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RESPONSE OF ALFALFA TO THE APPLICATION OF SHEEP DUNG AND N FERTILIZER UNDER SIWA OASIS CONDITIONS

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Under Siwa Oasis conditions in 1994 and 1995 seasons, fresh and dry alfalfa yields and their components were studied under the application of different sheep dung rates (SD) (20, 30 and 40 m^3 fad^{-1}; faddan=4200m^2), added in two installments during soil preparation and during winter of the second year. Nitrogen rates (0,10 and 15 kg fad^{-1}) was applied after each cut. The results indicated that applying sheep dung manure increased plant height, weight of stems, leaves yield per cut and seasonal yield in both seasons. Higher production occurred with 40 m^3 fad^{-1} SD and 10 kg N fed^{-1}. Generally, no significant differences were observed between 10 and 15 kg N fad^{-1} for most traits studied. The interaction of SD and N rates was insignificant for all traits studied.

Keywords: *medicago sativa*, alfalfa, organic manure, nitrogen, fresh and dry yeild.

Siwa farmers are accustomed to apply heavy rates of organic manure imported from Matruh area 305 km away. Aside from high costs, there is a high risk of the introduction of pathogens and weeds with imported organic manure. The local Siwa alfalfa variety has not been sufficiently studied; however, it was reported to produce the highest seasonal forage yield under different cutting systems when compared with other varieties (Haggag *et al.*, 1984). Siwa farmers consider organic manure very important for enriching the soil mineral content, improving soil physical conditions and of great benefit for enhancing alfalfa production.

Several investigators have reported favourable results on alfalfa of increased significantly fresh and dry forage yield and its component, i.e. stems, leaves and plant height from the application of organic manure (e.g., EL-Hadidy *et al.*, 1976 with rate of 2% sheep dung; EL-Sibaie *et al.*, 1983 at rate of 10 m^3 fad^{-1}SD; Wassif *et al.*, 1986; Ibrahim and AL-Afifi, 1989 at

rate of 20 m^3 ha^{-1} and Schmitt *et al.*, 1993 at rate of 12000 gallons $acre^{-1}$ of pig and cattle manure) compared to the control.

Other investigators reported a slight increase in alfalfa yield from the application of N fertilizer (EL-Hadidy *et al.*, 1976; Azzari and Abdel-Salam, 1978; Eardly *et al.*, 1985; Salem and Anter, 1985). However, Lamb *et al.*, (1995) found no response of alfalfa yield to N fertilizer.

The objective of the present study was to determine the combined effect of organic manure in the form of sheep dung and nitrogen fertilizer on the performance and yield of Siwa alfalfa under Siwa Oasis conditions, with a view to reduce organic manure rates and enhance alfalfa production.

MATERIALS AND METHODS

Two field trials were carried out at the experimental field at Khamisah, Siwa Oasis, Matruh Governorate through the "Biological Drainage Project" of the Desert Research Center, from 1993 to 1995. The trials were designed to the interaction effects of organic manure and nitrogen fertilizer on the performance of alfalfa. The study was started on September 28, 1993 and continued until November 18, 1995. Each trial includes all factorial combinations between three rates of sheep dung (SD), viz., 20, 30 and 40 m^3 fad^{-1}. Three rates of SD were divded in two equal applications during soil preparation and winter of the seecond year. Three nitrogen levels, viz., zero, 10 and 15 kg fad^{-1}, were added as ammonium nitrate (33.5%N) after each cut.

The experimental design was a factorial arranged in randomized complete blocks in three replications. Plot size was 10.5 m^3 (1/400 fad). Seeds were broadcast at the rate of 15kg fad^{-1} after inoculation with *Rhizobium melilotii* just prior to seeding. Calcium superphosphate (15.5 P_2O_5) was added at the rate of 100 kg fed^{-1} during seedbed prepration.

The irrigation interval was 4 days during seedling stage and was increased after establishment to 7 and 15 days during summer and winter, respectively. Plots were harvested 15 times during the whole study period at 10% bloom by cutting with a hand-sickle almost at ground level. The following traits were measured at each cut: - plant height, leaf / stem ratio (on dry basis), total fresh and dry forage yields, total weight of leaves fresh and dry and total weight of stems fresh and dry.

TABLE (1). Chemical analysis of applied sheep dung manure.

Year	Moisture Content%	Organic Carbon%	Total Nitrogen%	C/N ratio	Organic Matter%
1993	10.3	21.41	36.82	10.0	2.12
1994	10.9	19.34	34.17	13.0	1.45

TABLE (2a). Soil physical analysis of the experimental site.

Depth (cm)	Ca Co_3	Particle size distribution (mm)				Texture Class%
		Coarse Sand (1-0.5) %	Fine Sand (0.25-0.1) %	Silt 0.05-0.002%	Clay < 0.002%	
0-30	37.72	7.97	77.04	14.99	-	Sandy loam
30-60	59.42	6.44	77.78	15.78	-	Sandy loam

TABLE (2b). Soil chemical analysis of the experimental site.

Depth (cm)	pH	EC (mhos/cm)	Anions mg/l				Cations/ mg/l			
			CO_3^{--}	HCO_3^-	SO_4^{--}	Cl^-	Ca^{++}	Mg^{++}	Na^{++}	K^+
0-30	7.97	8.92	Nil	2.0	18.73	63.9	35.2	4.8	43.48	1.15
30-60	7.83	8.43	Nil	3.0	23.37	64.9	36.3	5.9	47.17	1.90

Well water having a salinity of 4200 - 4443 ppm was used for irrigation. Table (3) presents variation in water quality over seasons.

The average meteorological data of Siwa Oasis during 1994 and 1995 are shown in table (4).

TABLE (3). Chemical analysis of irrigation water.

Sampling date	pH	EC x 10^6 25 c	T.D.S PPM	Unit	Ca^{++}	Mg^{++}	Na^+	K^+	Total Catios epm	CO_3^{--}	HCO_3^-	SO_4^{--}	Cl^-	Total anions epm
Win.	7.6	9260	4200	ppm	259.08	150.85	1500	60	91.94	-	222.34	700	2819.9	
				epm	12.78	12.41	65.22	1.53		-	3.64	14.57	79.52	97.73
				%	13.9	13.49	70.93	1.66		-	3.72	14.9	81.36	
Sum.	7.8	9320	4375	ppm	259.96	162.64	1600	55	97.31	-	205.87	7.00	2895.39	
				epm	12.97	13.38	69.56	1.4		-	3.37	14.57	81.46	99.4
				%	13.32	13.74	71.48	1.43		-	3.39	14.65	81.95	

epm=equivalent per million

TABLE (4). The average meteorological data of Siwa Oasis

Month	Air temperature °C			R.H %	Rainfall (mm)	Evaporation mmday^{-1}	Mean wind speed (knot)
	Max.	Min.	Daily				
January	19.7	4.1	11.9	53	0.8	6.0	5.7
February	21.7	5.5	13.6	46	2.0	7.9	6.4
March	25.1	8.2	16.7	40	0.7	10.7	7.5
April	29.8	12.2	21.0	34	0.9	14.1	7.7
May	34.2	16.6	25.4	30	1.5	16.1	6.9
June	37.3	19.4	28.4	31	0.0	17.0	6.2
July	37.9	20.4	29.3	34	0.0	16.8	6.1
August	37.8	20.6	29.2	36	0.0	15.2	5.2
September	35.1	18.3	26.7	42	0.0	12.1	4.9
October	31.8	14.8	23 3	45	0.3	9.6	4.2
November	26.4	10.2	18.3	51	0.6	7.0	4.1
December	21.4	5.8	15.3	58	2.8	5.2	5.0

Source: Meteorological Authority, Cairo.

RESULTS AND DISCUSSION

I-Effect of Organic Manure (Sheep dung manure, SD)

Plant height

Table (5) shows the effect of the application of sheep dung manure (SD) on alfalfa in 1994 and 1995. SD showed a significant effect on alfalfa plant height in both years, with the tallest plants generally obtained from the application of 40 m^3 SD fad^{-1}. Reiad *et al.* (1995) found similar findings on fodder sorghum. Mohamed (1992) also found that sheep dung manure at 20 m^{-3} fad^{-1} significantly increased plant height of cowpea.

Leaves and stem yield

The weights of both leaves and stems were the highest at 40 m^3 fad^{-1} SD in both years. These results agreed with Mohamed (1992) on cowpea, Maamoun (1994) on *Vicia monantha* and Reiad *et al.* (1995) on fodder sorghum.

TABLE (5). Effect of sheep dung manure application on alfalfa growth number of surviving plants m^{-2} leaf / stem ratio (on dry basis)

Year	Organic manure, m^{-3} fad^{-1}			LSD 0.05
	20	30	40	
	Plant height (cm.)			
1994	71.8	73.1	74.3	0.239
1995	78.5	79.2	80.4	0.281
Mean	75.1	76.2	77.4	0.214
	L/S ratio			
1994	87.6	88.6	88.4	1.828
1995	81.9	82.3	82.1	0.540
Mean	84.0	84.8	84.6	0.902

L/S=Leave/System ratio

Insignificant differences were obtained in both years between treatments for this trait. These results are in agreement with those obtained by Reiad *et al.* (1995) on fodder sorghum and EL-Towkhy (1997) on *Vicia monantha*.

Fresh forage yield

Annual fresh forage yield significantly increased with adding SD up to 40 m^3 fad^{-1} in both seasons (Table 6). This may be due to the ability of organic manure to supply alfalfa plants with their needs from nutrients. Also, it may change soil pH towards neutrality or acidity which in turn could act as a suitable media for increasing nutrient absorption by plant roots (Fawy, 1995). Similar results were reported by EL-Hadidy *et al.* (1976), EL-Sibaie *et al.* (1983), Reiad *et al.* (1995) on cowpea and Mohamed (1992) on fodder sorghum in Siwa Oasis with 40 m^3 fed^{-1} sheep dung.

Dry forage yield

Dry forage yield from each cut as well as seasonal yield were significantly increased with increasing SD up to 40 m^3 fad^{-1} in both years and total accummulated yield (Tables 6 and 7). There was a positive relationship between alfalfa plant height and dry forage yield. The tallest pants gave the highest dry forage yield. This may be due to SD as a store house for nutrients, which increases mineral exchange, provides energy for micro-organism activity, releases carbon dioxide and buffers the soil against rapid change in acidity, alkalinity, and salinity (Tisdale *et al.*, 1994). This finding similar to that obtained by EL-Hadidy *et al.* (1976), EL-Sibaie *et al.* (1983), Ibrahim and AL-Afifi (1989), Mohamed (1992) on cowpea, and Reiad *et al* (1995) on fodder sorghum.

TABLE (6). Effect of sheep dung manure application on alfalfa yield.

Manure rate	Organic manure, m^3 Fad^{-1}			$LSD_{0.05}$
Year	20	30	40	
	Annual fresh forage yield (ton fed^{-1})			
1994	45.3	47.6	48.9	0.268
1995	76.7	79.3	81.0	0.410
Total	122.0	126.9	129.9	0.219
	Annual dry forage yield (ton fad^{-1})			
1994	12.0	12.7	13.2	0.218
1995	18.8	19.4	19.9	0.211
Total	30.8	32.1	33.1	0.245

TABLE (7). Effect of sheep dung manure application on alfalfa total yield of leaves and stems in 1994 and 1995

Year	20	30	40	$LSD_{0.05}$
	Annual fresh leaves yield (ton fad^{-1})			
1994	23.5	24.7	25.4	0.138
1995	37.0	38.3	39.1	0.201
Total	60.5	63.0	64.5	0.262
	Total fresh stem yield (ton fad^{-1})			
1994	21.6	22.7	23.3	0.121
1995	39.3	40.7	41.6	0.224
Total	60.9	63.4	64.9	0.255
	Total dry leaves yield (ton fad^{-1})			
1994	5.6	5.9	6.1	0.103
1995	8.4	8.7	8.9	0.099
Total	14.0	14.7	15.0	0.139
	Total dry stem yield (ton fed^{-1})			
1994	6.4	6.7	7.0	0.114
1995	10.3	10.6	10.9	0.120
Total	16.7	17.3	17.9	0.137

II- Effect of nitrogen fertilization

Plant height

No significant differences in the plant height were noticed in 1994, but in 1995 there were significant differences between zero and 15-unit nitrogen fertilization (Table 8). Results of EL-Hakeem (1981) on berseem clover are in agreement with this result.

Leaf / stem ratio (on dry basis)

No significant effect of N on alfalfa leaf / stem ratio is shown. This indicates that N encourages the formation of stems as well as leaves (Table 8). These results are in agreement with those obtained by EL-Hakeem (1981) on berseem clover.

Fresh forage yield

Adding 10 kg N fad^{-1} after each cut caused a significant increase in the total forage yield in both years. No significant differences were observed between 10 and 15 kg N. fad^{-1}.The same findings were found by Mohamed (1992) on cowpea.

Dry forage yield

Adding 10 kg N fad^{-1} significantly increased annual dry forage yield in both years. No significant effect was detected between 10 and 15 kg N fad^{-1} in both seasons. Salem and Anter (1985) and EL-Hossini (1990) in agreement with those obtained results. Increasing annual dry forage yield considered as a result of N effect on plant height, leaves and stems.

TABLE (8). Effect of nitrogen fertilization rates on alfalfa growth.

Nitrogen	Kg N fad^{-1}			LSD $_{0.05}$
	0.0	10	15	
Year	Plant height (cm.)			
1994	72.9	73.1	73.2	0.239
1995	79.1	79.4	79.6	0.281
Mean	76.0	76.3	76.4	0.214
Number of plants (25 cm^2)				
1994	19.5	19.7	19.6	0.154
1995	16.8	16.5	16.5	0.207
Mean	18.2	18.1	18.0	0.152
L/S ratio				
1994	87.6	88.6	88.5	1.828
1995	82.4	81.9	81.9	0.540
Mean	84.3	84.5	84.5	0.902

L/S=Leave/System ratio

TABLE (9). Effect of nitrogen fertilization rate on alfalfa yield

Year	Nitrogen rate Kg N/fad-1			$LSD_{0.05}$
	0.0	10	15	
	Total fresh forage yield (ton fad $^{-1}$)			
1994	46.6	47.5	47.6	0.268
1995	78.1	79.4	79.5	0.410
Total	124.7	127.0	127.2	0.519
	Total dry forage yield (ton fad $^{-1}$)			
1994	12.4	12.8	12.8	0.218
1995	19.1	19.5	19.5	0.211
Total	31.5	32.3	32.3	0.245
	Total fresh leaves yield (ton fad $^{-1}$)			
1994	24.2	24.7	24.7	0.138
1995	37.6	38.3	38.4	0.201
Total	61.8	63.0	63.1	0.262
	Total fresh stem yield (ton fad $^{-1}$)			
1994	22.2	22.6	22.7	0.121
1995	40.1	40.8	40.8	0.224
Total	62.3	63.4	63.5	0.255
	Total dry leaves yield (ton fad $^{-1}$)			
1994	5.7	6.0	6.0	0.103
1995	8.6	8.7	8.8	0.099
Total	14.3	14.7	14.8	0.139
	Total dry stem yield (ton fad $^{-1}$)			
1994	6.5	6.7	6.7	0.114
1995	10.5	10.7	10.7	0.120
Total	17.0	17.4	17.4	0.137

Leaves and stem

The heighest value of fresh and dry matter production at 15 kg N faddan^{-1} after each cut, but no significant differences were noticed between 10 and 15 unit nitrogen.

Sheep dung manure and nitrogen interaction

The interaction between SD and N was insignificant for fresh, dry, plant height, L/S ratio, leaves and stems yields.

Ibrahim and AL-Afifi (1989) found the same results on alfalfa and Mohamed (1992) on cowpea.

CONCLUSION

It was obvious from the results of this study that applying the high rate of SD (40 m^3 fed^{-1}) boosts plant height, fresh and dry yields of leaves and stems as well as seasonal forage yields.

This is true because the beneficial effects of the use of organic amendments, under the conditions of desert soil with poor fertility and saline water irrigation are well recognized. Ibrahim and AL-Afifi (1989) in U.A.E. showed that the effect of organic manure was more pronounced in sandy soil as yield increased over control by 190% compared to 24% in calcareous soils.

Alfalfa as other legumes can symbiotically fix atmospheric N. They need N for initial growth until nodule formation. N supplements may be

needed when symbiotic N supply is insufficient due to low temperature and unfavorable soil condition or low efficiency of the nodulating bacteria (*Rizobiun meloti*).

Additional N fertilizer may be required for rapid recovery between cuts on intensively managed the stems of forage legumes. Nitrogen Fertilizer was shown to increase plant height, leaf / stem ratio and sometimes an overall increase in forage yield.

Cost and benefit

Increasing organic manure OM application from 20 to 30 and 40 m^3 fed^{-1} (costed 100 and 200 L.E, receptively while the net gain increased dry yield by 700 and 1200 Kg fed^{-1} (net gain 70 and 120 L.E.fed^{-1}, respectively, Table 6).

From the economic viewpoint it could be included that adding more than 20 m^2 of OM fed^{-1} is not worthy . Although the net income decreased with increasing OM application more than 20 m^3 but on the long run this could be compensated by improving physical and chemical properties of this saline soil.

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استجابة البرسيم الحجازي للتسميد العضوي والآزوتي تحت ظروف واحة سيوه

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المحصول الغض والجاف ومكوناته فى البرسيم الحجازى " الالفالفا "درست تحت مستويات مختلفة من السماد العضوى (مخلفات الأغنام). ٢٠ ، ٣٠ ، ٤٠م٣/فدان أضيفت مرتين الأولى أثناء إعداد التربة للزراعة والمرة الثانية أثناء الموسم الشتوى فى العام الثانى وكذلك معدلات من السماد الازوتى صفر ، ١٠ ، ١٥ كجم/فدان بعد كل حشة وذلك بواحة سيوه فى عامى ١٩٩٤ ، ١٩٩٥.

وقد أظهرت النتائج أن إضافة السماد العضوى ادى الى زيادة كل من طول النبات ومحصول السيقان والأوراق وكذلك المحصول المتجمع الكلى وذلك خلال سنتى الدراسة .

كما أمكن الحصول على أعلى إنتاجية عند مستوى ٤٠م٣/فدان سماد عضوى كما أدى استخدام التسميد الازوتى عند مستوى ١٠كجم ازوت/فدان الى الحصول على أعلى محصول علفى (غض وجاف) . كذلك لم يلاحظ وجود تفاعل معنوى بين عاملى الدراسة على الصفات محل الدراسة خلال العامين.