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Z. Abdelhalim
Agricultural Research Center, Egypt

O. Niemeläinen
Agricultural Research Centre, Finland

I. A. Hanna
Agricultural Research Center, Egypt

A. M. Rammah
Agricultural Research Center, Egypt

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FORAGE PRODUCTION FROM PERENNIAL VS. ANNUAL CROP R~ ON IN SANDY SOILS IN EGYPT

Z. Abdelhalim[1], O. Niemelainenz[2], I.A. Hanna[3] and A.M. Rammah[1]

[1]Field Crops Research Institute, Agricultural Research Center, Giza, Egypt

[2]Agricultural Research Centre, Jokioinen, Finland

[3]Ismailia Agricultural Research Station, Agricultural Research Center, Egypt

Abstract

Forage production was studied on newly reclaimed sandy soil in Egypt trom perennial lucerne (*Medicago sativa* L.) and two annual crop rotations. The cropping systems were: A) lucerne, B) berseem clover (*Trifolium alexandrinum* L.) in the winter follov~ed by pearl millet (Pennisetum glaucum R. Br. Emend. Stantz.) in the summer and C) triticale (XX *Triticosecale* Wittm.) (forage cut + grain harvest) in the winter followed by maize (*Zea mays* L.) (grain + stover) in the summer. Mean annual dry matter yields (t ha^{-1}) were 20.65, 26.59 and 27.48 from A, B and C, respectively. However, lucerne provided the most even seasonal forage production.

Keywords: alfalfa, berseem, corn, dual purpose crop, Egyptian clover, lucerne, maize, pearl millet, ruiation, triticale

Introduction

Feed and food deficits due to rapidly growing populaüon have inereased cropping on marginal lands in Egypt. Livestock is an integral part of the land reclamation process and a secure

supply of forage is vitally important for sustainability of production. Berseem (*Trifolium alexandrinum* L.) is the predominant forage crop in Egypt in the winter season (Hathout et al. 1997), but search for new suitable feed resources and cropping strategies is an constantly ongoing process. Pearl millet (*Pennisetum glaucum* (L.) R. Br. Emend. Stantz.), maize (*Zea mays* L.), and lucerne (*Medicago sntiva* L.) are highly productive potential crops for production in Egypt (Abdelhalim et al. 1998). The objective of this study was to compare three different forage production strategies: a) perennial lucerne which is cut continuously for forage, b) the traditional summer and winter season rotation in which both crops are harvested for forage and c) a new strategy in which dual purpose crops for forage and grain are used in winter and summer season. In addition, the study was designed to provide information on lucerne vs. legume / cereal and cereal / cereal rotation on sandy soil cultivated for the first time.

Material and Methods

The experiment was established on 4 th of November 1996 at the Ismailia Agricultural Research Station in Egypt on soil with a deep sand profile. Farmyard manure was applied at a rate of 40 t ha^{-1} to the plots prior to establishment in the first sowing. No additional farmyard manure was applied on the crops. Lucerne, berseem and triticale (X *Triticosecale* Wittm.) were sown as winter forage and the experiment ran for approximately 24 months; the last cut of lucerne was taken on November 5th, of pearl millet on September 30th, and of maize on November 5th, 1998. The experiment was carried out under sprinkler irrigation. Cropping systems were: A) lucerne, B) berseem followed by pearl millet, C) triticale (forage plus grain) followed by maize (grain + stover). Plot size was 10 m^2 . Four replicates were included in a randomized block design. A summary of the treatments with sowing dates (in parentheses) was as follows:

Rotation		A	B	C
Season				
Winter	1996/97	lucerne (4.1 l.)	berseem (4.11.)	triticale (4.11.)
Summer	1997	lucerne	millet (30.4.)	maize (29.5)
Winter	1997/ 98	luccrne	berseem (8.10.)	triticale (10.11.)
Summer	1998	lucerne	millet (5.4)	maize (8.5.)

Harvest dates are presented in Table 2. Berseem and pearl millet were cut 4 times per season and lucerne was cut 10 times a year. Triticale served a dual purpose being fir~t cut for forage and at maturity being harvested for grain. Both maize grain and stover were harvested. Yields are presented on a dry matter basis.

Results and Discussion

Data from the all twenty individual harvest dates are presented in Table 1. This facilitates study of the season and within seasonal yield distribution. The seasonal yield data are presented in Table 2. Lucerne was the only crop which provided a yield at every harvest date. The yield of lucerne ranged between 0.52 and 3.72 t ha^{-1} per harvest. Crop rotation B did not produce any harvest in four of the 20 harvest dates and rotation C was harvested only at six harvest dates of the twenty. Therefore, it can be stated that in comparison with yields of lucerne the available yield varied from zero to 8.29 t ha^{-1} in rotation B, and from zero to 29.52 t ha^{-1} in rotation C. Although the crops in rotation B were cut for forage as soon as they were ready for harvesting, forage supply was very limited during the establishment period at the beginning of the winter and summer seasons. Rotation C produced, as anticipated, very high yield particularly during summer

but would require provision of storage facilities for excess forage at each harvest date and/or supplementing concentrate feed for livestock in between the cuts. Harvested grain could either be used as feed or sold as a cash crop.

In both winter seasons lucerne produced a clearly hígher yield than either berseem or triticale (Table 1). In summer maize and pearl millet produced substantially high yields, approximately 30 t ha^{-1} dry matter. However, the yield of both pearl millet and maize varied highly from the first summer season to the next. Low yield of pearl millet in the first year may haven been caused by problems in the irrigation system which resulted in a severe drought stress . The effect of cultivating forages continuously in sandy soil probably induced the reduction in yield of maize in the second year, Table 1.

Lucerne yield in the second summer season was low. It is possible, although it was not verified during this study, that disease or pest problems caused deterioration of the lucerne stand in the second year. However, during both winter seasons the total yield of the comparable 4 cuts of lucerne out yielded those of berseem cut on the same dates by 67.2 and 24.4 percent in the first and second year, respectively. Forge yield of triticale in the first winter was higher by 3.32 t ha ~1 than in the second because of the longer growth period (86 vs. 35 days). Yield reduction could have been enhanced by triticale in the second year following maize in the rotation and receiving no additional farmyard manure application. Variability in yield was high in this study emphasizing the importance of reliable management in the cultivation of newly reclaimed sandy soils in Egypt. Data on sensitivity of different crops would be valuable for deciding which crops to grow.

In conclusion, lucerne produced the most even distribution of forage over the two year period. However, the total yield in rotations C and B were higher than that of lucerne.

Including annual forage species (legume / cereal) along with lucerne within a forage crop rotation on sandy soil could guarantee sustainability and a high level of forage production.

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Table 1 - Seasonal dry matter yields (t ha^{-1}). Treatments: A) Lucerne, B) Berseem + millet, C) Triticale + maize, grain, and in parentheses (for grain + forage).

Season l Rotation		A	B	C	(grain + forage)
Winter (Nov-May)	1996/97	14.15 a (a)*	6.64 c (b)	7.08 c (b)	(1.99 + 5.10)
Summer (June-Oct)	1997	11.03b(b)	10.18b(b)	29.52 a (a)	(8.72 + 20.80)
Winter (Nov-May)	1997/ 98	1 1.54 b (a)	5.82 d (b)	3.57 d (c)	(1.78 + 1.79)
Summer (June-Oct)	1998	4.58 c (c)	30.53 a (a)	14.77 b (b)	(2.97 + 11.80)
Total DM yield t ha^{-1}		41.28 (b)	53.08 (a)	54.99 (a)	
Mean annual DM yield		20.65	26.59	27.48	

* Values in rows with different letters in parentheses are significantly different ($P < 0.05$) and values in columns marked with different letters without parentheses are significantly different ($P < 0.05$).

Table 2 - Forage yield (t DM ha^{-1}) in the individual cuts in two years.

Rotation:	---- A ----	-------- B ---------		---------- C ----------	
Date of harvest	Lucerne	Berseem	Millet	Triticale	Maize
29.1.1997	2.23	1 .89		5.10 (forage)	
28.2.1997	3.09	3.05		-	-
30.3.1997	2.47	0.85		-	-
30.4.1997	3.31	0.85		-	-
29.5.1997	3.05		4.67	1.99 (grain)	
3.7.1997	3.23		1.90		
2.8.1997	2.02		1.59		
5.9.1997	2.05		2.02	-	-
8.10.1997	3.72	-	-		8.72(grain)+20.8 (stover)
10.11.1997	3.32	-	-	-	-
15.12.1997	2.45	1.63	-	1.78 (forage)	
22.1.1998	2.19	1.65	-		-
28.2.1998	1.05	1.55	-		-
5.4.1998	1.55	0.9		-	-
8.5.1998	0.98	-	-	1.98 (grain)	-
14.6.1998	1.08		6.47	-	-
20.7.1998	1.25		8.29	-	-
25.8.1998	1.05		8.25	-	-
30.9.1998	0.52		6.92	-	-
5.11.1998	0.68	-	-	-	2.97 (grain)+11.8 (stover)