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CARRY-OVER EFFECT IN FORAGE ROTATIONS ON NEWLY RECLAIMED SANDY SOIL IN EGYPT

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Abstract

This study was carried out to investigate the carry-over effect of a preceding crop on the productivity of the following crop in various rotations in newly reclaimed lands in Egypt. The productivity of peanut (*Arachis hypogaea* L.), soyabean (*Glycine max* (L.) Merr.), maize (*Zea mays* L.) and pearl millet (*Pennisetum glaucum* (L.) R. Br.) in summer season were much higher following berseem (*Trifolium alexandrinum* L.) or lentil (*Lens culinaris* Medic) than after wheat (*Triticum aestivum* L.) or barley (*Hordeum vulgare* L.) in both years of the study. Soyabean was the best summer season pre-crop for lentil and berseem, whereas peanut was best for barley. Maize was a surprisingly good pre-crop in this study. The carry-over effect from pearl millet was inferior to that of maize. Of the winter season crops berseem had the most positive effect on the four summer crops studied. Winter season crops had a decreasing positive effect in the order: berseem, lentil, barley and wheat. The data suggest that, cropping systems on newly reclaimed sandy soils should include legume crops (soyabean or peanut in summer, and berseem or lentil in winter) to maximise production of the following crop.

Keywords: barley, berseem, corn, lentil, pearl millet, peanut, soyabean, wheat.

Introduction

Egypt has distinct summer and winter each seasons and different crops are cultivated in season. Cultivation is expanding to new marginal areas which are poor in fertility. In the early years of cultivating newly reclaimed sandy soil, two questions always arise: which crops to grow and what rotation to follow? The objective of the present study was to investigate the effect of various preceding crops on productivity of subsequent crops. Preceding crops affect soil fertility and consequently the productivity of the following crops. Peanut (*Arachis hypogaea* L.) grown after faba bean (*Vicia faba* L.) or berseem (*Trifolium alexandrinum* L.) produced higher yield than after barley (*Hordeum vulgare* L.) or wheat (*Triticum aestivum* L.) (Badr, 1971). Cereal crops have produced higher yield when grown following legumes than when grown in monoculture or after another cereal crop (Peterson and Varvel, 1989). Preceding crops (wheat, berseem and faba bean) significantly affected yield of maize (Aly *et al.*, 1993).

Material and Methods

The present study was carried out over two years from 1995 to 1997 at the Ismailia Agricultural Research Station in Egypt. The experimental site has a deep sand profile and cultivation depends entirely on irrigation. Berseem, lentil (*Lens culinaris* Medic), wheat and barley were sown on 19 November, 1995 in a randomized complete block design with four replicates (16 plots in total). The plots were 24 m², and were further divided into 4 plots in the following season. In the summer season peanut, soyabean [*Glycine max* (L.) Merr.], pearl millet [*Pennisetum glaucum* (L.) R. Br.] and maize (*Zea mays* L.) were grown in all possible combinations with the preceding crops (16 treatments). The experimental design was a split-plot with four replicate blocks. The design was applied in the following winter and summer seasons. Sowing dates were 12. 6. 1996 in the first summer, 26. 10. 1996 in the second winter,

and 28. 5. 1997 in the second summer. Grain crops were harvested in the first winter season on 23. 5. 1996, while berseem was cut three times in the same season on 30. 1., 7. 3., and 1. 4. 1996. Grain crops in the first summer were harvested on 17. 10. 1996, while pearl millet was cut twice on 28. 7 and 31. 8. 1996. In the second winter, grain crops were harvested on 14. 5. 1997, and berseem was cut three times during the season on 12.1., 25.2. and 28. 3. 1997. In the second summer grain crops were harvested on 10. 10. 1997, while pearl millet was harvested three times on 25. 7., 2. 9., and 4. 10. 1997. Crops were sprinkler irrigated. In winter season crops the statistical test was imposed on the grain yield only but in the summer season crops statistical testing was carried out on the total dry matter yield including both grain and stover or peanut and soyabean tops.

Results and discussion

The original fertility of the soil was low as indicated in Table 1. Yields of all crops (lentil, wheat, barley, and berseem) were very low when soil was cultivated for the first time compared with the yields of the same crops in the second year . Only the yield of wheat after pearl millet was lower in the second season in comparison with the yield in the first season when cultivation commenced. In all other treatments the carry-over effect was positive (Table 1). Of the summer season crops studied maize and soyabean were the best pre-crops. The yields of lentil and berseem were substantially higher after soyabean and maize than after peanut and pearl millet. Peanut was the best pre-crop for barley in this study. The pre-crop effect of pearl millet was weak. Surprisingly the yield of wheat after maize was higher by 17.1 and 19.2 percent, compared with yield when cultivated after peanut or soyabean, respectively. Soyabean was a better pre-crop than peanut for berseem in this study. Maize had a suprisingly high positive pre-crop effect in this study. However, the data on summer crops carry-over effect is based on the results from one year only.

Of the winter season crops berseem had the most positive effect on the four summer season crops studied in both years (Table 2). Lentil, the other leguminous crop, did not have as positive a carry-over effect, although it did have a consistently better effect than the cereals, barley and wheat. In order of decreasing utility the species were ranked: berseem, lentil, barley and wheat. Wheat was of low pre-crop value in this study.

The data suggest that cropping systems on newly reclaimed sandy soils should include legume crops (soyabean or peanut in summer, and berseem or lentil in winter) to maximise production of the following crop.

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Table 1 - Grain yield (t ha⁻¹ DM) of lentil, wheat and barley and total dry matter yield of berseem clover, cultivated after four different summer season crops. Cultivation of the field started in winter 1995/96.

Crop	Lentil	Wheat	Barley	Berseem
	-----	Grain yield	-----	DM yield
Previous summer crop Winter season 1995/96				
None	0.62 c	2.1 a	1.38 b	3.71
LSD _{0.05}	-----	0.64	-----	
Winter season 1996/97				
Pearl millet	1.42 d	1.55 d	1.63 d	4.42
Peanut	1.26 d	3.98 c	5.69 a	2.69
Soyabean	6.21 a	3.92 c	3.89 c	6.17
Maize	6.01 a	4.67 b	3.90 c	5.57
SD _{0.05}	-----	0.97	-----	0.75

Values with different letters are significantly different (p < 0.05).

Table 2 - Total dry matter yield (grain + tops or stover) (t DM ha⁻¹) of four summer season crops cultivated after four different winter season crops on newly reclaimed land.

Summer crops	Peanut	Soyabean	Maize	Pearl millet
Previous winter crops				
Summer season 1996				
Berseem	17.1 cde	18.6 cd	36.7 a	16.6 cde
Lentil	16.0 cdef	14.5 defg	27.7 b	15.8 cdef
Wheat	11.1 g	11.4 fg	16.6 cde	13.2 efg
Barley	12.9 efg	12.8 efg	19.9 c	14.5 defg
LSD _{0.05}	-----	4.05	-----	
Summer season 1997				
Berseem	17.5 c	18.7 c	34.7 a	13.3 ef
Lentil	18.0 c	17.1 c	27.4 b	11.7 f
Wheat	8.6 g	9.2 g	14.1 c	7.1 g
Barley	14.5de	14.5 de	16.6 cd	7.2 g
LSD _{0.05}	-----	2.21	-----	

Values with different letters are significantly different (P < 0.05).