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Evaluation of Growth and Forage Production for Six Varieties of Egyptian Clovers under Riyadh Conditions

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Abstract. The present work was carried out to investigate the potential growth of six cultivars of Egyptian clovers (Giza-1, Giza-5, Giza-6, Giza-15, Sakha-4, Sakha-86) under Riyadh conditions. The cultivars were sown on two planting dates (15 October and 15 November), and four cuts were taken. The agronomic traits studied were plant height, dry and fresh yield, seed yield, tillers number and dry matter percentage. The general trend of growth and yield production was higher at the first planting date (16.3 t/ha) than (13.5 t/ha) at the second planting date. However, maximum plant height, dry and fresh yields and seed yield were recorded was for Giza-15 and Giza-5. The 3rd and 2nd cut of first and second planting dates, respectively, produced the greatest yield during the month of February. The average seed production at the 1st planting date was 338.5 kg/ha, which was incomparable with 12.9 kg/ha recorded at the 2nd planting date.

Introduction

Egyptian clover (*Trifolium alexandrinum* L.), also known as berseem or clover, is one of the best annual crops for winter forage production [1]. It grows vigorously and produces high dry matter yields on medium loam soils that are slightly alkaline [2]. With supplemental irrigation, berseem has the ability to grow well in certain soils and conditions for which alfalfa is unsuited [1].

As a leguminous crop with high yield and nutritional value berseem has become one of the principal entries of successive crops in irrigated soils or as a green manure in cash crop rotations [3]. Also, it is quite common among berseem growers to take one or two cuts before leaving plants to produce seeds. Berseem can be grown as a pure stand or in a mixture with a companion crop and could be used as emergency forage, especially with multi-harvest cultivars [4].

On the basis of stem branching habit, cultivars of berseem are classified as: Mescawi, Saidi and Fahl. Mescawi type gives five to six cuts, the Saidi two to three cuts, while Fahl gives only a single cut [5, p. 291].

In Saudi Arabia, berseem is not a common forage crop in the agricultural sector. This could be attributed to the dominance of alfalfa (*Medicago sativa* L.) cultivation. Nevertheless, berseem could be grown to provide supplementary feed during winter when low temperatures suppress alfalfa production. Recently, due to the shortage of water, the government policy encouraged farmers to grow annual forage crops having low water requirements to replace perennial forage crops such as alfalfa. Although, berseem is comparable with alfalfa in many traits such as potential yield and forage quality, nutritional value and drought tolerance, local farmers are still reluctant to grow Egyptian clover due to the lack of information about its production. This study was undertaken to evaluate the forage potential of six Egyptian cultivars under Riyadh conditions.

Materials and Methods

A two years experiment was carried out at King Saud University Agricultural Research Station in Deirab (24 42 ^{o} N, 44 46 ^{o} E) near Riyadh during 1996-7 and 1997-8 seasons. The site of the experiment was a sandy loam soil (clay 11%). It contains moderate soluble salts (EC=4.5 dsm-1), high CaCO3 (38%), low organic matter (0.5%), and a pH value of 7.6. Average temperatures for October, November, December, January, February, March, and April were 25, 19, 16, 14, 16, 20 and 24 °C in 1996-7 season and 27, 20, 16, 14, 18, 21 and 27 °C for 1997-8 season, respectively. Total rainfall amounted to 89 mm and 120 mm in the respective seasons.

Six cultivars of Egyptian clover namely; Giza-1, Giza-5, Giza-6, Giza-15, Sakha-4 and Sakha-86 were sown in two planting dates; 15 October (D1) and 15 November (D2). A split plot design with four replicates was used. Each cultivar was sown on five rows of two meter long and 25 cm apart while cultivars in each replication were separated by 50 cm. For both planting dates, four scheduled cuts were taken at 60, 100, 130, 160 days after sowing, and then plants were left to produce seeds. Phosphate fertilizer was applied at a rate of 120 kg/ha P_2O_5 at planting, whereas a nitrogen fertilizer of urea 46% N was at a rate of 23 kg/ha N one week after sowing and after each cut. Plots were irrigated with treated municipal water whenever needed throughout the growing season.

Growth and yield characteristics measured were fresh and dry forage yields, number of stems per plant, plant height, dry matter percentage (DM%) and seed yield. Data for the two growing seasons were statistically analyzed using SAS software [6], while means were separated using the least significant difference method.

Results and Discussion

The pooled analysis of variance (Table 1) showed that year effect was not significant for all measured traits except for plant height and there was no significant year X planting date interaction. Planting dates significantly affected all of the measured traits except DM%. There was significant variation among cultivars in all measured traits except for dry yield. Year X cultivar interaction was significant for seed yield and number of stems/plant, while planting date X cultivar interaction was significant for dry forage yield and seed yield. The year X date X cultivar interaction was only significant for seed yield (Table 1).

Table 1. The pooled analysis of variance for the two growing seasons for six Egyptian clovers sown in two planting dates in the central area of Saudi Arabia

Variable	DY Ton/ha	DM %	SY Kg/ha	PH cm	S/P
Year	NS	NS	NS	**	NS
Planting dates	**	NS	**	*	**
Year* Date	NS	NS	NS	NS	NS
Cultivar	NS	**	**	*	**
Year*Cultivar	NS	NS	**	NS	**
Date*Cultivar	*	NS	**	NS	NS
Year*Date*Cul	NS	NS	**	NS	NS

Abbreviations: DY = Dry forage yield, DM% = Dry matter percentage, SY = Seed yield, PH = Plant height, S/P = number of stems per plant.
* & ** = Mean was significantly affected at level 5% and 1%, respectively.
NS= mean was not significantly affected at level 5%.

Planting date had a significant effect on forage yield and yield attributes. Total dry forage yield was significantly higher by 17% at the 15 October planting (16.3 t/ha) compared to the 15 November planting date (13.5 t/ha) (Table 2). Seed yield was also significantly higher at the first planting date (338.5 kg/ha) compared to the second planting date (12.9 kg/ha). The average seed yield at 15 October planting was quite satisfactory. Martiniello and Ciola [7] mentioned that the typical seed yield for berseem is approximately 150 to 200 kg/ha.

The first planting date had also significantly taller plants (68.6 cm) than the second date (60.3 cm). However, the second date had significantly higher number of stems/plant than the first planting date (Table 2). Graves *et al.* [1] reported that variation in basal buds growth contributes more to the variation in seasonal yield.

Cultivars varied significantly in yield and yield attributes except for DM% (Table 2). The cultivar Giza-15 had the highest total forage yield (15.88 t/ha). The Giza varieties appeared to be more productive than the Sakha varieties, although, only Giza-15 had significantly higher forage yield than the Sakha varieties. Giza-15 and Giza-5 had significantly higher seed yield than any other cultivar (280 and 257 kg/ha, respectively).

Giza-15 was significantly taller than any other cultivar while Giza-1 had the highest number of stems/plant (Table 2).

Table 2. Effect of planting date on the total dry forage yield (DY), dry matter percentage (DM%), seed yield (SY), plant height (PH) and stems/plant (S/P) for the six Egyptian clovers

	DY **(Ton/ha)**	DM **(%)**	**SY (kg/ha)**	**PH (cm)**	**S/P**
Planting date					
15 October	16.31	15.5	338.5	68.6	53.3
15 November	13.50	15.3	12.9	60.3	57.4
LSD (0.05%)	0.68	NS	39.8	1.4	1.7
Cultivars					
Giza-1	14.99	15.4	148.7	63.9	59.1
Giza-5	15.18	15.2	256.8	64.1	53.2
Giza-6	14.78	15.4	150.6	63.9	56.8
Giza-15	15.88	14.7	280.0	67.2	53.8
Sakha-4	14.51	15.8	91.8	64.1	55.2
Sakha-86	14.15	15.8	126.2	63.5	54.0
LSD (0.05%)	1.17	NS	68.9	2.4	2.9

NS= mean was not significantly affected at level 5%.

All cultivars performed and yielded significantly higher when planted on 15 October than on 15 November (Table 3). Hassanein [8] reported that berseem, in general, grows from October to May but produces forage principally from December to March. The highest forage yield per cut was obtained at the third cut at the first planting date while at the second planting date the highest forage yield per cut was obtained at the second cut (Table 3). Koriem *et al*. [9] reported that the forage yield of the 3rd cut of berseem could be used as an indicator to the total yield and, moreover, as a basis for selection between cultivars. In this study, Giza-15 had the highest total forage yield at both planting dates, nevertheless it ranked sixth and fourth at the 1st and 3rd cuts, respectively (Table 3).

Table 3. The average dry matter yield per cut (ton/ha) for the six Egyptian clovers at two planting dates (D1 and D2)*

Cuts	**Giza-1**		**Giza-5**		**Giza-6**		**Giza-15**		**Sakha-4**		**Sakha-86**		**LSD**
	D1	**D2**	**D1**	**D2**	**D1**	**D2**	**D1**	**D2**	**D1**	**D2**	**D1**	**D2**	**At 5%**
Cut 1	2.8	2.25	2.65	2.27	2.64	1.89	2.32	1.80	3.12	2.20	2.35	2.38	-
mean	2.53		2.46		2.26		2.06		2.66		2.37		0.31
Cut 2	3.62	4.33	3.55	4.30	3.98	4.32	4.34	4.80	3.88	3.80	3.61	4.39	-
mean	3.98		3.93		4.15		4.57		3.84		4.0		0.4
Cut 3	6.14	3.72	5.90	3.89	5.85	3.55	5.89	4.33	6.19	3.46	5.0	3.84	-
mean	4.93		4.89		4.7		5.11		4.82		4.42		0.61
Cut 4	4.0	3.11	4.54	3.26	4.04	3.30	4.36	3.72	3.61	2.76	3.44	3.29	-
mean	3.56		3.9		3.67		4.04		3.19		3.37		0.39

D1 and D2 are the two planting dates at 15 October and 15 November, respectively.

Cultivar X planting date interaction was significant for seed yield. However, all cultivars had significantly higher seed yield at the first planting date. Maximum seed yields recorded were 541.2 and 500 kg/ha for Giza-15 and Giza-5, respectively, which were significantly higher than any other cultivar (Table 4).

Table 4. The total fresh and dry forage yield (ton/ha), seed yield (kg/ha), plant height (cm) and the average number of stems/plant for each of the six Egyptian clovers at the two planting dates (D1 and D2)*

Growth parameters	Giza-1		Giza-5		Giza-6		Giza-15		Sakha-4		Sakha-86		LSD At 5%
	D1	D2	D1	D2	D1	D2	D1	D2	D1	D2	D1	D2	
Fresh forage yield	107.8	89.2	111.5	92.4	107.1	86.8	116.6	99.0	108.4	80.0	96.2	89.0	9.1
Dry forage yield	16.56	13.42	16.64	13.72	16.5	13.05	16.92	14.65	16.81	12.22	14.4	13.91	1.17
Seed yield	282.5	15.0	500	13.8	293.7	7.5	541.2	18.8	173.8	10.0	240.0	12.5	68.9
Plant height	68.5	59.3	67.8	60.4	67.6	60.1	70.7	63.7	69.0	59.1	67.7	59.3	2.4
Stems/plant	58.3	59.9	49.9	56.6	57.0	56.6	51.8	55.9	52.4	58.1	50.5	57.5	2.9

D1 and D2 are the two planting dates at 15 October and 15 November, respectively.

This study verified that all of the six cultivars followed the same trend of growth and yield production at both planting dates tested. However, the 15 October seemed to be better for all of the cultivars (Table 4). Evers [10] stated that late planting date may not affect significantly the total germination, but would reduce the rate of germination and results in slower establishment. Ahmed and Mohamed [11] reported that the average dry yield per cut in Egypt was 5.4 t/ha. While in this study, the average dry forage yields were only 4.1 and 3.4 t/ha for D1 and D2 planting dates, respectively (Table 2). Berseem productivity and quality can be increased markedly by cultural practices, including bacterial inoculation especially in virgin soils [12]. Therefore, additional research on management practices should be conducted to improve the potential use of Egyptian clover as winter forage in Saudi Arabia.

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تقييم نمو وإنتاج العلف لستة أصناف من البرسيم المصري تحت ظروف الرياض

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ملخص البحث. أجريت هذه التجربة لدراسة نمو ستة أصناف من البرسيم المصري (جيزة-١، جيزة-٥، جيزة-٦، جيزة-١٥، سخا-٤، سخا-٨٦) تحت ظروف منطقة الرياض. زرعت الأصناف في موعدي زراعة (١٥ أكتوبر، ١٥ نوفمبر) وأخذ منها أربع حشات. الصفات المحصولية المدروسة هي طول النبات، محصول العلف الرطب والجاف، محصول البذور، عدد السيقان للنبات الواحد ونسبة المادة الجافة. المنحى العام للنمو والإنتاج كان أعلى في موعد الزراعة الأول (١٦,٣ طن/هـ) مقارنة بالموعد الثاني (١٣,٥ طن/هـ). كما أن أعلى طول للنباتات وأعلى إنتاج للعلف الرطب والجاف وللبذور كانت لصنفي جيزة-١٥ و جيزة-٥. كما سجلت الحشات الثالثة (في الموعد الأول) والثانية (في الموعد الثاني) أعلى المعدلات من العلف وذلك في شهر فبراير. أما متوسط الإنتاج البذري لموعد الزراعة الأول فقد كان ٣٣٨,٥ كجم/هـ بينما تدنى إلى ١٢,٩ كجم/هـ لموعد الزراعة الثاني.