

EFFECT OF SOWING METHOD AND CUTTING SYSTEM ON FORAGE AND SEED PRODUCTION OF SOME EGYPTIAN CLOVER CULTIVARS (*TRIFOLUM ALEXANDRINUM*, L.).

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ABSTRACT

Two field experiments were conducted at the Research Farm of the Faculty of Agriculture, Suez Canal University in Al-Ismailia, during 2003/2004 and 2004/2005 winter seasons. The present investigation aimed to study the effect of two sowing methods (in rows and broadcasting) and three cutting systems (system (A): the three growth periods were 60, 35 and 30 days before the 1st, 2nd and 3rd cuts respectively. While, these periods were prolonged by 5 and 10 days in the second (B) and the third (C) systems, respectively. on forage and seed production of three Egyptian clover multicut cultivars namely Helaly, Sakha 4 and Giza 15 under sandy soil conditions. A split-split plot design with three replicates was used in both seasons.

The results revealed that broadcasting method gave higher values in plant height, fresh, dry yields and seed yield and its attributes than sowing in rows one. Whereas, forage quality (CP, DCP, TDN and SV percentages) were not significantly affected by sowing methods.

At the three cuts, prolonging the cutting intervals by 5 and 10 days in B and C systems caused a continuous and significant increase in each of plant height, fresh, dry forage and seed yields/fad.. The number of heads/plant was not significantly affected in both seasons. While, TDN and SV percentages were gradually increased by prolonging the cutting intervals but the CP and DCP percentages took an opposite trend in the first two cuts. Helaly cv. recorded the highest values of plant height, fresh, dry forage yields and seed yield and its components in the two seasons and their combined while, Giza 15 and Sakha 4 cvs, recorded the highest values of CP% and DCP% in the 2nd and 3rd cuts of the combined data followed by Helaly cv. in respective order.

The results did not show significant interaction effects between sowing methods and cutting systems in all studied traits except, plant height. There was a positive and significant correlation between each of plant height, total forage yield, TDN% and SV% on one hand and total dry forage yield per fad. on the other. However, the correlation between total dry forage yield and both CP% and DCP% negative and significant.

Results indicated that Helaly Egyptian clover cv. when broadcasted and cut as in C system can produced the highest forage and seed yields under sandy soil conditions of Ismailia Governorate..

Key words : Egyptian clover cultivars , sowing methods and cutting systems.

INTRODUCTION

Berseem, Egyptian clover is considered the main forage crop for feeding animals during winter season in Egypt. It is characterized by its high productivity, high adaptability in winter season and excellent quality, moreover, it has a special role in soil improvement. Maximizing the potentiality of clover could be achieved by selecting new high yielding cultivars of berseem, and adoption of the agronomic practices such as sowing method and cutting intervals.

The effect of sowing method on the production of berseem was studied by several researchers. Shihata (1982) reported that fresh, dry and seed yields of berseem were affected similarly by different sowing methods. He reported that the sown berseem in rows of 40 cm apart produced the highest forage yield of each cut as well as the total fresh yield and seed yield compared with other methods. However, Choubey *et al.* (1991), in India, tested the effect of sowing methods (broadcasting and sowing in rows 20, 30 or 40 cm apart) on forage production and seed yield of berseem (*Trifolium alexandrinum* cv. Mescavi). They confirmed that highest fresh weight and dry matter yields and net returns were obtained with broadcasting. El-Debaby *et al.* (1994), found that the plant height in the 2nd cut was significantly higher in broadcast sowing compared with row sowing. Also, broadcasting method produced higher fresh and dry forage yields than rows method. The increases in fresh yield were 0.84, 1.09, 1.43, 0.495 and 3.87 ton/fad. for the four cuts and total yield respectively. Arora *et al.* (1998) found that mean seed yield was 0.29 t/ha. from broadcasting and ranged from 0.16 – 0.20 ton/ha. with row sowing.

Regarding the effect of cutting intervals on forage yield and its quality of multicut Egyptian clover, Radwan *et al.* (1983), tested the effect of five different cutting scheduling on forage yields per cut, these yields were significantly increased with delaying the first cut from 55 to 75 days from sowing and the 2nd cut from 35 to 40 days from the first one. The seasonal forage yield was significantly increased when the period from sowing to the last cut was prolonged where the 3rd and 4th cuts were made in 30 days interval. Starch value and total digestible nutrients gave the same trend of forage yield under different cutting schedules.

Ahmed *et al.* (1991), showed that dry matter in berseem remained low (10.2%) in young cuts and reached more than 20% at the third one. Crude protein (CP) ranged from 27.8 to 15% with cut number. Also, Abdel-Gawad (1993-b),

reported that crude protein contents of berseem were decreased with delaying the first cut from 65 to 75 days and the subsequent cuts from 30 to 40 days. Gaballah (1996), found that fresh and dry forage yields of Egyptian clover per cut were increased significantly when the cutting intervals were increased. Increasing cutting intervals did not exert any significant influence on protein percentage while TDN and SV values were increased. He added that number of heads/m² was decreased as the last forage cut was delayed. However, cutting intervals did not affect significantly 1000-seed weight but, seed yield was increased significantly as cutting was delayed. Virender- Sardana and Narwal (1999) found that delaying cutting berseem for fodder increased the 1000-seed weight and seed weight per capsule. Moreover, Kandil *et al.* (2005), found that the highest crude protein (CP) in both leaves and stems was recorded from cutting plants in 25 days intervals.

Geweifel and Ramah (1990), evaluated six Egyptian clover cultivars and found that Sakha 4 and Giza 15 surpassed all other cultivars (Sakha 3, Giza 6 and Giza 10) in seed yield/fad. and its attributes. In a further study, Geweifel and Ramah (1991) found that Sakha 4 and Giza 15 cultivars surpassed the other cultivars in both green and dry forage yields. Abdel-Gawad (1993-a) evaluated seven varieties of berseem (Giza Gammha, Giza 10, Giza 15, Synthetic 79, Ahhaly, Sakha 87 and Khadarawi) and observed no significant differences in plant height but Synthetic 79 cv. out yielded all cultivars in fresh, dry, total digestible nutrients (TDN) and starch value (SV) yields in the first season. Whereas Ahhaly cultivar was the first in fresh and dry yields in the second season. He added that Sakha 87 cv. gave the highest protein yield (kg/fad.) followed by Khadrawi and Synthetic 79 cvs. in the first season whereas khadrawi cv. gave the highest protein yield followed by Ahhaly in the 2nd one. He further added that, Giza 15 cv. followed by Ahhaly cv. gave the highest average seed yield in both seasons. Abdel Halim *et al* (1993) found that the productivity of five cultivars differed within the individual cuttings and total yield/season as well. Sakha 4 and Giza 15 were the most productive cultivars (3.07 and 2.97 ton dry matter/fad., respectively). Giza 10, Giza 15 and Sakha 4 cvs. produced the highest crude protein content (20.19, 19.28 and 17.29%, respectively).

Gaballah (2001-a) grew four Egyptian clover cultivars viz., Sakha 4, Helely 4, synthetic Sids 6 and Giza 15. He mentioned that Synthetic Sids 6 cultivar gave the highest values of all studied characters except protein percentage and protein yield. Giza 15 cv. gave the highest value of protein percentage and protein yield/fad. in the two seasons and their combined. Gaballah (2001-b) reported that Synthetic Sids 6 cv. surpassed Sakha 4, Giza 15 and local cvs. Regarding seed yield/fad. and its attributes. Sarhan and Abd El-Maksoud (2002), found that plant height, fresh and dry forage yields, TDN and SV differed significantly among four Egyptian clover cultivars (Giza 6, Gemmiza 1, Serw 1 and local cv.) when grown under Agro-Horticultural system in a sandy soil.

MATERIALS AND METHODS

Two field experiments were conducted at the Research Farm of the Faculty of Agriculture, Suez Canal University in Al-Ismailia during 2003/2004 and 2004/2005 seasons to study the effect of two sowing methods (in rows 15 cm apart and broadcasting) and three cutting systems of three cuts. System A (60, 35 and 30 days between cuts), system B (65, 40 and 35 days) and system C (70, 45 and 40 days) on forage and seed production of three Meskawi Egyptian clover cultivars (Helaly, Sakha 4 and Giza 15). Thus, the last cut was carried out after 125, 140 and 155 days from sowing for the three systems of cutting. After words the plants were left for seed production. The soil texture of the experimental field was sandy with pH of 8.12. The available N, P and K were 14.11, 3.91 and 91.05 ppm, respectively.

A split-split plot design of three replications was used where, the two sowing methods occupied the main plots whereas, the three cutting systems occupied the sub-plots. The three cultivars occupied the sub-sub plots (3×3.5 m). Berseem cultivars seeds were obtained from the forage crops Dept., Agric. Research Center, Ministry of Agric. Egypt. Seeds were sown of rate of 30 kg/fad. on October 17th and 15th in the first and second seasons, respectively. Three cuts were taken from berseem during each season. Phosphorus as ordinary superphosphate (15.5% P₂O₅) at rate of 46 kg P₂O₅/fad. and potassium sulphate (50 kg K₂O/fad.) were added in two equal doses before sowing and after the first cut in both seasons. Sprinkling irrigation was followed. The preceding crop was fallow and peanut in the first and second seasons, respectively.

At every cut, a random sample of ten plants were taken to measure plant height (cm). Fresh forage yield (ton/fad./cut) was determined from the yield of 1m² taken from each plot. Dry forage yield/cut (ton/fad.) was calculated on the basis of fresh forage yield/cut/fad. and dry matter percentage (DM%). A fresh forage sample from each plot was oven dried at 70°C to a constant weight to calculate the dry matter percentage, as follows:

$$DM\% = \frac{\text{Dry forage weight of the sample}}{\text{Fresh forage weight of the sample}} \times 100$$

Representative samples were taken at random from each plot to determine:

- 1- Dry forage yield (DY) in tons/fad. per cut and total.
- 2- Protein percentage in forage yield was determined as a total nitrogen percentage of dry matter by using micro-Kjeldahle method (A.O.A.C., 1980), then converted to protein percentage by multiplying by 6.25 as used by Tripathi and Kdward (1978).
- 3- Digestible crude protein percentage (DCP%) content was calculated according to Minson (1977) formula as follows:
DCP% = 0.93 CP% - 3.99

- 4- The nutritive value estimated as total digestible nutrient (TDN) and starch value (SV) were calculated according the following formulae:

$$\text{TDN}\% = 0.625 \times \text{DM}\% - 0.15$$

$$\text{SV}\% = 0.435 \times \text{DM}\% + 1.20 \quad (\text{Abou- Raya } et al., 1981)$$

At harvest for seed yield, a sample of ten plants was taken at random from each plot where the following measurements were recorded:

- 1- Number of heads/plant.
- 2- Seed weight/plant (g).
- 3- 1000-seed weight (g).

An area of one square meter was harvested at random from each plot to calculate seed yield (kg/fad.).

The proper statistical analysis of split-split plot design was used. A combined analysis was performed for the characters recorded in both seasons. All data were statistically analyzed according to the method described by Snedecor and Cochran (1967). Significant differences among means were judged with the help of Duncan's multiple range- test (Duncan, 1955). In interaction tables, capital and small letters were used to compare rows and columns means, respectively.

RESULTS AND DISCUSSION

1- Effect of sowing method:

It is evident from Tables 1, 2, 3, 4 and 5 that the differences between the two methods of sowing were significant in most the tested traits except crude protein (CP), digestible crude protein (CDP), total digestible nutrient (TDN) and starch value (SV) percentages. This was observed in the first, second and third cuts. Broadcasting method produced taller plants as compared with in rows one. These significant differences were recorded at all cuttings except, the first cut in the second season. Generally, the tallest plants were obtained by broadcasting. Pain *et al.* (1973) indicated that plant height of alfalfa was not significantly affected by sowing either broadcasting or in rows. Also, El-Debaby *et al.* (1994), found that, broadcast sowing produced taller plants as compared with in rows method of Egyptian clover without significant difference at all cuttings except, the second one.

Regarding forage yield, broadcast method gave higher fresh and dry forage yields/fad. than in rows method. The increments of fresh yield were 0.158, 0.092, 0.150 and 0.400 ton/fad. for the three cuts and total yield respectively, in the combined analysis. The respective increases in dry forage yield were 0.026, 0.024, 0.044 and 0.094 tons/fad. (Tables 2 and 3). Similar results were reported by Shihata (1982), Choubey *et al.* (1991) and El-Debaby *et al.* (1994). Regarding seed yield, broadcast method gave significantly higher number of heads/plant, seeds weight/plant, 1000-seed weight and seed yield/fad. The increases of seed yield were 17.59 and 22.59 kg/fad. in 1st and 2nd seasons, respectively (Table 5).

Arora *et al.* (1998) found that the highest seed yield was obtained from broadcast method compared with row sowing.

To conclude the effect of sowing method on forage and seed yields and their attributes, the obtained results clearly indicate that broadcasting method out yielded row sowing where the former gave longer plants than the latter. This could possibly be attributed to favourable mutual shading among berseem plants, as well as, a more uniform distribution of these plants where the competition was in their favour against weeds. In row sowing, spaces between rows might have had given weeds better chance to grow and share berseem plants soil fertility and moisture. The obtained results, further indicate that the increase of forage yield was not on the expense of its quality. Furthermore, berseem plants in the broadcasting method produced more number of heads/m² with heavier 1000-seed weight and hence seed yield/plant than those in row sowing one.

2- Effect of cutting interval system:

The effect of the cutting systems on plant height at the three cuts in the two seasons and their combined is given in Table 1. Plant height was increased significantly and consistently as berseem cutting dates were five days delayed i.e as growth period had been prolonged. This was true at the three cuts under each cuttings system in each season and over the two seasons. The increase of plant height due to delaying cutting could be attributed to the increase in the amount of synthates accumulated in plants which improved the vegetative and root growth and hence the elongation of plants. These results are in harmony with those obtained by Abdel-Gawad (1993-b) and Gaballah (1996).

The fresh and dry forage yields (Tables 2 and 3) were significantly increased with delaying cutting and this was true for the three cuts in both seasons and their combined. The highest total fresh forage yield/fad. (25.34 ton/fad.) was obtained from the C cutting system. The increment in total fresh forage yield/fad. owing to the C and B systems compared with the A system were 6.26% and 2.87% in the first season, 5.36% and 2.85% in the second season and 5.80 and 2.88% over the two seasons, respectively.

The increments in fresh forage yield/fad. resulted from the increases in plant height. Dry forage yield cut/fad. (Table 3) at the three cuttings in the two seasons and combined analysis was significantly increased with delay of cutting. The total dry forage yield/fad. was higher by 9.22% and 5.02% in C and B systems, respectively compared with A system (combined data).

Data in Table 4 show significant differences among cutting systems regarding the protein percentage (CP%), digestible crude protein (DCP%), digestive nutrient (TDN%) and starch value (SV%) over the two seasons. The results revealed that CP% and DCP% of the 1st and 2nd cuts were significantly decreased with delaying cutting. So, system A surpassed the other two systems B

and C in this respect. However, this was not true in the 3rd cut. The total digestive nutrient percentage (TDN%) and starch value (SV%) of the three cuttings were significantly increased by increasing the period between cuts. The increase in TDN and SV may be mainly attributed to the increase of dry forage yield. These results are similar to those obtained by Abdel-Gawad (1993-b), Gaballah (1996) and Kandil *et al.* (2005).

Seeds yield and its components in the three cutting systems differed significantly except, the number of heads/plant in the two seasons. It is interesting to note that C system gave the highest values of seed yield and the highest averages of its yield attributes in both seasons (Table 5). Concerning seed yield/fad., the superiority of system C over systems A and B reached 32.46% and 2.63% in the 1st season and 36.99% and 6.39% in the 2nd season, respectively. These results are in harmony with those of Gaballah, (1996) and Virender and Narwal, (1999).

3- Varietal differences:

The data presented in Tables 1, 2, 3 and 4 show the differences among berseem cultivars regarding the plant height, fresh and dry forage yields, protein percentage and CDP% over the two seasons. The results revealed that there were significant differences among varieties in most studied traits. However, differences in the dry forage yield of the 2nd cut in the two seasons, CP% of the 1st cut in combined data, TDN% and SV% of the 1st, 2nd and 3rd cuts in the combined data were not significant among the studied cultivars. This was true in both growing seasons and combined analysis. Helaly cultivar gave the highest values of all studied characters except protein percentage and digestible crude protein percentage which were recorded by Giza 15 cv. in the 2nd and 3rd according to the combined analysis. The differences in growth, forage yield and yield components and quality of the three Egyptian clover cultivars could be attributed to their genetic structure. These results are in partial agreement with those obtained by Abde-Gawad (1993-a), El-Debaby *et al.* (1994), Gaballah (1996) and Sarhan and Abd El-Maksoud (2002).

Date presented in Table 5 showed significant differences among cultivars in number of heads/plant, seed weight/plant, 1000-seed weight and seed yield/fad. in the two seasons. It is interesting to note that Helaly cv. gave the highest values of seed yield and its attributes in both seasons. Concerning seed yield/fad., the superiority of Helaly cv. over Sakha 4 and Giza 15 cvs. reached 26.33% and 16.53% in the first season and 24.23% and 14.12% in the second season, respectively. These results are in harmony with those of Geweifel and Rammah, (1990), Gaballah, (1996) and Gaballah, (2001-b).

4- Interaction effect:

The data presented in Tables 1 to 5 show no significant interaction effects between sowing methods and cutting systems of berseem cultivars in all studied

traits in both growing seasons and their combined except plant height in the 3rd cut (combined data) as shown in Table 6. In general, broadcast method gave the tallest plants and surpassed in rows method under every cutting systems but the highest value was obtained by sowing broadcasting under cutting system C.

5- Correlation study:

The interrelationships between total dry forage yield/fad. of berseem, on one hand, and the studied characters on the other as simple correlation coefficients are shown in Table 7. It is clear from the combined data that the total dry forage yield/fad. was positively and significantly correlated with each of plant height, total fresh forage yield/fad., TDN and SV. Indicating that these characters could be used as selection criteria for improving forage yield of berseem. Similar results were reported by Gaballah (2001- a). However, the correlation coefficient between total dry forage yield and both CP% and DCP% was negative and significant. This negative relationship could be attributed to a dilution effect to the content of forage from protein due to the increase of dry forage yield.

Conclusively, results indicated that Helaly Egyptian clover cv. when broadcasted and cut as in C system can produced the highest forage and seed yields under sandy soil conditions of Ismailia Governorate..

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تأثير طريقة الزراعة ونظام الحش على إنتاج العلف والبذرة في بعض أصناف البرسيم المصرى

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أقيمت تجربتان حقليتان بمزرعة التجارب الزراعية بكلية الزراعة - جامعة قناة السويس بالإسماعيلية خلال موسمى ٢٠٠٣/٢٠٠٤ ، ٢٠٠٤/٢٠٠٥ لدراسة تأثير طريقة الزراعة (بدار - الزراعة فى سطور) وثلاثة نظم لفترات الحش (النظام الأول للحش (A) ثلاث فترات للنمو هى ٦٠ ، ٣٥ ، ٣٠ يوماً قبل الحشة الأولى والثانية والثالثة على التوالى ، ونظام الحش الثانى (B) كان الحش بعد ٦٥ ، ٤٠ و ٣٥ يوماً والنظام الثالث (C) كان

الحش بعد ٧٠ ، ٤٥ و ٤٠ يوماً) على إنتاج العلف والبذرة لثلاثة أصناف من البرسيم المصري (هلالى ، سخا ٤ وجيزة ١٥). وقد تركت النباتات بعد الحشة الثالثة (١٢٥ ، ١٤٠ و ١٥٥ يوماً من الزراعة لثلاث نظم للحش على التوالي) للنمو لإنتاج البذرة. وأستخدم تصميم القطع المنشقة مرتين في ثلاث مكررات وكانت أهم النتائج المتحصل عليها كالتالي:

- لوحظ زيادة معنوية في كل من ارتفاع النبات ومحصولي العلف الطازج والجاف وكذلك محصول البذرة ومكوناته عند الزراعة بطريقة البدار مقارنة بالزراعة في سطور وهو ما لم يلاحظ في كل من النسبة المئوية للبروتين الخام والبروتين المهضوم والمواد المهضومة الكلية ومعامل النشا خلال الموسمين في الثلاث حشات.

- سجل نظام الحش الثالث (C) أعلى القيم في ارتفاع النبات ومحصول العلف الطازج والجاف والنسبة المئوية للمواد المهضومة الكلية ومعامل النشا ومحصول البذرة ومكوناته تلاه النظام B ثم A بينما سجل النظام A أعلى القيم في النسبة المئوية لكل من البروتين الخام والبروتين المهضوم لمتوسط الموسمين في الحشتين الأولى والثانية.

- تفوق الصنف هلالى على بقية الأصناف في ارتفاع النبات ومحصول العلف الطازج والجاف لمتوسط الموسمين ومحصول البذرة ومكوناته بينما تفوق الصنفان جيزة ١٥ وسخا ٤ في كل من النسبة المئوية للبروتين الخام والبروتين المهضوم لمتوسط الموسمين في الحشتين الثانية والثالثة.

- أظهر التفاعل بين طرق الزراعة ونظم الحش أن أطول النباتات ظهر في طريقة الزراعة بدار وعند إتباع نظام الحش الثالث (C).

توصى الدراسة بزراعة صنف البرسيم المصري "هلالى" بالطريقة البدار مع إتباع نظام الحش الثالث (الحش بعد ٧٠ ، ٤٥ ، ٤٠ يوماً للحشات الثلاث على التوالي) للحصول على أعلى محصول من العلف والبذرة تحت ظروف الأراضي الرملية بمحافظة الإسماعيلية.