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Integrated Nutrient Management in Wheat (*Triticum aestivum* L.)*

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ABSTRACT

Results of the experiment conducted at Gujarat Agricultural University, Junagadh (India) to study the effect of organic and inorganic fertilizer in wheat revealed that application of FYM @ 10 t/ha significantly increased grain and straw yield during both the years and total uptake of nitrogen during 1993-94. Application of NP (120:60 kg/ha) significantly improved grain and straw yield, protein content in grain and total uptake of N, P and K over their lower levels. The beneficial effect of potassium was not observed in any parameters except total uptake of potassium which was maximum under the application of 50 kg K/ha. Grain and straw yield, protein content in grain and total uptake of nitrogen and sulphur were significantly higher under application of 40 kg S/ha as compared to no sulphur. Treatment combination of 10 T FYM with 120 – 60 NP kg/ha was found the best in most of all the parameters.

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INTRODUCTION

Wheat occupies the prime position among the food crops in almost all the countries in the world. In India, it occupies an area of 23.99 m ha with a total production of 54.55 m t (Anon., 1993). The productivity of wheat crop in Gujarat is 2014 kg grain ha. Still there is scope to increase the productivity by adopting integrated nutrient management approach. On account of sulphur deficiency, yield of the wheat crop can not be obtained upto the level. No work so far has been done on the effect of FYM, nitrogen, phosphorus, potassium, sulphur on the yield of wheat and nutrient uptake in this area. Taking note of the fact highlighted above an experiment entitled 'Integrated nutrient management in wheat' was carried out.

MATERIALS AND METHODS

An investigation was carried out at Instructional Farm, Gujarat Agricultural University, Junagadh (India) during *rabi* season of the year 1992-93 and 1993-94 on vertisol. The soil was low in available nitrogen (232.5 kg/ha) and sulphur (8.15 ppm), medium in available phosphorus (32.4 kg/ha) and rich in available potassium (338.35 kg/ha). The experiment comprising of 24 treatment combinations was laid out in split plot design with four replications. The main plot treatments consisted of FYM (no FYM & 10 t FYM/ha),

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while sub plot treatments consisted of twelve combinations of three levels of nitrogen : phosphorus (60:30, 90:45 and 120:60 kg/ha), two levels each of potassium (0 and 50 kg/ha) and sulphur (0 and 400 kg/ha). The FYM and sulphur (as gypsum) were applied seven days before sowing whereas, half the quantity of nitrogen and full amount of phosphorus and potassium were applied at sowing. The remaining quantity of nitrogen was applied at crown root initiation stage of the crop. The crop was sown keeping the inter-row spacing of 22.5 cm with recommended seed rate of 120 kg seed/ha.

RESULTS AND DISCUSSION

Effect of farmyard manure

Data presented in Table 1 revealed that application of FYM @ 10 t/ha has tremendous effect on grain as well as straw yield of wheat during both the years and in pooled results. When compared with no FYM, application of 10 t FYM/ha has increased 17.85 and 16.12 per cent grain and straw yield respectively in pooled results. This may be due to increase in microbial activity in soil and improvement in physical and chemical properties of the soil which resulted in better utilization of the nutrients as compared to no FYM. These findings are in confirmation with the results of Maliwal *et al.* (1985) and Patel *et al.* (1993). Protein content in grain remain unaffected due to the application of FYM during both the years as well as in pooled analysis. The uptake of nutrients was also remain unaffected in individual years as well as in pooled results, except total N uptake during 1993-94 and in pooled results where in N uptake was significantly higher under application of FYM as compared to control (Table 2). The higher N uptake under FYM application may be due to cumulative effect of higher nitrogen concentration in grain and straw and higher biological yield under FYM application. Similar significant effect was reported by Bhatiya *et al.* (1985) and Patel *et al.* (1993).

Effect of nitrogen : phosphorus

The yield of grain and straw was significantly increased with each increase in NP levels during both the years and in pooled results (Table 1). The application of NP at higher level (120:60 kg/ha) increase the grain and straw yields of wheat by 70.67 and 58.59 per cent over their respective lower level i.e. 60:30 kg/ha in pooled results. Maximum response under higher level of NP was might be due to higher growth and yield attributes of wheat and also increase the total uptake of N, P and K. Similar trend was also observed by Rana *et al.* (1982) and Singh *et al.* (1986). Protein content was also higher under NP. Fertilizing the crop (Table 2) with higher level of NP (120:60 kg/ha) significantly increased the total uptake of N, P and K over their respective lower levels. The maximum uptake of nitrogen (143.97 kg/ha), phosphorus (16.43 kg/ha) and potassium (99.88 kg/ha) were observed under the application of 120:60 kg/ha in pooled results which were higher by 108.56, 98.43 and 20.53 per cent over their respective lower level (60:30 kg/ha). Maximum uptake of N, P and K under higher level of NP was attributed to the cummulative effect of higher concentration in grain and straw and higher yield. Kalyan Singh *et al.* (1981) also observed the similar trend. The effect of application of NP was found non-significant on total uptake of sulphur eventhough the maximum total uptake of sulphur was recorded under higher level of NP fertilization.

TABLE 1

Effect of different treatments on yield of wheat and protein content in grain.

Treaments	Yield (q/ha)						Protein content (%)		
	Grain			Straw					
	1992-93	1993-94	Pooled	1992-93	1993-94	Pooled	1992-93	1993-94	Pooled
Levels of FYM (t/ha)									
F_0 0	39.84	36.36	38.10	53.43	48.72	51.06	9.97	10.44	10.21
F_1 10	46.82	42.98	44.90	61.72	56.31	59.29	10.99	12.18	11.58
C. D. at 5%	6.34	5.56	5.98	8.01	7.03	7.57	NS	NS	NS
Levels of N : P (kg/ha)									
NP_1 60:30	32.05	28.38	30.21	43.63	39.16	41.70	9.81	10.12	9.97
NP_2 90:45	44.39	41.13	42.76	59.73	55.51	57.73	10.00	10.75	10.38
NP_3 120:60	53.56	49.51	51.53	69.36	62.87	66.09	11.63	13.06	12.35
C. D. at 5%	2.59	2.10	2.36	2.63	1.88	2.25	1.02	1.08	1.04
Levels of Potassium (kg/ha)									
K_0 0	42.77	38.88	40.38	57.55	51.17	54.86	10.44	11.17	10.80
K_1 50	43.89	40.45	42.18	57.80	52.85	55.48	10.52	11.45	10.99
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Levels of Sulphur (kg/ha)									
S_0 0	41.33	38.18	39.75	55.60	51.33	53.47	10.06	10.83	10.44
S_1 40	45.33	41.16	43.25	59.60	53.69	56.82	10.90	11.79	11.34
C. D. at 5%	2.12	1.17	1.92	2.15	1.53	1.84	0.83	0.88	0.85

TABLE 2

Total uptake of N, P, K and S as affected by different treatments.

Treatments	*Uptake of nutrients (kg/ha)*											
	N			*P*			*K*			*S*		
	1992-93	*1993-94*	*Pooled*	*1992-93*	*1993-94*	*Pooled*	*1992-93*	*1993-94*	*Pooled*	*1992-93*	*1993-94*	*Pooled*
Levels of FYM (t/ha)												
F_0 0	115.17	85.99	100.58	12.23	11.12	11.68	96.04	85.45	90.74	8.94	8.06	8.50
F_1 10	120.45	99.35	109.90	13.20	12.56	12.88	98.04	88.01	93.03	9.20	8.35	8.79
C. D. at 5%	NS	10.60	8.00	NS	NS	NS	NS	NS	NS	NS	NS	NS
Levels of N : P (kg/ha)												
NP_1 60:30	80.72	57.34	69.03	8.80	7.76	8.28	89.75	75.59	82.87	8.58	7.96	8.27
NP_2 90:45	115.27	90.17	102.72	12.52	11.74	12.13	97.48	88.75	93.12	8.62	8.09	8.67
NP_3 120:60	157.44	130.50	143.97	16.84	16.02	16.43	103.89	95.87	99.88	9.38	8.58	8.98
C. D. at 5%	3.57	4.00	3.81	0.97	0.75	0.78	1.54	2.41	1.97	NS	NS	NS
Levels of Potassium (kg/ha)												
K_0 0	116.67	91.10	103.88	12.50	11.72	12.11	96.31	85.71	91.01	8.96	7.98	5.47
K_1 50	118.95	94.24	106.80	12.93	11.96	12.45	97.77	87.74	92.77	9.18	8.44	8.81
C. D. at 5%	NS	NS	NS	NS	NS	NS	1.25	1.97	1.61	NS	NS	NS
Levels of Sulphur (kg/ha)												
S_0 0	115.43	89.28	102.35	12.41	11.61	12.01	96.52	86.07	91.30	8.00	7.43	7.71
S_1 40	120.19	96.05	108.12	13.03	12.06	12.55	97.56	87.39	92.47	10.14	8.99	9.57
C. D. at 5%	2.92	3.27	3.11	NS	NS	NS	NS	NS	NS	0.80	0.60	0.70

TABLE 3

Effect of F x NP interaction on yield (q/ha) and uptake of nutrients (kg/ha).

NP (kg/ha)		*1992-93*			*1993-94*			*Pooled*		
FYM (t/ha)		NP_1	NP_2	NP_3	NP_1	NP_2	NP_3	NP_1	NP_2	NP_3
Grain yield	F_0	26.64	42.53	50.36	23.19	38.03	47.87	24.92	40.28	49.11
	F_1	37.46	46.24	56.76	33.56	44.22	57.17	35.51	45.23	53.96
C. D. at 5%			3.68			2.97			3.33	
Straw yield	F_0	36.83	57.65	65.80	32.08	52.35	61.73	34.48	54.97	63.72
	F_1	50.43	61.81	72.93	46.25	58.67	64.01	48.91	60.49	68.45
C. D. at 5%			3.72			2.65			3.18	
N uptake	F_0	80.35	112.70	152.47	54.73	83.03	120.21	67.54	97.86	136.34
	F_1	81.09	117.84	162.41	59.95	97.31	140.79	70.52	107.56	151.61
C. D. at 5%			5.05			5.66			5.39	
P uptake	F_0	8.83	12.03	15.85	7.43	11.31	14.63	8.13	11.67	15.24
	F_1	8.77	13.08	17.83	8.09	17.41	17.41	8.43	12.59	17.62
C. D. at 5%			1.17			1.06			1.10	

Effect of potassium

Data presented in Table 1 and 2 clearly indicated that application of potassium (50 kg/ha) has no positive effect on grain yield, straw yield, protein content in grain and total uptake of N, P and S during both the years and in pooled results. However, the total uptake of potassium was significantly increased by the application of potassium. The non response of K on most of the parameters was due to higher K status in soil before sowing of the crop.

Effect of sulphur

A perusal of data (Table 1) revealed that in comparison to control (no sulphur), application of 40 kg S/ha significantly increased yield of grain and straw as well as protein content in grain during both the years. The per cent increase due to sulphur application in grain yield, straw yield and protein content in grain were 8.80, 6.26 and 8.62 over their respective control in pooled results. This might be due to the increased supply of sulphur to plant which in turn resulted into profused vegetative growth and ultimately more nutrient uptake. These results confirm the findings of Ishwari *et al.* (1987). Potassium and phosphorus uptake did not differ due to sulphur application. The results might be due to antagonistic effect between sulphur and phosphorus (Tondon, 1989).

Interaction effect

The interaction effect between FYM and NP fertilization was found significant in case of grain and straw yields and uptake of N and P during both the years as well as in pooled results.

It could be seen from the results (Table 3) that fertilizing the crop with NP from 60:30 to 120:60 kg/ha appeared to be advantageous in promoting grain and straw yields of wheat under both the levels of FYM. Whereas, it was more pronounced with application of FYM as compared to control. The maximum grain (53.96 q/ha) and straw (68.45 q/ha) yields of wheat was recorded with the treatment combination of F_1NP_3 in pooled results. Yaduvanshi *et al.* (1981) also reported similar increase in yield with FYM and NP fertilization.

The data presented in Table 3 further indicated that at lower level of NP, the response of FYM application was not observed in nutrient uptake. However, at higher level of NP the effect of FYM was more pronounced on uptake of N and P. The maximum uptake of N (151.61 kg/ha) and phosphorus (17.62 kg/ha) was recorded under the treatment combination F_1NP_3 in pooled results which were significantly higher by 9.87 and 7.42 per cent over respective lower levels (F_0NP_1).

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