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Response of forage oat (var. OS-6) to nitrogen and phosphate fertilizers in the new alluvial zone of West Bengal

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ABSTRACT

The field experiment was carried at Central Research Farm of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal on forage oat during rabi season (December to March) of 2006-2008 to study the response of nitrogen and phosphate fertilizer and their interaction. The experimental soil is sandy loam in texture with neutral pH (6.90). The trial was laid out factorial randomized block design with sixteen treatments, replicated thrice. The treatment combinations were consisted of four levels of nitrogen viz. 0, 40, 80 and 120 kg/ha and four levels of phosphate viz. 20, 40, 60 and 80 kg/ha. The observations were taken on plant height, dry matter accumulation, LAI, CGR, GFY, DFY and CPY. Results reveal that the effect of different doses of nitrogen and phosphate influenced the plant height, dry matter accumulation, LAI, CGR, GFY, DFY and CPY. The fodder yield attributes i.e. GFY, DFY and CPY were the maximum when nitrogen was applied @ 80 kg/ha. Similarly, in case of phosphate, the different yield attributes were the maximum when applied @ 60 kg/ha. The interaction effect of N and P was significant in case of GFY and CPY. It was concluded that N_{80} and P_{60} proved to be the best, which are statistically at par with N_{120} and P_{80} respectively.

Key words: Forage oat, nitrogen and phosphate.

India has about one-fifth of the total cattle population of the world but we are highly deficient in various livestock products e.g., milk, meat and other products like hides in the leather industries, Among the forage crops grown during *rabi* season, oat (*Avena sativa* L.) has several advantages *viz.* high yield potential and nutritional quality and most prevalent of the cultivated fodder in Northern India. Most of the fodder growers rely only on nitrogenous fertilizers without bothering for balanced plant nutrition. OS-6, the variety has been newly recommended for this zone so the same has been taken up for the study. Very less amount of work has been done on the response of phosphorus and the farmers do not have a tendency to invest on phosphate sources for grasses. But the soil phosphate reserves are limited and we should take stock of the situation more comprehensively keeping in view the crops actual need and that of the soil of the posterity. Hence, a study was conducted in deltaic West Bengal condition to understand the effect of phosphorus application and its interaction with nitrogen.

MATERIALS AND METHOD

The field experiment was carried at Central Research Farm of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal on forage oat during *rabi* season (December to March) of 2006-2008. The experimental soil is of sandy loam in texture with a neutral pH (6.90). The trial was laid out to factorial randomized block design with sixteen treatments, replicated thrice. The plot size was 4×3m. The treatment combinations were consisted of four levels of nitrogen *viz.* 0, 40, 80 and 120 kg/ha and four levels of phosphate *viz.* 20, 40, 60 and 80 kg/ha. Seeds @ 120kg/ha were sown 30 cm apart in lines on 1^{st} week of December. Nitrogen in the form of urea was applied as per treatment in three equal splits: at sowing, at 30 DAS and at 60 DAS. Full dose of P_2O_5 as per treatment was applied in the form of SSP. Potash was applied @30kg/ha in the form of MOP, as basal. Irrigation was given as and when required. No plant protection measure was taken. The crop was harvested at 90 DAS for fodder purpose when 50% flowering of the crop was noted. Cutting was done at less than 10 cm above the ground level.

RESULTS AND DISCUSSION

Growth parameters

The results revealed that, the effect of different doses of nitrogen and phosphate influenced the plant height, dry matter (DM), leaf area index (LAI), crop growth rate (CGR), green and dry fodder as well as crude protein yield. As shown in table-1, the plant height responded significantly to nitrogen application up to a dose of 80 kg/ha at all stages of growth. Further increase in nitrogen level had adverse effect on plant height. However, the difference between N_{80} and N_{120} was statistically not significant. Among the phosphate levels the highest plant height was recorded from 80 kg P_2O_5 application *i.e.,* P_{80} which was statistically at par with that of P_{60}. The interaction between nitrogen and phosphorus for plant height was significant at 90 DAS only. The dry matter accumulation followed similar trend as that of plant height. Among the nitrogen levels, N_{80} recorded the highest dry matter accumulation at all the stages of growth except at 80 DAS where N_{80} and N_{120} were statically *at par* with each other. The minimum dry matter accumulation at all the stages was recorded when no nitrogen was applied. The effect of phosphate application was found to be significantly positive up to a dose of 60 kg P_2O_5/ha except at initial

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stage (20 DAS) where P_{80} was superior to P_{60}. The interaction effect of N and P was significant at 40, 60 and 80 DAS for this attribute.

The leaf area index (LAI) was the highest when nitrogen was applied @ 80 kg/ha which was at par with N_{120} level. The minimum LAI was recorded from N_0 level at all the growth stages. The trend is similar with phosphate application where maximum LAI was recorded at P_{60} level and this was at par with P_{80} level at all growth stages. The CGR at initial stage (20-40 DAS) was maximum when nitrogen was applied @ 120 kg/ha which was statistically *at par* with N_{80} level (Sharma and Verma 2004). However, at later stages N_{80} recorded higher CGR than N_{120}. The minimum CGR was obtained at N_{40} level at 60-80 DAS. The effect of phosphorus application on CGR of oat was significant up to a dose 60 kg P_2O_5/ha at initial stages. However, during 60 to 80 DAS the highest CGR was recorded from P_{80}.

Forage yield

The data on green forage yield revealed that nitrogen application @ 80 kg/ha recorded maximum fodder yield (Shukla *et al.,* 1988] along with phosphate application @ 60 kg/ha. The maximum DFY and Crude protein yield were recorded with nitrogen application @ 120 kg/ha which is at par with N application @ 80 kg/ha. The highest DFY and CPY were obtained with the phosphate application @60 kg/ha which is at par with phosphate application @80kg/ha. Interaction effect of nitrogen and phosphate is significant only in case of GFY. The nitrogen and phosphate application further registers that a significant interaction exists and maximum yield is shown by $N_{80}P_{60}$ combination having yield of 390.58 q/ha (Patel and Rajagopal, 2002). The lower levels of nitrogen application responded more to increasing phosphate application (Table 4)

From this experiment we can conclude from the experiment that nitrogen application @ 80 kg/ha along with phosphorus application @ 60 kg/ha can be recommended for improving yield and quality of forage oat in the new alluvial zone of West Bengal.

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Table1: Plant height and dry matter accumulation of fodder oats as influenced by level of nitrogen and phosphate (Pooled data)

Treatments	Plant height (cm)			Dry matter accumulation (g/m^2)			
	30 DAS	60 DAS	90DAS	20 DAS	40 DAS	60 DAS	80DAS
Nitrogen							
N_0	25.23	52.21	68.41	68.13	206.81	276.29	331.29
N_{40}	29.49	61.76	82.42	74.61	254.59	339.36	389.99
N_{80}	42.77	90.45	119.58	100.53	318.12	424.04	474.93
N_{120}	41.87	87.77	116.35	84.38	307.18	405.91	462.80
SEm (±)	**0.973**	**2.614**	**2.006**	**0.46**	**2.599**	**3.114**	**9.24**
LSD (0.05)	**2.334**	**6.272**	**4.81**	**1.103**	**6.236**	**7.22**	**22.17**
Phosphate							
P_{20}	29.05	60.34	81.21	68.92	247.62	330.68	384.43
P_{40}	34.14	71.19	93.30	76.66	267.32	356.32	413.10
P_{60}	37.52	79.40	104.88	86.50	291.75	388.90	442.28
P_{80}	38.67	81.27	107.37	95.60	280.01	369.69	419.20
S.Em. (±)	**0.973**	**2.614**	**2.006**	**0.46**	**2.599**	**3.114**	**9.24**
LSD (P=0.0 5)	**2.334**	**6.272**	**4.81**	**1.103**	**6.236**	**7.22**	**22.17**
Interaction effect							
SEm (±)	**1.946**	**5.228**	**4.024**	**0.919**	**5.198**	**6.228**	**18.48**
LSD(0.05)	**NS**	**NS**	**9.65**	**NS**	**12.472**	**14.44**	**44.33**

Table 2: Leaf area index (LAI) and crop growth rate (CGR) of fodder oats as influenced by level of nitrogen and phosphate (Pooled data)

Treatments	LAI			CGR (g/m^2/day)		
	30 DAS	**60 DAS**	**90DAS**	**20-40 DAS**	**40-60 DAS**	**60-80 DAS**
Nitrogen						
N_0	1.46	3.60	4.44	7.29	3.50	2.85
N_{40}	1.75	3.89	4.86	8.96	4.27	2.65
N_{80}	2.03	4.19	5.23	11.10	5.33	3.60
N_{120}	2.02	4.18	5.33	11.30	4.97	2.69
SEm (±)	**0.037**	**0.063**	**0.017**	**0.196**	**0.363**	**0.097**
LSD(0.05)	**0.088**	**0.151**	**0.407**	**0.470**	**0.87**	**0.233**
Phosphate						
P_{20}	1.71	3.83	4.80	8.97	4.18	2.81
P_{40}	1.81	3.96	4.95	9.58	4.49	2.97
P_{60}	1.91	4.05	5.05	10.31	4.89	2.81
P_{80}	1.85	4.02	5.05	9.80	4.52	3.22
SEm (±)	**0.037**	**0.063**	**0.17**	**0.196**	**0.363**	**0.097**
LSD(0.05)	**0.088**	**0.151**	**0.407**	**0.470**	**0.87**	**0.233**
Interaction effect						
SEm (±)	**0.074**	**0.126**	**0.237**	**0.391**	**0.676**	**1.947**
LSD(0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 3: Green forage yield (GFY), dry forage yield (DFY) and crude protein yield (CPY) of fodder oats as influenced by level of nitrogen and phosphate (Pooled data)

Treatment	GFY (q/ha)	DFY (q/ha)	CPY (q/ha)
Nitrogen			
N_0	285.03	47.01	2.68
N_{40}	330.57	53.57	3.27
N_{80}	382.07	55.74	3.68
N_{120}	363.95	56.03	3.90
SEm (±)	**6.622**	**1.096**	**0.110**
LSD(0.05)	**15.89**	**2.63**	**0.263**
Phosphate			
P_{20}	320.85	50.53	3.12
P_{40}	336.45	52.44	3.33
P_{60}	353.82	54.94	3.56
P_{80}	350.50	54.44	3.53
SEm (±)	**6.622**	**1.096**	**0.110**
LSD(0.05)	**15.89**	**2.63**	**0.263**
Interaction effect			
SEm (±)	**12.48**	**2.185**	**0.22**
LSD(0.05)	**29.94**	**NS**	**NS**

Table 4: Green fodder yield (q/ha) at harvest as influenced by nitrogen and phosphorus interaction

Phosphate	Nitrogen level				Mean
	N_0	N_{40}	N_{80}	N_{120}	
P_{20}	269.00	300.79	372.49	341.13	320.85
P_{40}	279.78	324.78	386.88	354.34	336.45
P_{60}	300.46	349.35	390.58	374.89	353.82
P_{80}	290.88	347.36	378.33	385.43	350.50
Mean	285.03	330.57	382.07	363.95	
	N	**P**		**N×P**	
SEm (±)	**6.622**	**6.622**		**12.480**	
LSD(0.05)	**15.890**	**15.890**		**29.940**	

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