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Response of oat (*Avena sativa* l.) on quality and economics to nitrogen and phosphorus levels under North Gujarat agro-climatic conditions

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Livestock population is the largest in the India, comprising 182.50 million cattle may be cow, 61.30 million buffaloes, 76.65 million goats, 41.30 million sheeps, 10.0 million pigs and 3.04 million other animals. The integrated efforts even could not improve the declining trend in per capita availability of milk from 263 g during 2011 because most of our animals are either low producer or under malnutrition and about 55.05 and 41.95 percent of the total cows and buffaloes respectively, remain dry and infertile. In India, about 6.91 million hectares of land which contributes about 4.4 per cent of the total cultivated area are under fodder crops cultivation. Out of which only 1.02 million hectares of land is irrigated. 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. Among the different *rabi* fodder crops, oat is one of the most important *rabi* fodder crop. Oat requires the cool and moist weather for germination, tillering, booting and heading stage. More over, oat make their best growth on loam soil in the state of Punjab, Haryana, U.P., Maharashtra, Orissa, Bihar, West Bengal and Gujarat. Oat grain makes a good balanced concentrate in the rations for poultry, cattle, sheep and other animals. Looking to the chemical composition on dry matter basis oat at milk stage contain 6.44 crude protein, 28.72 fiber, 53.20 nitrogen free-extract. Beside this, it contains 2.31 ether extract, 9.33 total ash, 0.47 calcium, 0.22 phosphorus, 0.22 magnesium, 0.52 sodium and 2.84 per cent potassium. (Sen and Ray, 1971).

Short Communication
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A field experiment was conducted at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada 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 ha^{-1} N (N_0), 75 kg ha^{-1} N (N_1), 100 kg ha^{-1} N (N_2) and 125 kg ha^{-1} N (N_3) and four levels of phosphorus *viz.,* no phosphorus (P_0), 25 kg ha^{-1} P_2O_5 (P_1), 50 kg ha^{-1} P_2O_5 (P_2) and 75 kg ha^{-1} P_2O_5 (P_3) were laid out in Randomized Block Design (factorial concept) with three replications having plot size 5.0 × 3.0 m, oat seed were had drilled by adopting a spacing of 30 cm. kent cultivar was used in the study. The experiment comprising of total sixteen treatment combinations consisting nitrogen (N) + phosphorus (P_2O_5) (kg ha^{-1}) combinations were laid out in randomized block design having factorial concept with three replications. Nitrogen and phosphorus chemical fertilizer treatments were applied in the form of urea and DAP respectively.

Quality, chemical analysis and economics

Effect of nitrogen

The data presented in table 1&2 showed that the effect of different levels of nitrogen were found significant at first cut, second cut (at harvest) and in the total values on crude protein yield (244.3, 519.50 and 763.80 kg ha^{-1}, respectively), nitrogen uptake (39.09, 83.12 and 122.21 kg ha^{-1}, respectively), phosphorus uptake (3.91, 7.13 and 11.04 kg ha^{-1}, respectively) with application of nitrogen @ 125 kg ha^{-1} was followed by the application of 100 kg ha^{-1} nitrogen. While, different levels of nitrogen did not differ significantly the crude protein content (%), nitrogen content (%), and phosphorus content (%) of fodder oat. In case of

Table 1: Nitrogen, phosphorus, crude protein content, crude protein yield and N, P and K after harvest of oat as influenced by nitrogen and phosphorus levels

Treatments	Nitrogen content (%)		Phosphorus content (%)		Crude protein content (%)		Crude protein yield kg ha^{-1}		N, P and K kg ha^{-1} after harvest		
	First cut	Second cut	First cut	Secondcut	First cut	Second cut	First cut	Secondcut	Available N	Available P_2O_5	Available K_2O
Nitrogen levels, (N kgha^{-1})											
N_0-50	0.962	1.194	0.096	0.101	6.01	7.46	142.37	314.48	121.51	32.71	266.65
N_1-75	0.998	1.230	0.100	0.105	6.24	7.69	168.97	368.93	131.87	35.54	276.83
N_2-100	1.010	1.242	0.101	0.106	6.31	7.76	183.59	399.15	137.88	37.17	280.04
N_3-125	1.029	1.260	0.103	0.108	6.43	7.88	244.30	519.50	174.21	47.07	285.29
S.Em(+)	**0.02**	**0.03**	**0.002**	**0.002**	**0.14**	**0.17**	**7.48**	**15.43**	**3.93**	**1.07**	**6.52**
LSD(0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**21.54**	**44.70**	**11.30**	**3.08**	**NS**
Phosphorus levels, (P_2O_5 kg/ha)											
P_0-0	0.958	1.190	0.096	0.101	5.99	7.44	131.87	293.64	111.88	30.09	265.46
P_1-25	0.995	1.227	0.100	0.105	6.22	7.67	162.35	360.07	129.82	34.98	275.98
P_2-50	1.020	1.252	0.102	0.107	6.37	7.82	207.06	446.01	154.59	41.73	282.86
P_3-75	1.026	1.258	0.103	0.108	6.41	7.86	237.95	502.33	169.18	45.70	284.51
S.Em(+)	**0.02**	**0.03**	**0.002**	**0.002**	**0.14**	**0.17**	**7.48**	**15.43**	**3.93**	**1.07**	**6.52**
LSD(0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**21.54**	**44.70**	**11.30**	**3.08**	**NS**
C.V. (%)	**8.03**	**7.84**	**8.03**	**7.64**	**8.03**	**7.84**	**14.02**	**13.34**	**9.62**	**9.72**	**8.14**
Interaction											
N X P	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 2: Nitrogen, Phosphorus uptake and economics of oat as influenced by nitrogen and phosphorus levels

Treatments	Nitrogen uptake kg.ha^{-1}			Phosphorus uptake kg.ha^{-1}			Total green fodder yield (q.ha^{-1})	Gross realization (₹ ha^{-1})	Total expenditure (₹ ha^{-1})	Net realization (₹ ha^{-1})	BCR
	First cut	Second cut	Total	First cut	Second cut	Total					
Nitrogen levels, (N kg/ha)											
N_0-50	22.78	50.32	73.10	2.28	4.27	6.55	326	32588	20165	12423	0.62
N_1-75	27.04	59.03	86.06	2.70	5.04	7.74	349	34812	20490	14322	0.70
N_2-100	29.37	63.86	93.24	2.94	5.45	8.39	361	36095	20816	15279	0.73
N_3-125	39.09	83.12	122.21	3.91	7.13	11.04	438	43829	21133	22695	1.07
S.Em(+)	**1.20**	**2.47**	**3.26**	**0.12**	**0.21**	**0.32**	**-**	**-**	**-**	**-**	**-**
LSD(0.05)	**3.45**	**7.10**	**9.39**	**0.34**	**0.60**	**0.92**	**-**	**-**	**-**	**-**	**-**
Phosphorus levels, (P_2O_5 kg/ha)											
P_0-0	21.10	46.98	68.08	2.11	3.98	6.09	305	30514	19377	11137	0.57
P_1-25	25.98	57.61	83.59	2.60	4.93	7.53	344	34372	20223	14149	0.70
P_2-50	33.13	71.36	104.49	3.31	6.11	9.42	397	39689	21076	18613	0.88
P_3-75	38.07	80.37	118.44	3.81	6.87	10.68	428	42749	21929	20820	0.95
S.Em(+)	**1.20**	**2.47**	**3.26**	**0.12**	**0.21**	**0.32**	**-**	**-**	**-**	**-**	**-**
LSD(0.05)	**3.45**	**7.10**	**9.39**	**0.34**	**0.60**	**0.92**	**-**	**-**	**-**	**-**	**-**
C.V. (%)	**14.02**	**13.34**	**12.07**	**14.02**	**13.20**	**13.12**	**-**	**-**	**-**	**-**	**-**
Interaction											
N X P	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**-**	**-**	**-**	**-**	**-**

Price rate of green fodder of oat = 1 ₹kg^{-1},Second cut at harvest.

available potassium, the effect of different nitrogen doses was found non- significant. The application of 125 kg ha^{-1} nitrogen recorded the highest net realization (22,695 ₹ /ha) and benefit: cost (1.07) and was followed by the application of 100 kg/ha nitrogen net realization (15,279 ₹) and benefit: cost ratio (0.73). Thus, it appears that improvement in these parameters due to application of nitrogen at right quantity and right time to the oat crop might be due to supply of plant nutrients improves soil physical and biological properties and increase the availability of nutrients. This could also be explained on the basis of better availability of desired and required nutrients in crop root zone and enhanced photosynthetic and metabolic activity resulting in better partitioning of photosynthates to sinks, which reflected in quality enhancement in terms of crude fibre content on account of availability of nitrogen in sufficient quantity. The higher uptake of nitrogen and phosphorus was due to higher dry fodder yield of oat crop as a resultant of higher growth and yield parameters due to higher availability of nitrogen to the crop through out the crop period. The findings are closely related with the findings of Sharma *et al.* (2001), Sharma and Verma (2005), and Tandon and Patel (2009).

Effect of Phosphorus

The data presented in table 1&2 showed that the effect of different levels of phosphorus were found significant at first cut, second cut (at harvest) and in the total values on crude protein (237.95, 502.33 and 740.28 kg ha^{-1}, respectively), nitrogen uptake (38.07, 80.37 and 118.44 kg ha^{-1}, respectively), phosphorus uptake (3.81, 6.87 and 10.68 kg/ha, respectively) with application of phosphorous @ 75 kg ha^{-1} and was followed by the application of 50 kg ha^{-1} phosphorous. While, different levels of phosphorus did not differ significantly the crude protein content (%), nitrogen content (%), and phosphorus content (%) of fodder oat. In case of available potassium, the effect of different phosphorus doses was found non-significant. The data showed that the application of 75 kg ha^{-1} phosphorus recorded the highest net realization (20,820 ₹ /ha) and benefit: cost ratio (0.95) and was followed by the application of 50 kg ha^{-1} phosphorus net realization (18,613 ₹) and benefit: cost ratio (0.88). Availability of phosphorus which proportionally increased with increase in dry fodder yield of oat crop. Similar results were also found by Nanda and Mukherjee (1999), Sood and Kumar (1994) and Singh *et al*. (1997), Sharma *et al.* (2001)

The interaction effect of nitrogen and phosphorus levels on crude protein content (%), nitrogen content (%), and phosphorus content (%),crude protein yield, nitrogen uptake, phosphorus uptake of fodder oat were found non-significant at first cut, second cut (at harvest) and in the total values of both cuts. The results are in accordance with the findings of the Sood and Kumar (1994), Sharma *et al.* (2001).

On the basis of results of one year experimentation, the maximum production and net realization of *rabi* fodder oat (Kent) can be achieved by the application of 125 N + 75 P_2O_5 kg/ha phosphorus per hectare under loamy sand soil of North Gujarat Agro-climatic conditions.

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