at the New Valley; where an upward trend yield increase from 29.59% in the first year followed by 42.76% in the second year and a sharp decline observed in the third year 27.65% (Table 7).These results may be due to the origination of each group cultivars from the same cluster and gene pool. These results are in agreement with Smith *et al.* (1991) who stated that a high degree of similarity existed between ecotypes within cluster. The superiority of Ismailia-1 and Siwa over the exotic cultivars (109/01, 109/02 and 109/03) regarding the accumulated dry forage per year for the 29 cuts at Ismailia could be attributed to their genetic potential as registered cultivars. These results supported by Oushy *et al* (1999) who reported that the accumulated dry forage yield in the second year was the highest (52.32%) compared with the first year of (47.68%).

Table 7. The accumulated forage dry yield (t h^{-1}) during three successive years as a percentage from the total yield of the 27 cuts at the New Valley Agricultural Research Station.

Cultivars	First year (2004)		Second year (2005)		Third year (2006)		Total
	total 8 cuts	% of total	total 10 cuts	% of total	total 9 cuts	% of total	yield of 27 cuts
109/01	30.2	29.22	46.0	44.49	27.2	26.29	103.5
109/02	28.7	30.23	39.6	41.73	26.6	28.05	95.0
109/03	27.5	28.37	43.1	44.49	26.3	27.14	97.0
Ismailia-1	35.8	30.38	49.1	41.69	32.9	27.93	117.8
Siwa	35.3	29.75	49.1	41.40	34.3	28.87	118.7
Average:	31.5	29.59	45.4	42.76	29.5	27.65	106.4
CV. % :	9..9		2.6		1.89		3.6
LSD (0.05) Cultivars:	2.02		0.75		0.36		2.16

4. Combined Total Dry Forage Yield:

The combined analysis of the total dry forage yield (t h^{-1}) over the two tested locations; Ismailia and the New Valley, revealed that the local cultivars; Ismailia-1 and Siwa were significantly higher in total dry forage yield (83.3 and 83.8 t h^{-1}); respectively, than the exotic cultivars (Table 8). These results reflected some regional adaptation for the local cultivars. Also, it shows that this group has originated from the same genetic cluster (Table 8). These results are supported by Rammah (1995), Smith *et al.*(19991), Oushy *et al.* (1995) who reported that the genotypic cluster of the New Valley cultivars was superior to the introduced genotypes in yield and yield components.

Table 8. Total dry forage yield (t h^{-1}) per year for the tested cultivars and their combined at Ismailia and the New Valley Research Stations.

Cultivars	Ismailia				New Valley				Total
	Yr-1	Yr-2	Yr-3	Total	Yr-1	Yr-2	Yr-3	Total	Combined
	10 cuts	10 cuts	9 cuts	29 cuts	8 cuts	10 cuts	9 cuts	27cuts	
109/01	9.2	8.5	7.3	25.1	30.2	46.0	27.2	103.5	64.3
109/02	9.5	9.0	7.4	25.9	28.7	39.6	26.3	95.0	60.5
109/03	9.9	9.4	7.2	26.5	27.5	43.1	32.9	97.0	61.6
Ismailia-1	17.9	17.1	13.9	49.0	35.8	49.1	34.3	117.8	83.3
Siwa	17.9	18.1	12.9	48.8	35.3	49.1	29.5	118.7	83.8
Average:	12.9	12.4	9.8	35.1	31.5	45.4	29.5	106.4	70.7
CV. % :	2.9	5.8	2.9	2.7	9.9	2.6	1.89	3.6	3.47
LSD (0.05) Cultivars:	0.24	0.5	0.2	0.16	2.02	0.75	0.36	2.16	1.06
LSD (0.05) Cul x Yrs:	---------- 0.3 ----------				---------- 1.2 ----------				

5. Plant Height:

Seasonal average plant height during the three growing years at Ismailia for the tested cultivar revealed similar trend for annual dry forage yield (Table 9). The local cultivars Ismailia-1 and Siwa expressed the highest significant plant height compared with the exotic group cultivars 109/1, 109/02 and 109/03, during the three growing years. Upward height trend was observed in the first year with 35.9 cm to the second year with 39.2 cm, over all cultivars. Whereas, downward height trend was observed during the third year with 35.8 cm (Table 9). No significant differences were observed between Ismailia-1 and Siwa regarding plant height except in the first year, where slight differences were observed.

Table 9. Seasonal average plant height (cm) during three successive years for the tested alfalfa cultivars at Ismailia Agricultural Research Station.

Cultivars	First year (2004)					Second year (2005)					Third year (2006)				
	Win. 2cut	Spr. 2cut	Sum 3cut	Aut. 3cut	Mean 10cut	Win. 2cut	Spr. 3cut	Sum 3cut	Aut. 2cut	Mean 10cut	Win. 2cut	Spr. 2cut	Sum 3cut	Aut. 2cut	Mean 9cut
109/01	35.7	30.4	30.5	35.6	33.1	36.8	36.7	34.8	36.5	36.2	30.9	22.9	34.8	37.1	31.4
109/02	34.2	30.4	31.1	36.2	33.0	37.3	35.3	35.2	36.1	36.0	31.0	24.1	35.6	37.3	32.0
109/03	32.3	28.3	27.7	36.0	31.1	40.6	41.4	36.1	36.3	38.6	29.5	23.6	36.4	37.6	31.8
Ismailia-1	44.6	45.1	41.2	37.3	42.1	43.4	43.2	43.1	42.2	43.0	40.5	41.1	44.3	43.5	42.3
Siwa	42.0	41.8	39.7	38.7	40.5	39.5	44.2	43.0	42.2	42.2	41.0	40.4	42.4	42.3	41.5
Average:	37.8	35.2	34.1	36.8	35.9	39.5	40.2	38.4	38.7	39.2	34.6	30.4	38.7	39.6	35.8
CV. % :	5.1	4.4	4.3	3.9	2.9	3.3	3.6	5.4	5.2	2.7	6.5	6.4	3.0	6.1	2.8
LSD (0.05)															
Cultivars:	3.0	2.4	2.3	2.2	1.5	2.0	2.2	3.2	3.1	1.6	3.2	3.0	1.8	3.7	1.6
LSD (0.05)															
Cul x Seas:	---------- 2.3 ----------					---------- 2.5 ----------					---------- 2.8 ----------				

At the New Valley, downward trend regarding plant height was observed from the first year (47.5 cm) to the third year (45.4cm). Similar results were obtained, where the local cultivars expressed higher rate of growth over the exotic cultivars (Table 10). None of the tested cultivars has the same superiority in plant height every season and year.

Generally, the average plant height overall tested cultivars was higher in Spring of the first year (50.6 cm) and the second year (47.3 cm) followed by winter of the third year (46.2 cm) (Table 10). At both sites, Ismailia and the New Valley, Ismailia-1 and Siwa cultivars expressed superiority over other cultivars regarding plant height with slight difference between them. These results are in agreement with the findings of Oushy *et al* (1999, Geweifel 1997, Mousa *et al* 1996 and Abdel-Halim *et al* 1992) These results are in agreement with Smith *et al.* (1991) who concluded that there is a high degree of similarity between ecotypes within cluster.

Table 10. Seasonal average plant height (cm) during three successive years for the tested alfalfa cultivars at the New Valley Agriculture Research Station.

Cultivars	First year (2004)					Second year (2005)					Third year (2006)				
	Win.	Spr.	Sum	Aut.	Mean	Win.	Spr.	Sum	Aut.	Mean	Win.	Spr.	Sum	Aut.	Mean
	1cut	2cut	3cut	2cut	8cuts	2cut	3cut	2cut	3cut	10cut	2cut	3cut	2cut	2cut	9cut
109/01	47.0	43.8	42.9	43.1	44.2	48.1	48.1	43.0	42.0	45.3	44.2	44.6	42.7	44.5	44.0
109/02	40.0	51.3	50.8	42.6	46.2	44.6	45.4	43.2	43.4	44.1	45.0	44.6	43.0	45.3	44.4
109/03	46.3	46.3	45.0	47.1	46.2	44.7	45.6	44.1	45.0	44.8	44.7	46.1	43.5	43.6	44.5
Ismailia-1	46.3	56.9	55.0	50.0	52.0	47.1	48.6	44.5	45.0	46.3	47.7	46.9	45.5	47.2	46.8
Siwa	40.0	55.0	52.1	47.8	48.7	49.2	49.0	44.8	45.5	47.1	49.4	47.2	45.4	47.6	47.4
Average:	43.9	50.6	49.2	46.1	47.5	46.7	47.3	43.9	44.2	45.5	46.2	45.7	44.0	45.6	45.4
CV. % :	21.4	6.8	8.8	8.1	5.8	3.5	2.1	1.8	1.9	1.2	1.8	0.6	2.1	2.7	0.9
LSD (0.05)															
Cultivars:	NS	5.3	6.7	5.7	4.3	2.5	1.5	1.2	1.3	0.9	1.3	0.4	1.4	1.9	0.6
LSD (0.05)															
Cul x Seas:	---------- 8.2 ----------					---------- 1.6 ----------					---------- 1.3 ----------				

6. Chemical Composition:

Noticeable variation in crude protein percentage (CP %), was observed among the tested cultivars (Table 11). It seems that the exotic cultivars were, in general, higher than the local cultivars by 1-2 CP%. In fact, the results showed that cultivars are divided into two distinct groups in CP%. CP% results indicated that the superiority of the exotic cultivars over the local group once whereas yield production exhibited an opposite trend. Therefore, in general we conclude that when alfalfa yield increased, CP% decreased and vice versa.

Table 11. Chemical composition of the tested alfalfa cultivars in the winter season of the second year at Ismailia site.

Cultivars	Crud Protein (%)	Crude Fiber (%)	Ether Extract (%)	Ash (%)
109/01	23.3	19.6	2.2	9.6
109/02	23.4	19.1	1.9	10.1
109/03	22.9	20.0	2.1	9.8
Ismailia-1	21.7	24.6	1.9	10.7
Siwa	21.4	25.1	1.8	11.8

Local cultivars have shown slight increase in CF% comparing with the exotic cultivars. Remarkable differences were observed in ether extract EE% and Ash%. In general the exotic cultivars expressed higher forage quality than the local cultivars in terms of high protein and Ether extract. However, these differences were insignificant and slightly affect the evaluation of these cultivars compared to dry forage yield and its distribution over the life cycle of the plants which is a more important consideration in evaluation and selection superior cultivars for commercial use.

CONCLUSION

The data revealed that the genetic performance of five alfalfa cultivars in two locations distinguished them into two categories. The superior category included the local cultivars, Ismailia-1 and Siwa which expressed significant performance and wide range of genetic base for yield superiority and adaptability in comparison with the exotic cultivars; 109/01, 109/02 and 109/03, under new reclaimed land conditions in Egypt. The total dry forage yield combined over Ismailia and the New Valley were 83.8 and 83.3 t h^{-1} for Siwa and Ismailia-1 cultivars, respectively. The exotic cultivars yielded 64.3, 60.5 and 61.6 t h^{-1} for 109/01, 109/02 and 109/03 cultivars, respectively. Local cultivars had similar genetic behavior either within or among seasons as well as years. This could be due to the fact that both cultivars originated from the same gene pool of Egyptian alfalfa landraces at New Valley and Siwa Oases.

The performances of the tested cultivars in terms of fresh forage yield were greatly affected by environment and genotypes. Also, none of the tested cultivars have maintained superiority in all seasons and years.

At Ismailia site, cultivars contributed the highest proportion (30.73%) of the total dry yield during the Summer season followed by Spring with (24.73%). However, at the New Valley site cultivars contributed the highest proportion (32.63%) of the total dry yield during Spring season followed by Autumn (25.31%). These different trends may be due to the heat stresses of Summer season at the New Valley site comparing with Ismailia site. The obtained genetic variability among the tested cultivars could be used as a breeding materials in further breeding program to develop new one. However, areas with alfalfa high productivity should be taken into consideration in our policy for expansion of alfalfa cultivation.

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سلوك أصناف محلية و أجنبية من البرسيم الحجازي تحت ظروف بيئية مختلفة في مصر

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أن التوسع في زراعة البرسيم الحجازي بمناطق الاستصلاح الجديدة كمصدر رئيسي للاعلاف الخضراء عالية القيمة الغذائية وكمحصول أستصلاح وبناء التربه أدي الي ذيادة الطلب علي زراعتة وأيضا علي ضرورة توفير تقاوي أصناف متفوقة تحت ظروف أراضي الاستصلاح الجديدة في مصر. لذلك كان هدف هذة الدراسة هو تقييم سلوك الصفات الانتاجية الموسمية والسنوية وصفات النمو والقيمة الغذائية لثلاث أصناف مستوردة من الولايات المتحدة الامريكية وهي 109/01, 109/02, 109/03 مقارنة مع صنفين مسجلين محليين هما أسماعلية-١ و سيوة من أنتاج مركز البحوث الزراعية. وقد تم أجراء التجربة في موقعين مختلفين بيئيا ويمثلان مناطق اللاستصلاح الجديدة بمصر في محطتي البحوث الزراعية في الاسماعيلية و الوادي الجديد. وقد تم أخذ عدد ٢٩ حشة من الإسماعلية خلال الفترة من يناير٢٠٣ الي اكتوبر2006 وعدد ٢٧ حشة من الوادي الجديد خلال الفترة من فبراير٢٠٠٣ الي اكتوبر٢٠٠٦ .

وقد اظهرت النتائج تفوق الاصناف المحلية علي الاصناف الامريكية المستوردة في كل من الاسماعلية و الوادي الجديد كما أظهر التحليل التجميعي للمحصول الجاف الكلي تفوق الاصناف المحلية المسجلة معنويا حيث حقق صنف سيوة (٨٣,٨ طنا" /هكتار) يليه الاسماعلية-1 (٨٣,٣ طنا" /هكتار) بينما اظهرت الاصناف المستوردة انخفاضا معنويا في المحصول الكلي الجاف حيث حقق الصنف 109/01 (٦٤,٣ طنا" /هكتار) و 109/02 (٦٠,٥ طنا" /هكتار) و 109/03(٦١,٦ طنا" /هكتار).

وقد اظهرت النتائج وجود تباين في محصول العلف الجاف بين المواسم و السنين للاصناف المدروسه، حيث انقسم السلوك الوراثي للاصناف الي مجموعتين متباعدتين وراثيا و متباعديتن معنويا في محصول العلف الجاف الموسمي و السنوي و الكلي، حيث اظهرت المجموعة الاولي التي ترجع اصولها الوراثية الي واحات سيوة و الوادي الجديد (اصناف سيوة و اسماعلية -1) تفوقا معنويا علي المجموعة الثانية التي تضم الاصناف المستورده (109/01–109/02- 109/03). و قد اظهرت النتائج في الاسماعلية ان نسبة محصول العلف الجاف في السنة الاولي من المحصول الكلي كانت (٣٦،٨٤%) و السنة الثانية كانت (٣٥،٢٣%) بينما حققت (٢٧،٩٥%) في السنة الثالثة، بينما كانت النسبة في الوادي الجديد (٢٩،٥٩%) للسنة الاولي و (٢٤،٧٦%) للسنة الثانية و ٢٧،٦٥% للسنة الثالثة.

كما اظهرت الاصناف المحلية المسجلة تفوقا معنويا في محصول السنوات الثلاث مع عدم وجود فروق معنوية بينها في المحصول. و قد اظهرت النتائج تأثر توزيع العلف معنويا بالظروف البيئية ما بين الاسماعلية و الوادي الجديد و مواسم النمو الأربعة و ايضا بالتراكيب الوراثية للأصناف الخمسة.

وقد اظهرت النتائج ان اعلي نسبة من المحصول الكلي للعلف في الاسماعلية نتجت في فصل الصيف (٣٠،٧٣%) ثم الربيع (٢٤،٧٣%) والشتاء (٢٢،٤٢%) والخريف (٢٢،١٧%) ، بينما اظهرت النتائج في الوادي الجديد ان أعلي نسبة في المحصول الكلي نتجت في الربيع (٣٢،٦٣%) ثم الخريف (٢٥،٣١%) والصيف (٢٥،١١%) وأقلها فى الشتاء (١٦،٩٥%). وقد اظهرت الدراسة تمتع الاصناف المستوردة ببعض الصفات الوراثية للجودة والقيمة الغذائية علي الرغم من انخفاض محصولها الكلي معنويا عن الاصناف المحلية.

وقد اوصت الدراسة باستخدام الاصناف المسجلة سيوة و اسماعلية-1 كاصناف متفوقة بأراضي الآستصلاح الجديدة وفي المشاريع القومية في توشكي و شرق العوينات وسيناء، وكذلك اوصت الدراسة بضرورة استخدام التباين الوراثي للاصناف المستخدمة بالدراسة كقاعدة وراثية لبرامج التربية المستقبلية لتطوير اصناف جديدة من البرسيم الحجازي كما يجب الأخذ في الاعتبار المناطق عالية الانتاج في سياسة التوسع في زراعة البرسيم الحجازى.