Effect of Mixing Different Ratios of Oat with Berseem Clover on Forage Yield and Protein

Al-Doss, A. A., N. A. Al-Suhaibani, and A. S. Soliman.
Plant Production Dept. College of Agric. king Saud University
P.O. Box 2460, Riyadh, 11451

ABSTRACT

Berseem clover and oat are considered among the best promising annual forage for cultivation in Saudi Arabia. This Study was conducted to investigate the effect of mixing ratio of oat and berseem clover on forage yield and quality. Five ratios of clover: oat mixtures were used in this study (0/100, 25/75.50/50,75/25and 100/0). The experiment was conducted at the Agricultural Research Station in Dirab during the 1999/2000 and 2000/2001 seasons. Results showed that forage yields of oat were significantly higher than those of berseem clover when oat ratio exceeds 25% in the mixture. The increase in oat proportion in the mixture had a significant negative effect on the representation of clover in the forage yield and on the protein percentage. According to this investigation, oat proportion in forage mixture with berseem clover should not exceed 25% in order to obtain more balanced forage yield with high quality.

INTRODUCTION

Forage production in Saudi Arabia depends on perennial forage crops such as alfalfa and Rhodes grass (Al-Doss, 1996). Currently, Alfalfa account for over 40 percent of forage production in Saudi Arabia (Ministry of Agriculture and water, 2001). Scarcity of water and high water requirements for forage production had increased emphasis on production of annual winter forage crops in Saudi Arabia (Assaeed, 1994; Al-Doss, 1996; Al-Khateeb, *et al.*, 2001; Al-Suhaibani and Al-Doss, 2003). Among the most promising annual forage crops are berseem clover and forage oats (Duke, 1981; Waldo and Jorgensen, 1981; Chatterjee and Das, 1989).

Berseem clover (*Trifolium alexandrinum* L.) has been the most dominant forage legume crop in Egypt because of its high productivity and nutritive value (Sarhan and El-Selemy, 1996). It is widely grown in India, Australia, North Africa and South western the United States (Chatterjee and Das, 1989). It is usually grown in pure stand or in mixtures with grasses for grazing or for green chops (Duke, 1981; Graves and Willims, 1987; Sood and Kumar, 1994). Berseem clover has the potential for cultivation in Saudi Arabia (Al-Khateeb, *et al.*, 2001; Al-Suhaibani and Al-Doss, 2003). Al-Suhaibani and Al-Doss (2003) evaluated several cultivars of multi-cut berseem clover successfully in Riyadh region. One of the problems that may limit cultivation of berseem clover for hay is low dry matter percentage which cause molding during hay drying (Waldo and Jorgensen, 1981). Therefore, it is common to grow berseem clover in mixtures with grasses (Sood and Kumar, 1994; Sarhan and El-Selemy, 1996).

Oat (*Avena sativa* L.) is one of the most important annual winter crops used in forage mixtures in South Europe (Evers *et al.*, 1999). Oat has been successfully grown in Saudi Arabia as a cereal forage crop (Assaeed, 1994). In

Egypt, Sarhan and El-Selemy (1996) found that berseem clover/ oat mixture had out yielded pure stands of both species. In the contrary, Al-Khateeb, *et al.* (2001) reported that highest forage yields were obtained from the monoculture of rye-grass or berseem clover and their mixture over barley and oat and their mixtures with berseem clover.

This study was conducted to determine the effect of mixing different ratios of forage oat and berseem clover on forage yield and quality.

MATERIALS AND METHODS

The experiment was conducted for two winter seasons of 1999/2000 and 2000/2001 at the Agricultural Research and Experimental Station of King Saud University near Riyadh (Dirab, 24 42 N, 44 46 E, 600 Alt.) Seeds of forage oat (*Avena sativa* L.) cv. Cayuse and berseem clover (*Trifolium alexandrinum* L.) cv. Maskawi were sown in pure stand and in three different mixtures (75/25, 50/50 and 25/75 clover/oat ratio). Seeds were sown at 20/10/1999 for the first season and at 25/10/2000 for the second season.

The experiment was arranged in a randomized complete block with four replications. Plot size was 1.6 X 2 m. with 8 lines 20 cm apart in each plot. Mixtures were sown in alternative lines according to the ratio of each crop in the mixture. Seeding rates used were 20 kg/ha. (1.14 g/line) for berseem clover and 100 kg/ha. (5.69 g/line) for oat. Fertilizers were applied at the rate of 100 kg/ha. Super phosphate and 100kg /ha. Urea at planting. In addition, 50 kg/ha urea was applied after each cut. Surface irrigation was applied weekly as needed. Three forage cuts were taken in each season after 80, 125, and 165 days from sowing.

At each harvest, the contribution of berseem clover to forage mixture, plant height (cm) and number of branches/ m2 were estimated for each species separately from 50X50 quadrants. Fresh forage yield is determined for each plot and calculated as ton /ha. Dry matter percentage was estimated from 100 g. samples from each plot. Protein percentage was calculated according to the colorimetric method of nitrogen then multiplied by 6.25 (Evenhuis and Deward, 1980).

Data for the two growing seasons were statistically analyzed using SAS software (SAS, 1988). Combined analysis of variance for the two seasons showed no year X treatment interaction in all studied traits. Therefore, data are presented as means for the two seasons.

RESULTS AND DISCUSSION

Data in (Table 1) showed that forage yield was increased significantly by increasing oat representation in the mixture in the first and second forage cut. However, in the third cut forage yield decreased with increased oat representation. There were no significant difference in total forage yield among pure Oat, 25/75 and 50/50 berseem/oat mixtures (19.49, 18.86 and 18.20 t/ha). Berseem clover had the lowest total forage yield (8.27 t/ha) followed by 75/25 berseem/oat mixture (12.96 t/ha). This result disagreed with that obtained by Al-Khateeb, *et al.* (2001) who reported that the highest forage yields were obtained from the monoculture of rye-grass or berseem clover and their mixture over barley and oat and their mixtures with berseem clover. Nevertheless, forage produced by berseem clover in this study was very similar to that reported by Al-Khateeb, *et al.* (2001). Therefore, the difference between the two studies could be attributed to the grass component in the mixture. In this study, a forage type oat cultivar (Cayuse) had great influence on forage yield. Holland and Brummer (1999) indicated that cultivars differ in their suitability as companion grasses with berseem clover.

Table 1. Forage dry weight for three cuts and total forage production and forage protein percentage of Egyptian clover, oat and three ratios of Egyptian clover: oat mixtures.

Treatment	Cut1	Cut2	Cut3	Total	protein
Berseem	3.59	3.41	1.26	8.27	23.96
75/25	6.24	5.37	1.35	12.96	21.21
50/50	9.96	7.17	1.07	18.20	19.94
25/75	10.70	7.22	0.76	18.68	18.76
Oat	10.89	7.75	0.85	19.49	16.02
LSD (0.,05)	1.97	1.62	0.43	2.47	2.16

The protein percentage in forage produced by berseem clover (23.96) was significantly greater than all mixtures (21.21, 19.94 and 18.76 for 75/25, 50/50 and 25/75 berseem/oat mixtures respectively) and oat (16.02). The protein percentage decreased by increasing proportion of oat in the forage mixture (Table 1). This result agreed with those obtained by Sarhan and El-Selemy (1996) and Fontaneli *et al.* (1999).

The representation of berseem clover in the forage mixture is presented in Table 2. Fractional representation of berseem clover decreased significantly with increased proportion of oat in the mixture. However, clover representation increased with cutting. The most balanced representation in the mixture was obtained at 25/75 berseem/oat mixture (45%).

The effect of mixture ratio on berseem clover and oat is illustrated by its effect on plant height and number of branches/m^2 (Table 3). Plant height for berseem in the 75/25 berseem/oat mixture (62cm) was similar to berseem monoculture (65 cm) but was significantly higher than valued reported for berseem in the other mixtures. On the other hand, there were no significant differences among plant heights for oat in monoculture or in mixtures (Table 3). The effect of mixture ratio on number of branches produced was significant on both species. However, the reductions in number of branches in berseem clover appear more drastic than on oat. The 75/25 berseem/oat mixture gave the most balanced representation in number of branches in the forage mixture (338 and 342).

Table 2. Percentage of Egyptian clover in forage dry weight for three cuts of berseem clover: oat mixtures.

Treatment	Cut1	Cut2	Cut3	Mean %
25/75	28	38	68	45
50/50	7	11	38	19
75/25	4	10	30	15
LSD (0.,05)	3	6	12	7

Table 3. Effect of mixture ratio on plant height and number of branches/ m^2 for berseem clover and forage oat at cut2.

	Plant height (cm)		Number of branches/ m^2	
Treatment	Berseem clover	Forage oat	Berseem clover	Forage oat
Pure stand	65	89	575	630
25/75	62	90	338	342
50/50	53	92	126	523
75/25	46	87	103	569
LSD (0.,05)	8	NS	63	43

It could be concluded from this study that forage oat had significantly higher forage yield than berseem clover. The representation of clover was greatly reduced in the forage mixture when Oat ratio exceeded 25%. Plant height and number of branches produced by berseem clover was greatly affected by the competition from oat. The reduction of representation of clover in the forage mixture decreased significantly the protein percentage in the forage mixture.

REFERENCES

Al-Doss, A. A. 1996. Forage crop production in Saudi Arabia between expansion and water conservation. *Agri. J.* (Saudi Arabia) 28 (2): 36-39.

Al-Kateeb, S. A., A. A. Leilah, S. S. Al-Thabet and K. M. Al-barak, 2001. Study on mixed sowing of Egyptian clover (*Trifolium alexandrinum* L.) with rye-grass (*Lolium multiflorum* L.), barley (*Hordeum vulgare* L.) and oat (*Avena fatua* L.) on fodder yield and quality. *Egypt J. Appl. Sci.* 16 (2): 159-171.

Al-Suhaibani, N. and A. A. Al-Doss, 2003. Evaluation of growth and forage yield of six Egyptian clovers in the Riyadh region. *JKSU Agri. Sci.* 16 (2): (in press).

Assaeed, A. M. 1994. Yield response of forage oats (*Avena sativa* L.) to nitrogen fertilization harvested at successive stages of maturity. *Alex. J. Agric. Res.* 39(3): 159-170.

Chatterjee, B. N. and P. K. Das, 1989. Forage crop production principles and practices. Oxford and IBH Publishing Co. New Delhi.

Duke, I. A., 1981. Hand book of legumes of world Economic importance. Plenum Press, New York. 345 pp.

Evenhuis, B. A. and P. W. De-Ward, 1980. Principles and practices in plant analysis. F.A.O. Soils, Bull. 38 (1): 152-163.

Evers, A. D., A. B. Blakeney and O. Brian, 1999. Cereal structure and composition. *Aust. J. Agric Res.* 50: 629 – 650.

Fontaneli, R. S., L. E. Sollenberger, and C. R. Staples, 1999. Seeding date effects on yield and nutritive value of cool–season annual forage mixtures. Fifty ninth annual meeting of the Soil and Crop Science Society of Florida, Sarasota, Florida, USA, 22-24 Sept. pp. 60-67.

Graves, W. L. and W. A. Williams, 1987. Berseem clover N_2 fixation and forage production . California ASA Mtg. Ontario, CA. pp 15.

Holland, J. B. and E. C. Brummer (1999). Cultivar effects on grass berseem clover intercrops. *Agron. J.* 91(2): 321-328

Ministry of Agriculture and Water, 2001. Statistical year book, Ministry of Agriculture and Water.

Sarhan, G. M., and H. E. El-Selemy, 1996. Evaluation performance of some new annual ryegrass *Lolium multiforum* L. varieties mixed with Egyptian clover *Trifolium alexandrinum* L. on forage yield at six different locations. *Assiut J. of Agric. Sci.*, 27 (3): 35 –44.

SAS Institute Inc. 1988. SAS user guide 6.03 Ed. SAS Institue, Cary, NC, USA.

Sood, B. R. and N. Kumar, 1994. Effect of nitrogen and phosphorus on forage and yield and nutrient uptake of oat-berseem mixture. *J. Crop Res.* (India), 8 (2): 239-244.

Waldo, D. R., and N. A. Jorgensen, 1981. Forages for high animal production: Nutritional factors and effects of conservation. *J. Dairy Sci.*, 64: 1207-1229.

الملخص العربي

تأثير خلط نسب مختلفة من الشوفان مع البرسيم المصري على كمية محصول العلف و البروتين

د. عبد الله الدوس د. ناصر السحيباني د. أحمد سليمان

قسم الإنتاج النباتي_كلية الزراعة جامعة الملك سعود

ص ب ٢٤٦٠ الرياض ١١٤٥١

يعتبر البرسيم المصري والشوفان من أفضل محاصيل الأعلاف الحولية التي يمكن زراعتها بنجاح في المملكة العربية السعودية. تم تنفيذ هذه الدراسة بهدف التعرف على تأثير تركيب مخلوط من البرسيم المصري والشوفان على كمية وجودة محصول العلف الناتج ، حيث تم استخدام خمس نسب خلط من بذور الشوفان والبرسيم هي : ١٠٠/٠، ٧٥/٢٥، ٥٠/٥٠، ٢٥/٧٥ و ١٠٠/٠ نفذت التجربة في موسم ١٩٩٩/٢٠٠٠ وموسم ٢٠٠٠/٢٠٠١م في محطة الأبحاث والتجارب الزراعية بديراب. أوضحت نتائج محصول العلف تفوق الشوفان معنويا على البرسيم المصري والمخلوط ٧٥/٢٥ معنويا عن محصول الشوفان . أدى زيارة نسبة الشوفان في المخلوط إلى نقص معنوي في نسبة مساهمة البرسيم المصري في محصول العلف كما أدت نتيجة لذلك إلى نقص معنوي في نسبة البروتين الكلي. من نتائج هذه الدراسة نتضح أن معدل الخلط ٢٥/٧٥ برسيم إلى شوفان يعطي أفضل توازن بين النوعين مما ينتج عنة محصول جيد ذو جودة عالية.