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Effect of nitrogen and phosphorus levels to yield attributes and fodder yield of forage oat (*Avena sativa* L.) under north Gujarat conditions

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ABSTRACT

A field experiment was conducted during *rabi* season of 2011-12 at S. D. Agricultural University, sardarkrushinagar to study the effect of nitrogen levels (50, 75, 100, 125 kg N/ha) and phosphorus levels (0, 25, 50, 75 kg P_2O_5/ha) on fodder yield of forage oat in randomized block design with three replications. The soil of experimental field was loamy sand in texture with low in organic carbon and available nitrogen, medium in available phosphorus and high in potash having pH value of 7.8. Fertilizing the forage oat crop with 125 kg nitrogen/ha + 75 kg phosphorus/ha recorded significantly the highest plant height, leaf and stem weight per plant (green and dry), green and dry fodder yield per plant and green and dry fodder yield q/ha at first cut, at harvest and in the total values of both cuts.

Key words: Oat, forage, nitrogen and phosphorus

In Gujarat state, total animal population is about 18.44 million and their optimum fodder requirement is 42.2 million tonnes, whereas only 20.0 million tonnes of fodder is made available in normal year. Thus, fodder and concentrate production is not enough to feed the animals and there is a wide gap between the actual requirements and availability of feeds and fodders for the present population of livestock. Moreover, due to rapid reduction of grassland and pasture areas in recent year and also due to improper management of the remaining pasture further aggravated the deficit which providing insufficient quantity and quality of available fodder. As a result, livestock suffers continuously with malnutrition round the year, resulting in their production capacity at sub-optimum level. It is therefore, very essential to maximize the quantity and quality of fodder production per unit area and time by proper management of grassland, pasture and also by utilizing the proper agro-techniques for fodder crop production during *kharif* and *rabi* seasons. Among the different *rabi* fodder crops, oat is one of the most important *rabi* fodder crop. Oat is used as green fodder, straw, hay or silage. Oat grain makes a good balanced concentrate in the rations for poultry, cattle, sheep and other animals. But due to paucity of information on oat cultivation in north Gujarat, an experiment was planned to find out the effect of nitrogen and phosphorus levels on green fodder yield of forage oat.

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MATERIALS AND METHODS

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, during the rabi season of 2011-12. The soil of experimental field was loamy sand in texture with low in organic carbon and available nitrogen, medium in available phosphorus and high in potash having pH value of 7.8. Total sixteen

treatment combinations comprising four levels of nitrogen *viz.*, 50 kg N/ha (N_0), 75 kg N/ha (N_1) 100 kg N/ha (N_2) and 125 kg N/ha (N_3) and four levels of phosphorus *viz.*, no phosphorus (P_0), 25 kg P_2O_5/ha (P_1), 50 kgP_2O_5/ha (P_2)and 75 kgP_2O_5/ha (P_3)were laid out in Randomized Block Design (factorial concept) with three replications. Seeds of the oat crop (var. Kent) were drilled at spacing of 30 cm between two rows. All the cultural operations were carried out as per the requirement of the crop. Total two cuts were taken. The first cut of the oat were taken 65-70 days after sowing (DAS) and the second cut were taken at the time of the harvesting (*i.e.* at harvest).

RESULTS AND DISCUSSION

Yield attributes and Yield

Effect of Nitrogen

Yield attributing characters like green and dry weight of leaves and stem, green and dry weight per plant were significantly influenced by different doses of nitrogen (Table 1 & 2). Fertilizing the forage oat crop with 125 kg nitrogen per hectare recorded significantly more value of green and dry matter weight of leaves and stem during first cut, at harvest and in total of both cuts. Similarly significantly more green as well as dry matter yield per plant was observed with 125 kg nitrogen application than rest of the doses of nitrogen during first cut, at harvest and in total values of both cuts but application of 75 and 100 kg nitrogen per hectare were found equally effective on green and dry matter yield per plant. The maximum green and dry matter yield were contributed by stem and followed by leaves which increased with increasing in nitrogen levels. This might be attributed due to increase in rate of nitrogen availability under adequate nitrogen application which might be resulted in higher uptake of nitrogen and ultimately increased yield attributes. The higher values of stem weight per plant, leaf weight per plant and green and dry matter yield per plant were reflected in to higher green and dry matter yield per hectare of forage oat (Table 3). Thus green and dry fodder yield of forage oat was significantly increased with application of 125 kg nitrogen per hectare during first cut, at harvest and in the total of both cuts. The percentage increase in green and dry fodder yield of oat was 34.4 and 57.9 than that of 50 kg nitrogen per hectare in total values of both the cuts. The lowest green and dry matter yield of forage oat was registered by the application of 50 kg nitrogen per hectare. This was might be due to lower availability of nitrogen for the growth of forage oat. The findings are closely related with the findings of Bali *et al.* (1998), Patel and Rajgopal (2002), Sharma (2009), Malik and Paynter (2010) and Patel *et al.* (2010). More or less similar results were recorded by Sharma and Verma (2005) with respect to green and dry fodder yield q/ha in oat crop. The crude protein yield was also significantly influenced by the nitrogen levels as crude protein yield is corresponding increased with the increase in dry matter yield of oat crop.

Effect of Phosphorus

Different levels of phosphorus brought significant differences on yield attributes of forage oat *viz.*, leaves and stem weight and fodder yield per plant (Table 1 & 2). Significantly more values of green as well as dry matter weight of leaves and stem were found in the application of 75 kg phosphorus per hectare. Similarly application of higher dose of phosphorus produced significantly higher green and dry accumulation per plant of forage oat over lower doses of phosphorus application during first cut, at harvest and total values of both the cuts. The mean percentage increase in green and dry matter yield of forage oat was 40.3 and 65.5 as compared to lower doses of phosphorus which in turn recorded higher green and dry fodder yield per hectare. The maximum contribution in total green and dry fodder yield were comes from stems and leaves which increased with increase in phosphorus levels This indicates the better development of sink under assured supply of nutrients. Application of phosphorus improved the nutrient availability status resulting in greater uptakes which might be increased photosynthesis and also translocation to different parts which ultimately increased the dry matter yield of forage oat. These findings are closely related with the findings of Nanda and Mukherjee (1999), Sharma *et al.* (2001), Tiwana and Puri (2004), Sharma (2009), Tandon and Patel (2009). More or less similar results were recorded by Patel and Rajgopal (2002) with respect to plant height and green and dry fodder yield q/ha in oat crop.

Table 1. Stem weight per plant and leaf weight per plant (green and dry) of oat as influenced by nitrogen and phosphorus levels

Treatments	Stem weight per plant (g)						Leaf weight per plant (g)					
	Green			Dry			Green			Dry		
	First cut	At harvest	Total	First cut	At harvest	Total	First cut	At harvest	Total	First cut	At harvest	Total
Nitrogen levels, (N kg/ha)												
N_0-50	20.47	25.18	45.65	3.26	3.85	6.90	5.46	5.92	11.37	0.80	0.86	1.70
N_1-75	22.45	27.38	49.83	3.72	4.25	7.51	5.91	6.33	12.24	0.88	0.94	1.81
N_2-100	22.87	27.90	50.76	3.82	4.32	7.65	6.09	6.51	12.60	0.91	0.96	1.87
N_3-125	28.80	35.14	63.94	4.99	5.58	9.64	7.63	8.16	15.79	1.14	1.24	2.34
S.Em±	0.75	0.94	1.45	0.14	0.17	0.23	0.21	0.23	0.42	0.04	0.03	0.07
C.D.at 5 %	2.16	2.72	4.17	0.40	0.50	0.65	0.60	0.65	1.22	0.10	0.09	0.20
Phosphorus levels, (P_2O_5 kg/ha)												
P_0-0	19.69	24.02	43.71	3.24	3.73	6.59	5.23	5.60	10.83	0.78	0.83	1.61
P_1-25	21.77	26.76	48.53	3.62	4.24	7.34	5.89	6.38	12.28	0.87	0.94	1.83
P_2-50	25.48	31.08	56.56	4.18	4.79	8.52	6.68	7.14	13.82	0.99	1.05	2.05
P_3-75	27.65	33.74	61.39	4.75	5.24	9.25	7.28	7.79	15.08	1.08	1.18	2.23
S.Em±	0.75	0.94	1.45	0.14	0.17	0.23	0.21	0.23	0.42	0.04	0.03	0.07
C.D.at 5 %	2.16	2.72	4.17	0.40	0.50	0.65	0.60	0.65	1.22	0.10	0.09	0.20
C.V. (%)	11.00	11.32	9.55	12.14	13.40	9.83	11.58	11.61	11.32	13.03	11.38	12.21
Interaction												
N X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2 Leaf-stem ratio and yield per plant of oat as influenced by nitrogen and phosphorus levels

Treatments	Leaf: stem ratio						Yield per plant (g)					
	Green			Dry			Green forage			Dry matter		
	First cut	At harvest	Total	First cut	At harvest	Total	First cut	At harvest	Total	First cut	At harvest	Total
Nitrogen levels, (N kg/ha)												
N_0-50	0.270	0.237	0.253	0.250	0.224	0.237	25.93	31.10	57.03	4.06	4.70	8.77
N_1-75	0.264	0.233	0.249	0.238	0.222	0.230	28.36	33.71	62.07	4.60	5.19	9.79
N_2-100	0.266	0.235	0.250	0.237	0.224	0.230	28.95	34.41	63.36	4.73	5.28	10.01
N_3-125	0.266	0.233	0.249	0.229	0.224	0.227	36.43	43.30	79.73	6.12	6.82	12.94
S.Em±	0.01	0.01	0.07	0.01	0.01	0.04	0.87	1.05	1.73	0.16	0.19	0.31
C.D.at 5 %	NS	NS	NS	NS	NS	NS	2.52	3.03	4.98	0.47	0.55	0.89
Phosphorus levels, (P_2O_5 kg/ha)												
P_0-0	0.266	0.233	0.249	0.242	0.224	0.233	24.92	29.62	54.54	4.02	4.56	8.58
P_1-25	0.271	0.240	0.255	0.242	0.224	0.233	27.66	33.15	60.81	4.49	5.18	9.67
P_2-50	0.265	0.232	0.248	0.240	0.221	0.230	32.15	38.22	70.37	5.17	5.84	11.01
P_3-75	0.264	0.232	0.248	0.230	0.225	0.228	34.94	41.53	76.47	5.83	6.42	12.25
S.Em±	0.01	0.01	0.07	0.01	0.01	0.04	0.87	1.05	1.73	0.16	0.2	0.30
C.D.at 5 %	NS	NS	NS	NS	NS	NS	2.52	3.03	4.98	0.47	0.6	0.90
C.V. (%)	10.97	12.59	9.25	9.71	11.21	5.85	10.13	10.23	9.15	11.59	12.12	10.28
Interaction												
N X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3 Green and dry forage yield and crude protein yield of oat as influenced by nitrogen and phosphorus levels

Treatments	Yield (q/ha)						Crude protein yield(kg/ha)		
	Green forage			Dry matter					
	First cut	At harvest	Total	First cut	At harvest	Total	First cut	At harvest	Total
Nitrogen levels, (N kg/ha)									
N_0-50	120	206	326	24	42	66	142.37	314.48	456.85
N_1-75	129	220	349	27	48	75	168.97	368.93	537.90
N_2-100	133	228	361	29	51	80	183.59	399.15	582.74
N_3-125	163	275	438	38	66	104	244.30	519.50	763.80
S.Em±	4.18	6.9	10.5	1.0	1.7	2.6	7.48	15.43	20.40
C.D.at 5 %	12.00	20.00	30.00	3.0	5.0	8.0	21.54	44.70	58.71
Phosphorus levels, (P_2O_5 kg/ha)									
P_0-0	112	193	305	22	39	61	131.87	293.64	425.51
P_1-25	125	219	344	26	47	73	162.35	360.07	522.43
P_2-50	147	250	397	32	57	89	207.06	446.01	653.07
P_3-75	160	268	428	37	64	101	237.95	502.33	740.28
S.Em±	4.2	6.9	10.5	1.0	1.7	2.6	7.48	15.43	20.40
C.D.at 5 %	12.0	20.0	30.0	3.0	5.0	8.0	21.54	44.70	58.71
C.V. (%)	10.65	10.23	9.92	11.75	11.57	11.21	14.02	13.34	12.07
Interaction									
N X P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Interaction effect

The interaction effect of nitrogen and phosphorus levels on leaf and stem weight per plant (green and dry), green and dry fodder yield per plant and green and dry fodder yield q/ha were found non-significant at first cut, at harvest and in the total values of both the cuts. The findings are closely related with the findings of Sood and Kumar (1994) and Patel and Rajgopal (2002).

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