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EFFECT OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON YIELD AND QUALITY OF TWO ALFALFA VARIETIES UNDER NEWLY RECLAIMED SANDY SOIL AT MIDDLE EGYPT

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ABSTRACT

Alfalfa (*Medicago sativa*, L.) is a perennial forage crop well adapted to grow in the newly reclaimed sandy soil. This investigation was carried out in the newly reclaimed area at West Bani Siuef Governorate (Middle Egypt) over a two-year period (1999/2000 and 2000/2001) to evaluate two alfalfa varieties (Local and introduced one) for forage yield and quality under three levels of phosphorus (15, 45, and 75 Kg P_2O_5/fed) and three levels of potassium (24, 48 and 72 Kg K_2O/fed) fertilization. The experiment set up was in a split-split plot design with four replications.

The results showed that application of phosphorus up to 75 Kg P_2O_5/fed, resulted in significant increase in fresh and dry yields as well as the quality traits compared with the medium and lowest doses (45 and 15 Kg P_2O_5/fed, respectively). Also data revealed that potassium fertilizer had a significant effect on fresh and dry yields in addition to chemical constituents of herbage. Application of high potassium level (72 K_2O Kg/fed) was the most favorable treatment in producing forage yield with high quality.

Differences observed between the two varieties in yield and quality characters were significant. Local alfalfa variety (Ismailia-1) attained superiority in fresh and dry forage yields as well as protein, fiber, ash and oil yields over introduced variety (Siriver). The potential of alfalfa forage production and its quality was higher and more responsive by cultivating local variety (Ismailia-1) with the application of 75 Kg P_2O_5 and 72 Kg K_2O /fed.

Keywords: Alfalfa, fertilization (PK), forage yield and quality, sandy soil

INTRODUCTION

Alfalfa (*Medicago sativa*, L.) is an important perennial leguminous fodder crop, generally regarded as one of our most valuable forage crops in the newly reclaimed sandy soil. Either spring or fall is an acceptable time for seeding alfalfa in Egypt. Few; if any; other forage crop is equal to it in its capacity to produce heavy yields of highly nutrition's palatable feed to the animals, and well tolerate considerable drought and persist for several years. Also, it increases and improves soil fertility as well as to reduce soil erosion.

In a newly reclaimed area at West Bani Siuef, it is of importance to justify the suitable alfalfa cultivar to be grown in this environment and the proper quantities of phosphorus (P) and potassium (K) fertilizers which are the main elements for this crop.

Phosphorus and potassium fertilizers are very important nutrients for alfalfa herbage production. Therefore, the knowledge of proper phosphorus and potassium fertilizers rates or choosing adapted varieties is a paramount importance for alfalfa productivity in a newly reclaimed soil. On soil with

medium phosphorus and high potassium contents, Tiwana and Puri (1985) found that application of 80 Kg P_2O_5 and 40 Kg K_2O/ha increased the fresh and dry forage yields by 22 and 4% compared with control treatment, but further increase in P and K rates were not effective. In Sharkia Governorate under newly reclaimed soil conditions, Geweifel (1990) found that fresh and dry yields of alfalfa increased by increasing application of phosphorus and potassium fertilizers.

In a study of alfalfa productivity in Mediterranean environment characterized by hot dry climate and soil with low fertility. Maiorana *et al.* (2000) reported that the highest fresh fodder yield was obtained with the application of 100 Kg P_2O_5/ha. Also, Rice *et al.* (2000) found that there was little response of alfalfa to phosphorus fertilizer at five sites in Canada. In recent research, Lioveras, *et al.* (2001) concluded that the average annual dry matter yield showed a small linear response to K fertilization.

Soil fertility is the most limiting factor in forage quality. Adequate fertilizer of phosphorus and potassium has controlled forage quality of alfalfa (Tiwana and Puri 1985). The chemical composition vary greatly depending on different phosphorus levels, Zeidan *et al.* (1988) indicated that crude protein (CP) and ash were increased with phosphorus fertilization, while crude fiber (CF) was decreased. Significant progress has been made in crude protein (CP) content by PK application of alfalfa pasture (Geweifel 1990, and Walworth and Sumner 1990). In contrast, Schmitt *et al.* (1993) reported that herbage N concentration did vary due to the imposed PK treatments when the soil test showed medium concentration of the two elements.

The effect of P fertilizer levels on quality traits of alfalfa herbage has received attention of some workers. Solanki and Patel (1998) reported that ash, crude protein, and fiber contents linearly increased with increases in phosphorus from 60 to 120 Kg P_2O_5/ha. Maiorana *et al.* (2000) reported that alfalfa gave satisfactory content of crude protein when applied 100 Kg P_2O_5/ha.

Efforts to enhancing alfalfa production and increasing its cultivated area must focus on developing varieties adapted to wide range of environmental conditions. In new valley Egypt, Ghobrial (1978) found that the local alfalfa variety gave the highest green forage yield than that of the introduced varieties. Also, under sandy soil or newly reclaimed sandy land conditions, the differences among alfalfa cultivars have been mentioned by some investigators (Mousa 1982; Younis *et al.*, 1986; Rammah and Hamza 1988; Abd El-Halim *et al.*, 1992 and Mousa *et al.*, 1996). In Mississippi, USA under fine sandy loam soil conditions, Hovermale (1998) evaluated twenty alfalfa (*Medicago sativa*, L.) cultivars, and found dry matter yield over 5 years ranged from 6134 to 7122 lb / acre / annually.

Younis *et al.* (1986); Rammah and Hamza (1988); Mousa *et al.* (1996) and Hovermale (1998) determined that there were significant differences observed in protein, ash and fibers between alfalfa varieties.

The objective of this study was to investigate the performance of two alfalfa varieties (local and introduced) under three levels of phosphorus and potassium fertilizers on forage yield and its quality under new reclaimed sandy soil at the Middle Egypt.

MATERIALS AND METHODS

A field experiment was established on new reclaimed sandy soil at West Bani-Swief Governorate (Middle Egypt) from spring growing season 1999 to spring 2001, to study the behavior of two alfalfa varieties i.e. local cv. Ismailia-1 and Siriver (introduced) under different levels of phosphorus and potassium fertilizers on forage productivity and quality. The physical and chemical traits of the soil in the experimental site before sowing are listed in Table 1.

Table 1: The physical and chemical analyses of the soil before sowing

Analysis components	year 1999
Mechanical analysis	
Sand %	72.34
Silt %	17.53
Clay %	10.13
Texture class	loamy sand
Chemical analysis	
pH	8.10
available N (ppm)	18.73
P (ppm)	10.00
K (ppm)	90.00

The experiment was laid out in a split-split-plot design with four replications. The main plots were randomly assigned to three phosphorus levels 15, 45, and 75 Kg P_2O_5/fed, the sub-plots devoted to three potassium levels 24, 48 and 72 Kg K_20/fed and the sub-sub-plots were occupied the two alfalfa varieties namely local variety (Ismailia-1) and introduced variety c.v (Siriver). Each sub-sub plot was 3m X 4m ($12m^2$). Inoculated alfalfa seeds were broadcasted at the rate of 25 Kg/fed on March 25th 1999, and surface irrigation was applied to establish the stand.

The P and K treatments were added in one dose i.e. annually in broadcasting before sowing in the first season, and the same dose repeated before the first cut of the second season. Thirty Kg N/fed was applied as top dressing in two equal doses, the first one after germination and the second dose after 20 days from the first dose. The normal cultural practices for alfalfa cultivation in the new reclaimed land were applied. Thirteen cuts were harvested by hand secile, when plants were at 25% budding in the two successive years. 6 cuts in the first season and 7 cuts in the second season were taken due to the scarcity of irrigation water. The first cut began on May 26th 1999, and last cut on March 22nd 2001.

Fresh forage yield of each plot at each cut was weighted to record the yield of green forage. A representative sample from each plot was collected and dried to constant weight in a forced air oven at 105°C to estimate the percentage of dry matter and the total dry forage yield. Dried samples at 70°C were further used for determination of crude protein (CP), crude fiber (CF), oil, and ash contents for each cut of the two years according to AOAC (1980) and the percentage of each constituent was transferred into Kg/fed.

Analysis of variance and combined analysis were performed on all data according to Snedecor and Cochran (1980) using MSTAT computer program V.4 (Russell, 1986).

RESULTS AND DISCUSSION

1- Effect of phosphorus, potassium fertilizers and varieties performance on fresh and dry forage yields

a- Phosphorus levels:

The data presented in Tables 2 and 3 revealed that the application of phosphorus fertilizer had a significant effect on fresh and dry forage yields of the individual cuts, establishment year (1999/2000), second year of the stand (2000/2001) and their combined except the 5th cut in the second year for dry forage yield. Shifts were also seen in yield performance at individual cuts in both years. The reduction in the yield of summer season at the year of establishment is attributed to the deficiency of irrigation water which pushed the alfalfa plants to flowering earlier than normal age, thus, the yield per cut was less than normal.

Increasing annual phosphorus application rates from 15 up to 75 Kg P_2O_5/fed led to significant increase in fresh and dry forage yields in both years and their combined (Table 2). On an average basis over the two-years period, annual application of 45 and 75 kg P_2O_5/fed led to increasing fresh and dry forage yields by (10.49 and 23.08%), (8.89. and 21.62%), respectively, compared with 15 Kg P_2O_5/fed. In general, these results indicated that the highest response of fresh and dry forage yield was achieved by applying 75 Kg P_2O_5/fed. On the other hand, the lowest fresh and dry forage yields were produced by the application of 15 Kg P_2O_5/fed under the trial site conditions. This may be due to the fact that sandy soil is naturally poor in available phosphorus (less than 15 ppm). These results are in a good agreement with those obtained by Zeidan *et al.* (1988), Geweifel (1990), Berg *et al.* (1999) and Maiorana *et al.* (2000).

b- Potassium levels:

The statistical analysis for fresh and dry forage yields of the 6 and 7 cuts in the first and second years as well as over the two years showed significant differences among potassium levels as shown in Tables 2 and 3. Significant differences were observed within the individual cuts in fresh and dry forage yields, except the 1st, 2nd, 3rd and 5th cuts in first year for fresh and dry yields, as well as the 5th cut only for fresh yield and 1st and 5th cuts for dry yield in the second year, respectively. Also, data showed that increasing annual potassium rates from 48 to 72 Kg K_2O/fed, increased total fresh and dry forage yields significantly in both years and their combined over the two years. When averaged over the two-years period, annual application of 48 and 72 Kg K_2O/fed increased fresh and dry forage yields by (2.69 and 7.64%) and (2.24 and 8.49%) for the two rates, respectively, compared to 24 Kg K_2O/fed.

Table 2: Fresh forage yield (ton/fed) of the two alfalfa varieties grown under three rates of phosphorus and potassium in 1999/2000, 2000/2001 and combined over two years.

Treatments	1999 / 2000							2000 / 2001							Com.
	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Seasonal Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Seasonal Yield	Over Years
Phosphorus (P)15Kg/fed	2.04	3.61	4.42	4.64	5.49	6.35	26.55	4.74	4.72	4.38	7.67	7.21	6.99	3.50	39.21	32.88
45Kg/fed	2.37	3.83	4.81	4.87	6.17	6.91	28.96	5.13	5.57	5.39	7.86	7.37	8.00	4.37	43.69	36.33
75Kg/fed	2.69	4.37	5.56	5.34	7.13	7.81	32.90	6.12	6.33	6.47	8.19	8.01	8.33	4.59	48.04	40.47
LSD (0.05)	0.21	0.41	0.48	0.27	0.18	0.19	0.80	0.27	0.08	0.51	0.35	0.38	0.63	0.35	1.08	0.59
Potassium (K) 24Kg/fed	2.27	3.75	4.87	4.76	6.12	6.82	28.59	5.14	5.32	5.18	7.74	7.43	7.47	3.81	42.09	35.34
48Kg/fed	2.38	4.02	4.90	4.97	6.26	6.96	29.49	5.23	5.59	5.24	7.80	7.51	7.62	4.10	43.09	36.29
72Kg/fed	2.45	4.04	5.03	5.13	6.41	7.29	30.35	5.61	5.71	5.81	8.19	7.63	8.23	4.54	45.72	38.04
LSD (0.05)	NS	NS	NS	0.29	NS	0.35	0.88	0.26	0.21	0.26	0.30	NS	0.34	0.37	0.61	0.52
Varieties (V) local	2.82	4.47	5.33	6.11	7.84	8.87	35.44	6.87	6.62	6.92	9.31	8.86	8.76	4.72	52.06	43.75
Intr.	1.92	3.40	4.53	3.79	4.69	5.17	23.50	3.79	4.56	3.90	6.51	6.20	6.84	3.58	35.35	29.42
F. test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
P x K	NS	NS	0.42	NS	NS	NS	NS	NS	0.36	0.45	0.52	NS	0.60	NS	1.06	0.90
P x V	NS	NS	0.53	NS	NS	NS	0.99	0.40	0.22	0.36	0.52	0.36	0.51	NS	1.03	0.71
K x V	NS	NS	NS	NS	NS	NS	NS	NS	0.22	NS	NS	0.36	0.51	0.45	1.03	0.71
P x K x V	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.88	0.89	0.78	1.79	1.21

P = Phosphorus; K = Potassium; V = Varieties; Comb. = Combined; Intr. = Introduced, NS = Not significant and * = Significant

Table 3: Dry forage yield (ton/fed) of the two alfalfa varieties grown under three rates of phosphorus and potassium in 1999/2000, 2000/2001 and combined over two years.

Treatments	1999 / 2000							2000 / 2001								Com.
	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Seasonal Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Seasonal Yield	Over Years
Phosphorus (P) 15Kg/fed	0.46	0.86	1.04	1.09	1.32	1.55	6.32	0.68	0.75	1.01	1.51	1.84	1.79	1.17	8.75	7.54
45Kg/fed	0.51	0.88	1.10	1.13	1.45	1.67	6.74	0.73	0.87	1.21	1.57	1.86	1.98	1.46	9.68	8.21
75Kg/fed	0.58	1.01	1.30	1.27	1.70	1.89	7.75	0.87	1.03	1.49	1.61	1.95	2.13	1.51	10.59	9.17
LSD (0.05)	0.05	0.11	0.13	0.06	0.04	0.05	0.18	0.04	0.01	0.12	0.07	NS	0.16	0.13	0.32	0.17
Potassium (K) 24Kg/fed	0.49	0.87	1.13	1.12	1.47	1.65	6.73	0.73	0.86	1.18	1.50	1.87	1.89	1.28	9.31	8.02
48Kg/fed	0.50	0.93	1.14	1.16	1.47	1.66	6.86	0.77	0.88	1.21	1.54	1.88	1.89	1.37	9.54	8.20
72Kg/fed	0.56	0.95	1.18	1.21	1.54	1.78	7.22	0.78	0.91	1.33	1.65	1.89	2.12	1.50	10.18	8.70
LSD (0.05)	NS	NS	NS	0.07	NS	0.09	0.19	NS	0.03	0.06	0.06	NS	0.09	0.13	0.15	0.12
Varieties (V) local	0.62	1.04	1.25	1.45	1.88	2.16	8.40	0.97	1.05	1.58	1.93	2.20	2.22	1.58	11.43	9.92
Intr.	0.42	0.79	1.04	0.88	1.11	1.24	5.48	0.55	0.72	0.90	1.30	1.56	1.71	1.19	7.93	6.71
F-test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
P x K	NS	NS	0.09	NS	NS	NS	0.33	0.26	0.06	0.10	0.10	NS	0.15	N S	NS	0.21
P x V	NS	NS	0.12	NS	NS	NS	0.23	0.06	0.03	0.08	0.11	0 09	0 13	NS	0.12	0.15
K x V	0.07	NS	NS	NS	NS	NS	NS	NS	0.03	NS	0.11	0.09	NS	0.11	0.12	0.15
P x K x V	NS	NS	NS	NS	NS	NS	NS	0.10	0.06	NS	0.18	0.16	0.22	0.19	0 36	0.27

P = Phosphorus; K = Potassium; V = Varieties; Comb. = Combined; Intr. = Introduced; NS = Not significant and * = Significant

Whereas, applied 72 Kg K_2O/fed produced the highest fresh and dry forage yields (38.04 and 8.70 ton/fed) compared to 48 Kg K_2O/fed showed a slight advantage (36.29 and 8.20 ton/fed). On the other hand, 24 Kg K_2O/fed recorded the lowest fresh and dry yields (35.34 and 8.02 ton/fed, respectively). In general, data indicated that the crop response to the low and medium rates of K fertilizer were similar. In addition application of high rate of K fertilizer is required for alfalfa production on newly reclaimed soil. This may reflects the poor K content of the experimental site which contains available K close to the critical K level (90 ppm). Similar results were reported by Geweifel (1990) and Walworth and Sumner (1990).

C- Variety performance:

According to the data listed in Tables 2 and 3 significant differences were observed between the two alfalfa varieties in both fresh and dry forage yields for the individual cuts in both years as well as combined over years. However, the maximum fresh and dry forage yields were obtained from the local variety (Ismailia-1) comparing with introduced variety (Siriver) in both years and their combined. Over all, local variety (Ismailia-1) showed a higher advantage over the introduced variety for fresh and dry forage yields by 48.71 and 47.84%, respectively. These results indicated that the local variety proved to be higher in its fodder production than the introduced variety when grown in reclaimed sandy soil. This could be attributed to the interaction between the genetic material and the environment conditions in the experimental site and its capability to be more adapted to the Egyptian environment since it was developed from a local germplasm. These results are in line with those obtained by Mousa (1982); Rammah and Hamza (1988); Mousa (1996) and Hovermale (1998).

2-Effect of phosphorus, potassium fertilizers and varieties on forage quality

a- Phosphorus levels:

The variation in crude protein, crude fiber, ash, and oil yield (Tables 4-7) among phosphorus fertilizer levels was significant, and increased with increasing phosphorus levels from 15 up to 75 Kg P_2O_5/fed within the individual cuts in both years and combined over the two years except at the 5^{th} cut in second year for protein yield, as well as the 2^{nd} and 4^{th} cuts in the first and second years for ash yield, respectively. On an average basis, over the two years period annual application of 45 and 75 Kg P_2O_5/fed increased crude protein, crude fiber, ash and oil yield by (9.55 and 25.83%), (10.53 and 22.12%), (11.72 and 27.04%) and (12.84 and 28.35%), respectively, comparing with 15 Kg P_2O_5. Also, results indicated that the highest forage quality as crude protein, crude fiber, ash and oil yield Kg/fed were (1697.35, 2044.96, 1034.56 and 120.79) resulted from the application of 75 Kg P_2O_5 /fed. On the other hand, the lowest forage quality (1348.89, 1674.53, 814.33 and 94.11) was obtained with 15 Kg P_2O_5/fed. Generally, results obtained clarified that alfalfa requires mineral phosphorus fertilizer to enable the crop to produce adequate quantity of good quality forage. The probable reason for this increase was that phosphorus plays a primary role in photosynthesis by the way of energy transfer increasing the photosynthetic efficiency of leaves.

Also, the increase in crude protein content might resulted from increasing content of nitrogen due to availability of phosphorus, which have helped in more protein synthesis. The crude fiber and ash contents increased with increasing in phosphorus due to high lignifications of plant tissues and more uptakes of minerals as a result of better root development. These findings are in accordance with those obtained by Geweifel (1990); SolanKi and Patel (1998) and Maiorana *et al.* (2000).

b- Potassium levels:

Total crude protein, crude fiber, ash and oil yields in alfalfa herbage of the establishment year and second-year of the stand over cuts as well as combined over the two years were significantly affected by potassium fertilizer application (Tables 4 to 7). According to the data in the same tables, significant differences were observed within the individual cuts by adding potassium fertilizers in chemical composition of herbage, except at the 4th and 5th cuts of total protein yield, the 2nd and 3rd cuts of fiber yield, and 5th cuts of oil yield in the first year. While in the 2nd season differences among K levels were not significant for 1st cut only of total protein and fiber yield, the 1st and 5th cuts of ash yield and the 1st and 3rd cuts of oil yield. Changes in total crude protein, crude fiber, ash and oil yields occurred by applied potassium fertilizers levels annually each growing season.

On an average over the two years period, crude protein and ash yields increased significantly by increasing potassium levels from 48 to 72 Kg K_2O/fed; but crude fiber and oil yields increased significantly by increasing potassium levels from 24 up to 72 Kg K_2O/fed/annually. Also, data showed that potassium fertilizer rates of 48 and 72 Kg K_2O/fed increased crude protein, crude fiber, ash and oil yields by (3.03 and 10.28%), (7.49 and 12.39 %), (3.15 and 10.18%) and (5.77 and 12.57%), respectively compared with 24 Kg K_2O/fed. Previous studies have shown that low and medium potassium rates produced poor or moderate forage respectively but high rate produced the highest quality as crude protein or ash yields. This implies that low potassium rate did not enhanced N_2 fixation or fodder N concentration in this study. It is clear that alfalfa fodder quality was largely influenced by high rates of potassium fertilization. These results are in line with that obtained by Geweifel (1990).

C- Variety performance:

Significant varietal differences were observed regarding crude protein, crude fiber, ash, and oil yields in both years and over the two years (Tables 4 to 7). Where, local variety (Ismailia-1) produced the higher values of chemical composition in the establishment year and second-year of the stand, and their combined. On an average basis, local variety contained crude protein, crude fiber, ash, and oil yields by 48.27, 49.66, 48.69, and 57.66%, respectively, over the introduced variety, for the components in the same order above. It is clear from data obtained, that local variety (Ismailia-1) is well adapted to our environmental conditions especially in the newly reclaimed soil, and provides a high forage yield of good quality suitable to the animal feeding. Similar results were reported by Younis *et al.* (1986); Rammah and Hamza (1988) and Mousa (1996).

Table 4: Crude Protein yield (Kg / fed) of the two alfalfa varieties grown under three rates of phosphorus and potassium in 1999/2000, 2000/2001 and combined over two years

Treatments	1999 / 2000							2000 / 2001							Com.
	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Seasonal Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Seasonal Yield	Over Years
Phosphorus (P) 15Kg/fed	74.26	173.31	128.66	196.03	299.39	314.81	1186.46	166.29	163.65	213.07	256.55	327.18	247.91	136.68	1511.32	1348.89
45Kg/fed	77.32	180.99	140.89	197.33	310.57	344.95	1252.05	179.70	202.91	264.10	271.06	334.66	269.17	181.67	1703.27	1477.66
75Kg/fed	93.27	214.40	145.35	239.27	403.49	392.28	1488.07	220.25	242.93	305.23	261.29	339.63	330.38	206.92	1906.63	1697.35
LSD (0.05)	7.79	22.39	13.71	31.77	10.22	10.26	33.81	10.73	3.41	22.68	11.36	N.S	22.31	16.87	54.18	28.44
Potassium (K) 24Kg/fed	74.41	177.69	134.39	203.72	354.68	337.24	1262.15	183.01	196.61	255.34	247.42	315.51	269.82	158.04	1625.75	1443.95
48Kg/fed	77.26	188.89	137.17	211.27	334.16	348.64	1297.39	187.92	200.62	255.96	255.08	341.39	270.06	166.58	1677.91	1487.65
72Kg/fed	93.17	202.13	143.39	237.63	344.61	366.16	1367.09	195.31	212.27	271.10	286.39	344.57	307.30	200.65	1817.59	1592.34
LSD (0.05)	10.97	13.43	7.20	NS	NS	17.68	38.48	NS	7.54	13.88	10.01	13.22	13.60	16.60	27.14	22.65
Varieties (V) local	93.68	217.03	152.34	260.37	425.15	450.30	1598.87	235.35	238.35	321.71	296.93	390.73	317.72	202.62	2003.41	1801.14
Intr.	69.56	162.10	124.25	161.38	250.49	251.07	1018.85	142.14	167.98	199.89	229.00	276.92	247.26	147.55	1410.75	1214.80
F-test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
P x K	11.99	NS	12.47	21.88	27.02	NS	NS	18.14	13.07	24.05	17.34	22.90	23.56	28.75	46.99	39.23
P x V	10.90	NS	14.89	13.64	19.86	NS	41.74	15.53	8.18	18.98	18.05	16.35	19.25	14.14	35.15	26.59
K x V	10.90	NS	14.89	13.64	19.86	NS	41.74	15.53	8.18	18.98	18.05	16.35	19.25	14.14	35.15	NS
P x K x V	18.88	NS	25.79	23.63	NS	37.69	72.30	26.90	14.18	NS	31.26	28.31	33.34	24.49	60.88	46.06

P = Phosphorus; K = Potassium; V = Varieties; Comb. = Combined; and Intr. = Introduced; NS = Not significant and * = Significant

Table 5: Crude Fiber yield (Kg/fed) of the two alfalfa varieties grown under three rates of phosphorus and potassium in 1999/2000, 2000/2001and combined over two years.

Treatments	1999 / 2000							2000 / 2001								Com.
	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Seasonal Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Seasonal Yield	Over Years
Phosphorus (P) 15Kg/fed	99.19	183.77	302.95	203.75	273.19	248.19	1311.04	134.83	125.26	158.72	335.56	429.60	511.38	342.67	2038.02	1674.53
45Kg/fed	107.07	208.46	312.96	222.29	276.47	302.93	1430.18	145.69	135.15	190.89	357.30	465.77	566.14	410.62	2271.56	1850.87
75Kg/fed	126.21	219.36	390.41	249.83	326.85	338.88	1661.55	167.90	178.44	229.79	360.11	485.17	581.56	433.39	2428.36	2044.96
LSD (0.05)	10.91	25.07	34.33	14.27	8.13	9.70	46.54	6.50	2.00	17.39	15.43	22.73	45.85	39.26	79.71	41.09
Potassium (K) 24Kg/fed	91.21	194.85	327.23	208.81	279.65	262.45	1364.20	146.91	135.83	169.73	346.57	446.74	512.15	360.56	2118.49	1741.35
48Kg/fed	115.20	203.63	336.40	231.22	301.65	297.22	1485.32	148.18	144.97	188.12	350.89	457.85	559.18	409.06	2258.25	1871.79
72Kg/fed	126.06	213.12	342.69	235.85	305.29	330.33	1553.25	153.33	150.06	221.56	355.50	475.95	587.75	417.06	2361.21	1957.23
LSD (0.05)	14.98	NS	NS	12.63	13.16	14.59	38.48	NS	5.48	8.48	13.64	18.04	23.91	37.73	39.02	26.36
Varieties (V) local	137.84	239.69	371.13	283.14	378.90	384.19	1794.89	200.16	177.95	268.93	418.03	530.91	614.18	447.35	2657.45	2226.17
Intr.	83.81	168.04	299.76	167.44	212.10	209.15	1140.29	98.85	109.28	117.34	283.95	389.45	491.82	343.78	1834.52	1487.41
F-test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
P x K	NS	27.53	28.52	21.88	22.79	25.27	66.64	12.01	9.49	14.68	23.63	31.25	41.41	NS	67.38	45.65
P x V	NS	NS	36.29	14.71	NS	16.53	55.73	10.32	5.94	12.67	23.73	22.59	35.95	NS	53.17	37.54
K x V	15.08	NS	NS	14.71	16.90	16.53	NS	10.32	NS	12.67	23.73	22.59	35.95	32.60	53.17	37.54
P x K x V	NS	NS	NS	25.47	29.29	28.63	NS	17.87	10.29	21.95	41.10	39.12	62.26	56.47	92.10	65.02

P = Phosphorus; K = Potassium; V = Varieties; Comb. = Combined and Intr. = Introduced; NS = Not significant and * = Significant

Table 6: Ash yield (Kg/fed) of the two alfalfa varieties grown under three rates of phosphorus and potassium in 1999/2000, 2000/2001 and combined over two years

Treatments	1999 / 2000							2000 / 2001								Com.
	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Seasonal Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Seasonal Yield	Over Years
Phosphorus(P) 15Kg/fed	39.65	80.12	93.90	116.10	140.81	204.24	674.82	96.27	107.25	118.70	195.37	197.73	146.74	91.78	953.84	814.33
45Kg/fed	49.33	86.56	93.91	119.27	173.26	229.66	751.99	104.37	126.37	146.44	199.34	201.16	175.54	114.41	1067.63	909.81
75Kg/fed	56.67	93.13	120.75	134.77	194.96	252.79	853.07	122.21	146.51	203.65	200.73	211.17	203.23	128.54	1216.04	1034.56
LSD (0.05)	4.31	NS	10.10	6.96	5.11	5.58	18.78	5.74	2.04	15.19	N. S	10.36	14.57	11.13	34.63	17.54
Potassium (K) 24Kg/fed	43.75	82.20	98.25	119.33	164.95	222.53	731.01	103.69	123.16	145.99	190.51	198.83	164.57	103.15	1029.90	880.46
48Kg/fed	47.59	84.90	103.61	121.08	168.53	225.69	751.40	108.99	126.50	150.07	195.16	205.04	172.61	106.57	1064.97	908.19
72Kg/fed	54.32	92.72	106.70	129.73	175.57	238.48	797.51	110.17	130.47	172.72	209.76	206.19	188.29	125.00	1142.60	970.06
LSD (0.05)	6.34	6.23	5.37	7.31	7.96	11.47	21.98	NS	4.59	7.34	7.30	NS	8.47	10.64	16.31	13.14
Varieties (V) local	58.05	95.25	115.25	153.67	212.92	291.97	927.11	136.70	151.22	197.11	231.13	238.35	190.29	127.08	1272.06	1099.59
Intr.	39.05	77.96	90.46	93.09	126.44	165.83	592.83	78.53	102.20	115.41	165.65	168.36	160.05	99.07	886.26	739.54
F-test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
P x K	10.89	NS	9.30	NS	NS	NS	37.94	9.81	7.95	12.79	12.64	14.20	NS	NS	27.60	22.75
P x V	6.95	NS	11.24	NS	NS	NS	23.89	8.50	4.61	10.79	13.20	10.04	12.52	8.79	23.35	16.28
K x V	6.95	12.49	NS	NS	NS	NS	23.89	NS	4.61	NS	13.20	NS	NS	8.79	23.35	16.28
P x K x V	12.03	NS	19.47	NS	NS	NS	41.38	14.72	7.98	18.68	22.87	17.39	21.68	15.22	40.46	28.20

P = Phosphorus; K = Potassium; V = Varieties; Comb. = Combined and Intr. = Introduced; NS = Not significant and * = Significant

Table 7: Oil yield (Kg/fed) of the two alfalfa varieties grown under three rates of phosphorus and potassium in 1999/2000, 2000/2001 and Combined over two years.

Treatments	1999 / 2000							2000 / 2001								Com.
	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Seasonal Yield	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Seasonal Yield	Over Years
Phosphorus(P) 15Kg/fed	8.00	13.87	13.34	14.98	22.21	19.36	91.76	10.41	9.72	15.19	13.53	19.87	17.53	10.20	106.45	94.11
45Kg/fed	9.03	15.53	15.05	15.91	24.53	23.89	103.94	11.07	11.53	17.90	14.68	20.68	20.16	12.42	108.34	106.19
75Kg/fed	11.07	17.40	16.21	16.30	28.69	27.55	117.22	11.84	13.12	21.37	14.92	22.28	24.63	16.20	124.36	120.79
LSD (0.05)	0.75	1.83	1.52	0.81	0.77	0.74	2.60	0.55	0.18	1.68	0.67	1.04	1.64	3.28	3.77	2.04
Potassium (K) 24Kg/fed	8.14	14.61	12.91	15.06	25.02	21.56	97.30	11.03	10.87	18.03	12.75	20.31	20.09	11.35	104.43	100.86
48Kg/fed	9.84	15.87	13.94	15.44	25.16	24.13	104.38	11.14	11.57	18.04	14.32	21.08	20.53	12.31	108.99	106.68
72Kg/fed	10.13	16.32	17.75	16.69	25.25	25.11	111.25	11.15	11.92	18.39	16.06	21.44	21.71	15.16	115.83	113.54
LSD (0.05)	1.20	1.09	0.95	0.96	NS	1.22	3.24	NS	0.43	NS	0.55	0.77	1.08	1.21	3.84	1.79
Varieties (V) local	11.14	17.96	17.26	19.41	31.89	29.91	127.57	14.08	13.53	23.98	16.83	25.17	25.26	15.53	134.38	130.98
Intr.	7.60	13.24	12.47	12.06	18.40	17.29	81.06	8.13	9.38	12.33	11.92	16.71	16.29	10.34	85.10	83.08
F-test	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
P x K	2.07	1.89	1.64	1.67	1.96	2.11	5.60	0.93	0.75	1.56	0.95	1.33	1.56	2.09	3.18	3.10
P x V	1.35	NS	1.73	NS	1.47	1.51	3.64	0.80	0.45	1.13	1.05	0.94	1.45	0.99	2.24	2.08
K x V	1.35	NS	1.73	NS	1.47	1.51	NS	0.80	NS	NS	1.05	0.94	1.45	0.99	2.24	2.08
P x K x V	2.34	NS	3.00	1.80	1.54	2.62	NS	NS	0.77	1.96	1.31	1.63	2.51	1.72	3.38	3.61

P = Phosphorus; K = Potassium; V = Varieties; Comb. = Combined and Intr. = Introduced; NS = Not significant and * = Significant

3-Interaction effects:

The combined analysis over years Tables 2 to 7 demonstrated that all interactions between phosphorus X potassium; phosphorus X varieties, potassium X varieties and phosphorus X potassium X varieties had a significant effect on fresh and dry fodder yields as well as crude protein, crude fiber, ash and oil yields except the interaction between potassium X varieties for protein yield. The significance of interaction indicated that the relative performance of the two varieties was not consistent across phosphorus and potassium levels, as well as phosphorus treatments did not respond the same to changes in potassium treatments. These results are not in agreement with that obtained by Geweifal (1990) who found that the interaction between phosphorus and potassium fertilization did not has a significant effect on forage yield and quality.

In general, with respect of the three variables interaction results revealed that local variety (Ismailia-1) fertilized with 75 Kg P_2O_5 and 72 Kg K_2O/fed, recorded the highest forage production quantity and quality of alfalfa under newly reclaimed sandy soil in Middle Egypt. Meanwhile, introduced variety, (Siriver) must be tested in a wide range of environments before recommend to be grown in a specific site.

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تأثير التسميد الفوسفاتى والبوتاسى على المحصول والجودة لصنفين من البرسيم الحجازى تحت ظروف الاراضى الرملية المستصلحة حديثا فى منطقة مصر الوسطى

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أجرى هذا البحث تحت ظروف الاراضى الرملية المستصلحة حديثا غرب محافظة بنى سويف (مصر الوسطى) خلال سنتين متتاليتين ١٩٩٩/٢٠٠٠، ٢٠٠٠/٢٠٠١ بغرض تقييم صنفين من البرسيم الحجازى صنف محلى وهو إسماعيلية ١ وصنف مستورد هو سيريفر للمحصول والجودة تحت ثلاث مستويات من كل من التسميد الفوسفاتى هى ١٥، ٤٥، ٧٥ كجم فوءا/فدان/سنويا والتسميد البوتاسى وهى ٢٤، ٤٨، ٧٢ كجم بوءا/فدان/سنويا.

وكان تصميم التجربة فى قطع منشقة مرتين فى أربع مكررات.

وكانت أهم النتائج المتحصل عليها:-

١- إضافة التسميد الفوسفاتى حتى ٧٥ كجم فوءا/ فدان/ سنويا أعطى زيادة معنوية للمحصول الأخضر والجاف ومثلة فى صفات الجودة بالمقارنة بالمعدل المتوسط ٤٥ كجم فوءا، والأقل ١٥ كجم فوءا على الترتيب.

٢- أيضا أظهرت البيانات أن التسميد البوتاسى له تأثير معنوى على المحصول الأخضر والجاف بالإضافة للقيمة الغذائية للعلف الناتج. ووجد أن إضافة المعدل العالى من التسميد البوتاسى ٧٢ كجم بوءا/فدان/سنويا كان أكثر استجابة للمحصول وصفات الجودة بالمقارنة بالمعدل المتوسط ٤٨ كجم بوءا والأقل ٢٤ كجم بوءا.

٣- أوضحت النتائج أن هناك اختلافات معنوية بين الأصناف فى المحصول والجودة للعلف الناتج. حيث أظهر الصنف المحلى إسماعيلية ١ معنوية عالية عن الصنف المستورد سيريفر فى المحصول الأخضر والجاف ومحصول البروتين والألياف والرماد والدهون.

٤- أظهر التفاعل بين المعاملات المدروسة أن إنتاجية وجودة البرسيم الحجازى كانت عالية وأكثر استجابة عند زراعة الصنف المحلى إسماعيلية ١ والتسميد الفوسفاتى بمعدل ٧٥ كجم/فدان/سنويا مع التسميد البوتاسى بمعدل ٧٢كجم /فدان/ سنويا تحت ظروف الاراضى المستصلحة حديثا فى منطقة غرب محافظة بنى سويف.