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GROWTH, FORAGE YIELD AND ITS COMPONENTS OF RYEGRASS (*Lolium multiflorum*, L.) AS AFFECTED BY NITROGEN FERTILIZER FORMS AND APPLICATION TIME

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ABSTRACT

Two field experiments were carried out at the Experimental Farm, Sers-Elliyan Agricultural Research Station, Menoufia Governorate, during two successive seasons (1998/99 and 1999/2000) to study growth characters, fresh and dry forage yield and its components of ryegrass as influenced by different forms and time of nitrogen fertilizer application. The results could be summarized as follows:

Ammonium sulphate was more efficient in enhancing plant height, number of tillers/plant, leaf area/plant, stem diameter, fresh and dry forage yield, crude protein, crude fiber and ash yield of ryegrass than urea. The application of nitrogen fertilizer as four splits, ¼ three weeks after sowing + ¼ before the 2nd, 3rd and 4th cuts significantly increased growth characters, fresh and dry forage yield and forage quality [crude protein, crude fiber and ash yields] of ryegrass.

The interaction between nitrogen forms and time of nitrogen application had insignificant effect on growth characters (plant height, number of tillers/ plant, leaf area/plant, and stem diameter), fresh and dry forage yield, except the fresh yield at the 1st cut of the 1st season and dry forage yield at the 2nd cut of the first season and at 1st cut of 2nd season were significant. Also, forage quality (crude protein, crude fiber and ash yield) was insignificant in both season.

INTRODUCTION

Italian ryegrass (*Lolium multiflorum* L.) is a native annual winter grass in the Mediterranean region and adapted to a wide range at soil. It could be grown alone as a forage crop or in mixtures with legumes under local conditions of Egypt. The plant gives quick cover after cutting, highly palatable and it has good quality of hay. Several research workers have observed positive response of ryegrass to nitrogen fertilizer source and application time. Zhang *et al.*, (1995) found that increasing nitrogen fertilization increased N contents in annual ryegrass Kasprczyk and Kacorzyk (1996) found that higher N fertilization rate (180 kg/ha) increased pasture yielding of perennial ryegrass. Griffith *et al.*, (1997 a and b) showed that ammonium nitrate fertilization increased tiller number per unit area of Italian ryegrass. They found also, that Italian ryegrass accumulated the greatest protein of plant, N and dry mass during the period from tiller elongation and mid-heading.

El-Hefnawy *et al.*, (1991) showed that both ammonium sulphate and ammonium nitrate were better for wheat than urea. Mohamed *et al.*, (1992) on a sandy soil, showed that ammonium sulphate performed better than ammonium nitrate. On the contrary, El-Hindi *et al.*, (1998) reported that on barley, ammonium nitrate as a form of N increased plant height, leaf area /plant, grain yield/fed and grain protein content compared with either

ammonium sulphate or urea. On the other hand, urea as a form of nitrogen led to the lowest values in all studied characters. Moselhy (1995) found that five N splits produced longer plants with greater number of spikes/plant than four or three splits. Also, Abou Salama *et al.*, (1995), El-Far and El-Nagar (1995), Abd El-Hakem (1996) and Ibrahim and Gendy (1996) recorded similar reports.

El-Sherbieny *et al.*, (1999 b) reported that ammonium sulphate was the most efficient N form among the three tested N-fertilizers and gave the greatest grain yield of wheat. On the other hand, urea fertilizer gave the smallest yield of grain. Also, agronomic characters such as plant height, spike length, number of spikelets per spike were affected by the different tested treatments. The same conclusion was obtained by Mohamed *et al.*, (1992), Moselhy (1995), Makhloof (1996), Abdul Galil *et al.*, (1997) and Abdul Galil *et al.*, (2000) found that the increase in the number of nitrogen splits (as ammonum sulphate) from five to seven splits reflected a highly significant increase in each of wheat plant height, number of tiller/plant under sandy soil conditions. Marei and Darwish (2000) found that nitrogen fertilizer of ryegrass with 90 kg/fed exhibited significant increases in growth (plant height, number of tillers/plant), forage yield (fresh and dry) and forage quality (crude protein, crude fiber, and ash yields) when nitrogen fertilizer was added four equal doses after sowing and each cut.

This study aimed to investigate the effect of forms and time of nitrogen fertilizer applications on growth characters, fresh and dry forage yield and forage quality.

MATERIALS AND METHODS

Two field trails were performed in 1998/99 and 1999/2000 season at the Experimental Farm at Sers-Elliyan Agricultural Research Station, Menoufia Governorate, to study the growth characters, forage yield and its components of ryegrass as influenced by different sources and time of nitrogen fertilizer application. A split-plot design with four replications was used. Two forms of nitrogen fertilization were used i.e. ammonium sulphate $(NH_4)_2SO_4$ (20.5% N), and urea Co $(NH_2)_2$ (46.5% N) at the rate of 90 kg N/fed in the main plots. The five different application time, were assigned in the sub-plots.

1- (T_1) all the nitrogen amount was added 3 weeks after sowing.
2- (T_2) two splits, ½ before the second cut + ½ before the third cut.
3- (T_3) two splits, ½ three weeks after sowing + ½ before the third cut.
4- (T_4) Four splits, ¼ three weeks after sowing + ¼ before the second, third, and fourth cuts respectively.
5- (T_5) control-without fertilizer.

The plot size measured 6 m^2 (2×3m) in both growing seasons. Phosphorus and potassium fertilizers were added during seed bed preparation at the rate of 150 kg/fed calcium superphosphate (15.5% P_2O_5) and 50 kg/fed potassium sulphate (48.5% K_2O). Seeds were planted at a rate of 15 kg/fed in rows (20 cm a part) in 20 th and 22 th November for the first and second seasons, respectively.

Other recommended agricultural practices were applied. Four cuts were taken throughout each growing season. The studied characters were:

A- Growth: plant height (cm.), stem diameter (cm.), number of tillers per plant, and leaf area (cm^2)
B- Forage yield: fresh yield (ton/fed) and dry yield (ton/fed).
C- Forage quality: crude protein, crude fiber and ash yield (kg/fed.), which determined according to A.O.A.C. (1980).

The obtained data were subjected to statistical analysis presented by Gomez and Gomez (1984), means were compared by least significant difference test (LSD) at 5% probability, which was developed by Fisher (1958).

RESULTS AND DISCUSSION

1- Effect of nitrogen forms:

a- Growth characters:

The results presented in Tables (1 and 2) indicate that the two nitrogen forms differed significantly with regard to their effect on plant height of ryegrass. Such effect was observed in both first and second cut of the first and second seasons, respectively. Nitrogen fertilizer as ammonium sulphate expressed the highest values of plant height, as compared with urea.

Nitrogen form significantly affected the number of tillers/plant in both seasons, except the second cut of the second season. The highest value was obtained from plants fertilized with ammonium sulphate.

Regarding the effect of nitrogen forms, data indicate that the leaf area/plant was insignificantly affected, whereas, the 3rd and 4th cuts in the first season and 2nd cut in the second season were significantly affected. Ammonium sulphate gave significantly higher values than urea in both seasons. Data in Tables (1 and 2) show that the stem diameter was significantly higher with nitrogen fertilizer ammonium sulfate as compared with urea in most cuts except in the 2nd cut.

The results clearly indicate that ammonium sulphat was more efficient in enhancing plant elongation and tillering. Similar results were obtained on wheat by Bassiouny *et al.*, (1993), El-Karamity and Salem (1993), Abdul Galil *et al.*, (1997) and El-Sherbiney, *et al.*, (1999 a).

b- Forage yield

Data in Tables (3 and 4) show the effect of nitrogen fertilizer forms on fresh and dry forage yield of ryegrass. Ammonium sulphat gave the greatest fresh and dry forage yield, as compared with urea. The highest fresh and dry forage yields were obtained at the second cut in both seasons, while the lowest values for fresh forage yield and dry forage yields were obtained at the first cut in both seasons. According to these data, it could be concluded that ammonium sulphate was the most efficient nitrogen form among the two tested nitrogen forms. Similar results were obtained on wheat by Mohamed *et al.*, (1992) Moselhy (1995), Makhloof (1996), Abdul Galil *et al.*, (1997) and El-Sherbieny *et al.*, (1999 a).

Table (1): Effect of nitrogen fertilizer forms, time of application and their interaction on plant height, number of tillers/plant, leaf area/plant, stem diameter, of ryegrass in 1998/1999 season.

Traits	Time of N application (B)	Nitrogen forms (A)											
		1st cut			2nd cut			3rd cut			4th cut		
		AS	U	mean	AS	U	mean	AS	U	mean	AS	U	mean
Plant height (cm)	T_1	31.02	31.05	31.04	34.68	24.25	29.46	37.24	36.47	36.85	32.20	30.98	31.59
	T_2	33.50	31.18	32.43	46.00	34.23	40.11	37.96	37.07	37.51	35.45	33.98	34.71
	T_3	37.60	35.45	36.53	48.68	41.80	45.24	42.33	39.69	41.01	39.28	36.93	38.10
	T_4	40.13	37.63	38.88	50.63	44.50	47.56	48.32	41.87	45.09	42.85	38.80	40.83
	T_5	25.20	24.73	24.96	32.55	22.58	27.56	29.25	25.03	27.14	26.48	25.03	25.75
	mean	33.49	32.01		42.51	33.47		39.02	36.02		35.25	33.14	
	L.S.D%	A = 0.64 B = 1.59			A = 2.81 B = 4.02			A= N.S B = 5.36			A= N.S B =3.34		
		A×B = N.S.			A×B = N.S.			A×B = N.S.			A×B = N.S.		
No. of tillers/plant	T_1	2.55	1.55	2.05	3.05	2.90	2.98	2.88	2.23	2.55	2.71	1.91	2.31
	T_2	2.75	2.05	2.40	3.60	3.20	3.40	3.40	2.25	2.83	3.08	2.15	2.61
	T_3	2.95	2.10	2.53	3.80	3.65	3.73	3.48	2.55	3.01	3.21	2.33	2.77
	T_4	3.50	3.15	3.33	4.35	3.95	4.15	4.13	3.30	3.71	3.81	3.35	3.58
	T_5	2.40	1.48	1.94	2.88	2.50	2.69	2.40	1.80	2.10	2.40	1.64	2.02
	mean	2.83	2.07		3.54	3.24		3.26	2.43		3.04	2.28	
	L.S.D%	A=0.88 B=0.70			A=0.39 B=0.62			A=0.19 B=0.74			A=0.41 B=0.47		
		A×B= N.S.			A×B= N.S.			A×B=N.S.			A×B=N.S.		
Leaf area/plant (cm^2)	T_1	13. 78	13.72	13.75	17.62	14.64	16.13	15.44	14.88	15.16	14.61	14.30	14.46
	T_2	14.49	13.83	14.16	18.96	16.69	17.82	18.17	15.89	17.03	16.34	14.86	15.59
	T_3	14.81	14.32	14.56	21.54	19.79	20.67	20.28	16.13	18.20	17.54	15.23	16.38
	T_4	16.25	15.67	15.96	23.17	20.40	21.78	21.88	16.46	19.17	19.07	16.07	17.57
	T_5	12.01	10.84	11.42	14.96	11.05	13.00	13.92	12.17	13.04	12.97	11.50	12.24
	mean	14.27	13.67		19.25	16.51		17.94	15.11		16.11	14.39	
	L.S.D%	A=N.S B=1.99			A=N.S. B=3.25			A=2.83 B=2.4			A=1.51 B=1.48		
		A×B=N.S.			A×B=N.S.			A×B=N.S.			A×B=N.S.		
Stem diameter (cm)	T_1	1.18	0.95	1.06	2.30	2.23	2.26	2.08	1.88	1.98	1.63	1.42	1.53
	T_2	1.18	0.96	1.07	2.38	2.28	2.33	2.09	1.89	1.99	1.64	1.43	1.54
	T_3	1.19	0.97	1.08	2.45	2.43	2.44	2.15	1.92	2.04	1.68	1.45	1.56
	T_4	1.23	0.98	1.10	2.68	2.45	2.56	2.17	1.93	2.05	1.70	1.46	1.58
	T_5	0.99	0.94	0.97	2.18	2.10	2.14	1.89	1.87	1.88	1.45	1.41	1.43
	mean	1.15	0.96		2.39	2.29		2.08	1.89		1.62	1.43	
	L.S.D%	A=0.11 B=N.S.			A=N.S. B=0.37			A=0.08 B=N.S.			A=0.02 B=N.S.		
		A×B=N.S.			A×B=N.S.			A×B=N.S.			A×B=N.S		

AS = Ammonium sulphat
U = Urea

Table (2): Effect of nitrogen fertilizer forms, time of application and their interaction on plant height, Number of tillers/plant, leaf area/plant, stem diameter, of ryegrass in 1999/2000 season.

Traits	Time of N application (B)	Nitrogen forms (A)											
		1st cut			2nd cut			3rd cut			4th cut		
		AS	U	mean	AS	U	mean	AS	U	mean	AS	U	mean
Plant height (cm)	T_1	36.80	34.80	35.80	40.65	36.30	38.48	38.25	35.50	36.88	39.10	31.85	35.48
	T_2	41.80	37.45	39.63	42.75	40.65	41.70	42.15	40.95	41.55	41.45	36.65	39.05
	T_3	45.40	42.75	44.08	49.35	44.60	46.98	46.00	45.50	45.75	44.80	40.70	42.75
	T_4	50.00	45.40	47.70	56.05	52.75	54.40	52.75	50.00	51.37	49.70	45.35	47.53
	T_5	30.88	30.65	30.76	38.95	31.85	35.40	37.45	31.60	34.53	32.70	29.10	30.90
	mean	40.98	38.21		45.55	41.23		43.32	40.71		41.55	36.73	
	L.S.D%	A = 3.26 B = 6.22 A×B = N.S.			A = 3.58 B = 7.81 A×B = N.S.			A= N.S B = 9.89 A×B = N.S.			A= N.S B =5.56 A×B = N.S.		
No. of tillers/plant	T_1	2.00	2.03	2.01	2.66	2.34	2.50	2.49	2.01	2.25	2.33	2.00	2.16
	T_2	2.33	2.04	2.18	2.96	2.38	2.67	2.74	2.19	2.46	2.66	2.13	2.39
	T_3	2.55	2.10	2.33	3.00	2.68	2.84	2.85	2.49	2.67	2.74	2.34	2.54
	T_4	2.85	2.16	2.51	3.19	3.09	3.14	3.08	2.83	2.95	2.96	2.51	2.74
	T_5	1.93	1.60	1.76	2.44	2.33	2.38	2.14	1.98	2.06	2.19	1.74	1.96
	mean	2.33	1.99		2.85	2.56		2.66	2.29		2.58	2.14	
	L.S.D%	A=0.13 B=0.45 A×B= N.S.			A=N.S. B=0.43 A×B= N.S.			A=0.17 B=0.41 A×B=N.S.			A=0.06 B=0.51 A×B=N.S.		
Leaf area/plant (cm^2)	T_1	9.23	8.79	9.02	23.05	22.52	22.78	21.98	21.09	21.54	15.61	14.95	15.28
	T_2	10.52	9.95	10.23	26.74	23.36	25.05	22.86	22.42	22.64	16.69	15.43	16.06
	T_3	11.29	10.46	10.88	28.79	24.61	26.69	24.89	23.38	24.14	18.10	16.93	17.51
	T_4	12.41	11.31	11.86	37.48	25.02	31.25	26.06	25.29	25.67	19.24	18.30	18.77
	T_5	8.95	8.71	8.83	22.12	21.53	21.83	18.81	18.42	18.62	13.89	13.56	13.72
	mean	10.48	9.84		27.64	23.41		22.92	22.12		16.70	15.83	
	L.S.D%	A=N.S B=2.80 A×B=N.S.			A=5.53 B=5.77 A×B=N.S.			A= N.S. B=4.99 A×B=N.S.			A=N.S. B=3.08 A×B=N.S.		
Stem diameter (cm)	T_1	1.29	1.04	1.17	2.53	2.45	2.49	2.29	2.07	2.18	1.80	1.56	1.68
	T_2	1.30	1.06	1.18	2.61	2.53	2.57	2.30	2.09	2.19	1.81	1.57	1.69
	T_3	1.32	1.07	1.19	2.70	2.67	2.68	2.37	2.11	2.24	1.84	1.59	1.72
	T_4	1.35	1.07	1.21	2.94	2.70	2.82	2.39	2.13	2.26	1.87	1.60	1.74
	T_5	1.09	1.04	1.06	2.39	2.31	2.35	2.09	2.06	2.07	1.59	1.55	1.57
	mean	1.27	1.06		2.64	2.53		2.29	2.09		1.78	1.58	
	L.S.D%	A=0.15 B=N.S. A×B=N.S.			A=N.S. B=N.S. A×B=N.S.			A=0.19 B=N.S. A×B=N.S.			A=0.07 B=N.S. A×B=N.S.		

AS = Ammonium sulphat
U = Urea

Table (3): Effect of nitrogen fertilizer forms, time of application and their interaction on fresh forage yield ,dry forage yield , crude protein, crude fiber and ash yield of ryegrass in 1998/1999 season.

Traits	Time of N application (B)	Nitrogen forms (A)												Total
		1st cut			2nd cut			3rd cut			4th cut			
		AS	U	mean	AS	U	mean	AS	U	mean	AS	U	mean	
Fresh forage yield ton/fed	T_1	3.57	3.52	3.55	6.91	5.44	6.17	5.34	4.58	4.96	4.33	3.57	3.95	18.63
	T_2	8.49	5.79	7.14	9.72	8.13	8.92	8.79	6.49	7.64	8.58	2.52	7.05	30.75
	T_3	9.08	8.49	8.79	11.13	9.42	10.28	9.65	8.69	9.17	9.28	8.50	8.89	37.13
	T_4	9.56	8.84	9.20	11.15	10.43	10.79	10.45	9.11	9.78	10.08	9.00	9.54	39.31
	T_5	2.63	2.15	2.39	6.68	4.33	5.50	4.20	3.86	4.03	3.20	2.63	2.91	14.83
	mean	6.66	5.76		9.12	7.55		7.69	6.55		7.09	5.84		
	L.S.D%	A=N.S. B=0.95 A×B= 1.34			A=1.21 B=0.76 A×B=N.S.			A=1.33 B=0.75 A×B=N.S.			A=1.62 B=1.44 A×B=N.S.			
Dry forage yield ton/fed	T_1	0.60	0.59	0.59	1.89	1.45	1.67	1.34	1.31	1.33	1.00	0.89	0.94	4.53
	T_2	1.54	0.89	1.21	2.73	1.51	2.12	2.07	1.56	1.81	1.61	1.31	1.46	6.60
	T_3	1.72	1.31	1.51	3.41	2.55	2.98	2.41	2.25	2.33	2.00	1.56	1.76	8.58
	T_4	2.11	1.62	1.86	3.97	3.14	2.55	2.76	2.62	2.69	2.62	2.41	2.52	9.62
	T_5	0.59	0.39	0.49	1.42	1.36	1.39	0.97	0.80	0.89	0.70	0.60	0.65	3.42
	mean	1.31	0.96		2.68	2.00		1.91	1.71		1.59	1.35		
	L.S.D%	A=0.15 B=0.26 A×B=N.S.			A=0.28 B=0.42 A×B=0.59			A=0.08 B=0.19 A×B=N.S.			A=0.17 B1.29 A×B=N.S.			
Crude protein yield kg/fed	T_1	118.15	102.15	110.15	162.32	127.44	144.88	138.05	120.75	129.40	128.10	108.95	118.53	502.96
	T_2	126.74	101.14	113.94	167.28	131.39	149.33	142.30	125.75	134.03	134.52	111.70	123.11	520.41
	T_3	129.24	104.15	116.69	174.04	138.33	156.19	144.54	126.85	135.69	136.89	115.50	126.19	534.76
	T_4	138.28	120.58	129.43	192.18	156.38	174.28	160.50	137.75	149.13	149.39	127.42	138.40	591.24
	T_5	80.51	67.31	73.91	95.10	72.92	84.01	77.01	66.33	71.67	74.26	62.01	68.14	297.73
	mean	118.58	99.06		158.18	125.29		132.48	115.49		124.63	105.12		
	L.S.D%	A = N.S B = 20.13 A×B = N.S.			A = 31.05 B = 24.92 A×B = N.S.			A= 13.99 B = 20.76 A×B = N.S.			A= 11.89 B =14.79 A×B = N.S.			
Crude fiber yield kg/fed	T_1	137.75	122.63	130.19	248.75	222.76	235.76	242.00	223.78	232.89	156.46	156.79	156.63	755.47
	T_2	144.75	135.71	140.23	262.75	232.75	247.75	253.00	236.75	244.88	172.53	167.86	170.19	803.05
	T_3	157.75	142.53	150 14	274.79	257.50	266.14	257.05	247.85	252.45	180.50	175.83	178.16	846.89
	T_4	160.50	154.68	157.59	289.77	266.00	277.89	261.00	251.76	256.38	201.29	192.75	197.02	888.88
	T_5	79.20	75.19	77.19	151.75	101.02	126.39	121.07	115.31	118.19	95.88	79.05	87.46	409.23
	mean	135.99	126.15		245.56	216.01		226.82	215.09		161.33	154.46		
	L.S.D%	A=N.S B=28.48 A×B= N.S.			A=24.06 B=55.46 A×B= N.S.			A= N.S. B=49.60 A×B=N.S.			A=N.S. B=25.34 A×B=N.S.			
Ash yield kg/fed	T_1	45.78	39.55	42.66	144.55	132.56	138.55	117.25	102.00	109.63	107.62	100.58	104.09	394.93
	T_2	55.69	53.79	54.74	156.76	156.59	156.68	130.75	111.75	121.25	117.53	106.60	112.06	444.73
	T_3	66.56	58.54	62.55	161.90	164.70	163.30	133.80	117.77	125.79	120.53	125.50	123.01	474.65
	T_4	90.80	70.90	80.85	183.56	166.65	175.10	142.50	130.79	136.65	132.55	129.80	131.18	523.78
	T_5	33.95	27.32	30.63	80.91	65.26	73.09	73.01	56.38	64.69	69.91	56.78	63.35	231 76
	mean	58.55	50.02		145.54	137.15		119.46	103.74		109.63	103.85		
	L.S.D%	A=7.38 B=11.11 A×B=N.S.			A=N.S. B=31.61 A×B=N.S.			A= 7.81 B=25.27 A×B=N.S.			A=N.S. B=24.00 A×B=N.S.			

Table (4): Effect of nitrogen fertilizer forms, time of application and their interaction on fresh forage yield , dry forage yield ,crude protein, crude fiber and ash yield of ryegrass in 1999/2000 season.

Traits	Time of N application (B)	Nitrogen forms (A)												Total
		1st cut			2nd cut			3rd cut			4th cut			
		AS	U	mean	AS	U	mean	AS	U	mean	AS	U	mean	
Fresh forage yield ton/fed	T_1	4.79	4.48	4.64	8.58	6.37	7.47	5.51	4.79	5.15	4.96	4.32	4.64	21.9
	T_2	5.12	4.75	4.94	9.80	8.58	9.19	7.47	6.86	7.16	5.97	5.49	5.73	27.02
	T_3	5.33	4.85	5.09	10.47	9.44	9.96	7.75	7.32	7.53	6.20	5.85	6.03	28.61
	T_4	6.35	5.80	6.07	12.06	9.90	10.98	9.83	8.49	9.16	7.86	6.79	7.33	33.54
	T_5	4.14	3.78	3.96	7.53	6.15	6.84	4.86	4.53	4.69	4.38	4.08	4.23	19.72
	mean	5.15	4.73		9.69	8.09		7.08	6.40		5.87	5.31		
	L.S.D%	A=N.S. B=0.50 A×B= N.S.			A=0.88 B=1.31 A×B=N.S.			A=0.86 B=1.55 A×B=N.S.			A=0.66 B=1.27 A×B=N.S.			
Dry forage yield ton/fed	T_1	1.93	1.76	1.84	4.13	2.39	3.26	2.22	1.82	2.02	2.03	1.80	1.92	9.04
	T_2	2.70	2.05	2.37	4.77	3.38	4.07	3.39	2.52	2.96	2.95	2.33	2.64	12.04
	T_3	3.03	2.29	2.66	5.07	4.76	4.92	3.94	3.25	3.59	3.42	2.63	3.03	14.2
	T_4	3.96	2.39	3.17	5.63	4.64	5.14	4.55	3.36	3.95	4.04	2.77	3.40	15.66
	T_5	1.83	1.42	1.62	3.37	2.05	2.71	2.06	1.58	1.82	1.94	1.45	1.69	7.84
	mean	2.69	1.98		4.59	3.44		3.23	2.51		2.88	2.19		
	L.S.D%	A=0.37 B=0.41 A×B=0.58			A=0.28 B=0.76 A×B=N.S.			A=0.45 B=0.63 A×B=N.S.			A=0.94 B=0.60 A×B=N.S.			
Crude protein yield kg/fed	T_1	96.34	77.44	86.89	126.09	102.20	114.15	110.14	93.68	101.91	95.29	78.06	86.68	389.63
	T_2	106.56	81.03	93.79	140.55	108.25	124.40	118.07	103.18	110.62	111.07	90.53	100.80	429.61
	T_3	116.32	93.73	105.02	156.64	124.49	140.56	130.09	114.17	122.13	123.20	103.95	113.58	481.29
	T_4	129.95	104.17	117.06	173.96	141.74	157.85	145.45	124.98	135.21	137.70	115.68	126.69	536.81
	T_5	62.11	51.28	56.69	75.38	54.69	65.03	59.64	50.50	55.07	66.83	55.81	61.32	238.11
	mean	102.26	81.53		134.52	106.28		112.68	97.30		106.82	88.81		
	L.S.D%	A = N.S B = 14.87 A×B = N.S.			A = 9.15 B = 27.99 A×B = N.S.			A= N.S. B = 20.92 A×B = N.S.			A= 16.24 B =15.73 A×B = N.S.			
Crude fiber yield kg/fed	T_1	113.98	109.36	111.67	202.88	176.99	189.93	186.80	172.40	179.60	139.67	134.36	137.02	618.22
	T_2	120.28	122.15	121.21	225.48	203.48	214.48	205.70	183.08	194.39	155.23	146.33	150.78	680.86
	T_3	131.84	128.27	130.06	246.31	221.75	234.03	219.35	193.07	206.21	162.45	158.25	160.35	730.65
	T_4	144.45	139.21	141.83	260.79	238.40	249.60	232.90	215.59	224.25	182.16	174.48	178.32	794.00
	T_5	71.28	71.07	71.17	136.57	111.22	123.89	108.96	103.78	106.37	86.15	81.85	84.00	385.43
	mean	116.37	114.01		214.41	190.37		190.74	173.58		145.13	139.05		
	L.S.D%	A=N.S B=27.39 A×B= N.S.			A=N.S B=47.19 A×B= N.S.			A= N.S. B=44.17 A×B=N.S.			A=N.S. B=26.95 A×B=N.S.			
Ash yield kg/fed	T_1	66.86	54.01	60.43	161.00	137.82	149.41	124.93	101.45	113.19	94.88	77.14	86.01	409.04
	T_2	72.26	59.17	65.71	173.17	152.25	162.71	133.69	111.43	122.56	110.28	88.21	99.24	450.22
	T_3	76.99	68.63	72.81	189.09	171.18	180.13	147.18	130.55	138.87	113.43	108.05	110.74	502.55
	T_4	97.83	76.99	87.41	200.92	183.31	192.12	156.56	143.89	150.22	135.81	122.78	129.29	559.04
	T_5	37.34	35.15	36.24	106.80	86.31	96.56	80.30	74.41	77.36	76.91	62.46	69.68	279.84
	mean	70.25	58.79		166.19	149.17		128.53	112.35		106.26	91.73		
	L.S.D%	A=9.26 B=13.77 A×B=N.S.			A=N.S. B=33.77 A×B=N.S.			A= N.S B=25.84 A×B=N.S.			A=N.S. B=26.36 A×B=N.S.			

c- Forage quality:

The obtained data Tables (3 and 4) indicate that nitrogen form significantly affected the crude protein except the first cut in both seasons and 3rd cut in second season, where, the highest value was obtained from plants fertilized with ammonium sulphate .

Furthermore, data in Tables (3 and 4) demonstrate that the effect of nitrogen forms on crude fiber was insignificant in both seasons but the significant effect was noticed only at the second cut of the first season. Ammonium sulphate resulted in the maximum increases in all studied characters compared with urea.

Data indicate that ash yield was significantly affected in the first cut for both seasons and 3rd cut in the first season. The insignificant effect was noticed in the 2nd , and 4th cut in first seasons and 2nd, 3rd and 4th cut in the second seasons. It could be suggested that the increase in crude protein, crude fiber and ash yields may be due to the increase in dry forage yield and an increase in their percentages. Also, the second cut was superior in crude protein yield in both seasons, crude fiber yield and ash yield, while the first cut was the inferior. These results are similar to those found by Thomet *et al.*, (1990), Babnik (1993) and Zhang *et al.*, (1995).

2- Effect of time application:

a- Growth characters:

Nitrogen application induced observable significant differences on plant height, number of tillers/plant, and leaf area/plant in both seasons Tables (1 and 2). The results indicate that splitting nitrogen to four doses (T_4) led to highest increases in all studied characters compared with the other treatments. The increase percentages in plant height for the plants of (T_4) over the control amounted to 55.77, 72.57, 66.14, and 58.56% in the first season and 55.07, 53.40, 48.77 and 53.82% in the second season at the four cuts, respectively. The increase amounted to 71.65, 54.28, 76.67 and 77.23% and 42.61, 31.93, 43.20 and 39.80% for number of tillers/ plant in the four cuts in both seasons, respectively, The percentage increase was 39.75, 67.54, 47.01 and 43.55% and 34.31, 43.15, 37.86 and 36.81% for leaf area/plant at the four cuts in the two seasons, respectively. Also, data shown in Tables (1 and 2) indicate that time of nitrogen fertilizer application insignificantly affected stem diameter in both seasons with the exception in the second cut of the first season. Data also revealed that splitting nitrogen to four doses (T_4) markedly produced the highest value in stem diameter compared with (T_5) in both seasons. On the other hand, the second cut was superior in plant height, number of tillers / plant, leaf area / plant and stem diameter in both seasons. The first cut was inferior in plant height, number of tillers/plant, leaf area/plant and stem diameter in both seasons. This may be due to growth activity during the second cut. These results are in agreement with those given by Mahmoud *et al.*, (1993), and Malko *et al.*, (1993).

b- Forage yield:

The results in Tables (3 and 4) it is clear that the application of nitrogen in four splits, ¼ three weeks after sowing + ¼ before the second,

third, and fourth cuts (T_4), significantly increased fresh and dry forage yield (ton/fed) of ryegrass. The greatest fresh and dry forage yields were given by (T_4). In comparing T_1, T_2, T_3 and T_4, with T_5 as total of fresh and dry yield of the four cuts, the increase in fresh forage reached 25.62, 107.35, 150.37 and 165.07% and 11.05, 37.02, 45.08 and 70.08% in both seasons respectively. Also, dry forage yield increased by 32.46, 92.98, 150.88 and 181.29 and 15.31, 53.57, 81.12 and 99.74% at the same respective treatments. The highest fresh and dry forage yields were obtained at the second cut, while the lowest values for fresh and dry forage yield at the first cut in the two successive seasons. The increases in fresh and dry forage yield may be due to the nitrogen deficiency in the Egyptian soils and therefore its addition promotes growth and photosynthesis and the accumulation of assimilates and consequently yield are enhanced. These results agree with those of Calancea *et al.*, (1993), Mahmoud *et al.*, (1993), Malko *et al.*, (1993), Zalewska and Nowak (1995) and Kasperczyk and Kacorzyk (1996).

c- Forage quality:

As presented in Tables (3 and 4) it is clear that crude protein, crude fiber, and ash yields were significantly affected by the time of nitrogen application in both seasons. The obtained data indicate that crude protein yield increased with (T_4) than the other treatments i.e. T_1, T_2, T_3 and T_5. Also, either crude fiber yield or ash yield followed the same trend.

The increase percentages for the plants of T_1, T_2, T_3 and T_4 over the control T_5 reached (68.93, 74.79, 79.62 and 98.58%); (63.62, 80.42, 102.12 and 125.44%) in total of crude protein in the four cuts, (84.60, 96.23, 106.94 and 117.20%); (60.39, 76.65, 89.56 and 105.99%) in crude fiber and (70.41, 91.89, 104.80 and 126.00%); (46.17, 60.89, 79.58 and 99.77%) in ash yield, respectively in both seasons. It could be suggested that the increase in crude protein, crude fiber and ash yields may be due to the increase in dry forage yield and an increase in their percentages. Also, the second cut was superior in crude protein yield, crude fiber yield and ash yield, while the first cut was inferior for the three respective yields. These results are similar to those found by Thomet *et al.*, (1990), Babnik (1993) and Zhang *et al.*, (1995).

3- Effect of the interaction between nitrogen fertilizer forms and application time on:

A- Growth characters:

The interaction between nitrogen form and time of application Tables (1 and 2) had insignificant effect on plant height, number of tillers/plant, leaf area/plant and stem diameter. On the other hand, the results clearly indicate that ammonium sulphate in four doses led to the highest increase for plant height, number of tillers/ plant, leaf area / plant and stem diameter in both seasons.

B- Forage yield:

The data also show that the interaction among the two studied factors had insignificant effect on fresh and dry forage yield in both seasons Tables (3 and 4). But the fresh yield at the 1st cut of the 1st season and dry forage yield at the 2nd cut of the 1st season and at 1st cut of 2nd season were significantly affected. The highest values for fresh forage yield and dry forage yield in both seasons, were obtained from ammonium sulphate applied in four doses in both seasons

C- Forage quality

Tables (3 and 4) demonstrate that the interaction between the two studied factors had insignificant effects on crude protein yield, crude fiber yield and ash yield in both seasons. The highest value was obtained from plant fertilized with ammonium sulphate divided to four parts (T_4).

CONCLUSION

It could be concluded that applying nitrogen fertilizer in four splits, ¼ three weeks after sowing + ¼ before the second, third and fourth cuts in the form of ammonium sulphate produced good ryegrass plants for growth, forage yield and forage quality under the conditions of Menoufia Governorate.

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تأثير مصادر التسميد الأزوتى وموعد إضافته على النمو والمحصول ومكوناته للراى جراس (جازون العلف)

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أجريت تجربتان حقليتان فى موسمى ١٩٩٨/١٩٩٩، ١٩٩٩/٢٠٠٠ بمحطة البحوث الزراعية – بسرس الليان– محافظة المنوفية لدراسة صفات النمو والمحصول الأخضر والجاف ومكوناته للراى جراس وتأثرهم بصور وموعد إضافة سماد النيتروجين.

وتتلخص أهم النتائج المتحصل عليها فيما يلى:

١- كان سماد سلفات النشادر أكثر فعالية على صفات النمو (طول النبات – عدد الفروع للنبات ومساحة الأوراق للنبات وقطر الساق) ومحصول العلف (أخضر وجاف) وجودة العلف (البروتين والألياف الخام والرماد) عن سماد اليوريا كمصدر للتسميد الأزوتى.

٢- أدى موعد إضافة النيتروجين على ٤ دفعات (¼ بعد ٣ أسابيع من الزراعة ، ثم¼ قبل كل من الحشة الثانية والثالثة والرابعة على التوالى) إلى زيادة معنوية لصفات النمو الخضرى والمحصول الأخضر والجاف وجودة العلف (البروتين والألياف الخام والرماد).

٣- أظهر التفاعل بين صور النيتروجين وموعد الإضافة تاثيرا غير معنوى على كل من صفات النمو ومحصول العلف أخضر وجاف وجودة العلف بينما اظهرالمحصول الأخضر فى القطعة الأولى للسنة الأولى والمحصول الجاف فى القطعة الثانية للسنة الأولى والقطعة الأولى للسنة الثانية تأثيراً معنوياً.

٤- يمكن التوصية من النتائج السابقة بصفة عامة استعمال سماد سلفات النشادر كمصدر للنيتروجين مع إضافته على ٤ دفعات (¼ بعد ٣ أسابيع من الزراعة ثم ¼ قبل كل من الحشة الثانية، والثالثة، والرابعة على التوالى للحصول على أفضل نمو ومحصول أخضر وجاف بجودة عالية كمصدر آخر لغذاء الماشية فى فصل الشتاء مع البرسيم المصرى.