

Response of Wheat to N, P, K and Zn Application on Farmers' Fields in Kutch District of Gujarat

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ABSTRACT

The experiments were conducted on cultivators' fields to study the response of nitrogen, phosphorus, potash and zinc on the grain yield of wheat in Kutch district during 1977-78 to 1979-80 in *rabi* season. From the results of three years it was revealed that the grain yield increased significantly with increasing rate of nitrogen from N_{40} to N_{120} kg/ha and that of phosphorus from 20 to 60 kg P_2O_5 /ha. However, the response of potassium was significant, while no significant response was observed with the application of zinc sulphate. The highest grain yield (36.61 q/ha of J-18 and 39.26 q/ha of J. 24) was obtained with the application of $N_{120} P_{60} K_{60}$ during 1977-78.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops grown in the world. The responses of applied fertilizers to wheat differ from field to field depending on their native fertility status. It was, therefore, important to study the response of major plant nutrients as well as that of Zn under varied farm conditions in order to formulate fertilizer recommendations for their judicious use by the farmers. With this end in view, the experiments on cultivators' fields were conducted in Kutch district (Gujarat) to study the response of wheat to the application of N, P, K and Zn.

MATERIALS AND METHODS

This investigation was conducted on Wheat (*Triticum aestivum* L.) variety 'J-18' and 'J-24' in different zones on randomly selected blocks, villages, cultivators and fields in Kutch district of the

Gujarat State for three years from 1977-78 through 1979-80 in *rabi* season under the All India Co-ordinated Agronomic Research Project (I.C.A.R.). The whole Kutch district was stratified into four agriculturally homogeneous zones by suitably combining contiguous talukas, taking into consideration homogeneity in respect of climate, soil, cropping pattern, rainfall, irrigation facilities etc. The soil samples were collected prior to conducting the experiments from 0-15 cm depths from randomly selected fields and analysed for nutrient status. Texturally the soils were sandy. The initial soil pH ranged from 7.3 to 9.0. The status of organic carbon was low to medium. The soils were low to medium in nitrogen, low to medium in phosphorus and low to very high in potash content. The number of experiments conducted during each year and the initial soil fertility status is shown in Table 1. The details of treatment in three years were :

Year	Zone	No. of villages i.e. experiments	Range of available nutrients in the soil, kg/ha		
			N	P ₂ O ₅	K ₂ O
1977-78	I	10	126-308 (197) *	13-47 (27.6)	100-1000 (496)
1978-79	I	5	112-168 (136)	21-46 (30)	230-460 (352)
	II	5	77-154 (120)	30-107 (62)	80-410 (277)
	III	5	91-189 (147)	15-53 (26)	210-600 (335)
	IV	5	35-168 (101)	10-43 (22)	120-270 (199)
1979-80	I	10	118-392 (228.5)	8-35 (28.5)	200-985 (586)
	III	10	140-221 (177.8)	11-64 (21.7)	400-900 (646.5)
	IV	10	132-224 (191.8)	11-29 (20.1)	215-985 (563.0)

$$\begin{array}{lll} 1. \text{N}_0\text{P}_0\text{K}_0 & 5. \text{N}_{40}\text{P}_{20}\text{K}_0 & 9. \text{N}_{80}\text{P}_{40}\text{K}_{40} \\ 2. \text{N}_{40}\text{P}_0\text{K}_0 & 6. \text{N}_{80}\text{P}_{40}\text{K}_0 & 10. \text{N}_{120}\text{P}_{60}\text{K}_{60} \\ 3. \text{N}_{80}\text{P}_0\text{K}_0 & 7. \text{N}_{120}\text{P}_{60}\text{K}_0 & 11. \text{N}_{120}\text{P}_{60}\text{K}_{40} \\ 4. \text{N}_{120}\text{P}_0\text{K}_0 & 8. \text{N}_{40}\text{P}_{20}\text{K}_{20} & 12. \text{N}_{120}\text{P}_{60}\text{K}_{60} \\ & & \text{Zn}_{25} \end{array}$$

RESULTS AND DISCUSSION

Response of Nitrogen

The response of nitrogen was significant in all the years. There was significant increase in yield of wheat variety 'J-18' with increase in level of nitrogen from 40 to 120 kg/ha. However, the differences between N_0 and N_{40} were not significant. The variety 'J-24' yielded significantly higher at 40 kg N/ha than

no nitrogen. There was no significant difference between N_{40} and N_{80} during 1977-78 for variety 'J-24'. In the presence of N_{40} , N_{80} and N_{120} , the variety 'J-24' yielded 3.46, 5.66 and 8.92 q/ha, respectively, higher than the control. It was found that the variety 'J-24' yielded higher than 'J-18' at the same level of N_{40} . Considering three years average of zones, in Zone-I N_{120} produced an additional grain yield of 6.22 q/ha over the control. However, in Zone-II, the response was very low (1.77 q/ha at N_{120}). Considering the district mean over three years period, the response was 0.81, 3.09 and 5.24 q/ha with the application of N_{40} , N_{80} and N_{120} , respectively. The net incremental cost benefit ratio for N_{120} was 1:1. Increased wheat yield with increasing levels of nitrogen has been also reported by Singh *et al.* (1971) and Borse and Mahajan (1980).

Response of phosphorus over nitrogen

The response of phosphorus was not significant during 1977-78. In 1978-79, the responses to only P_{20} over N_{40} in Zone-I and to P_{20} over N_{40} and P_{40} over N_{80} in Zone-II were significant. In

TABLE 2

Response (q/ha) of wheat grain to different combination levels of N, P, K and Zn.

Varieties	Zone	Nos. of trials	Mean yield of control plot, q/ha	Response to nitrogen at		Response to P ₂ O ₅ over N		Response to K ₂ O over N and P		Mean yield at N ₁₂₀ P ₆₀ K ₄₀		Mean yield at N ₁₂₀ P ₆₀ K ₄₀		Response to Zn SO ₄ 25 kg/ha over N ₁₂₀ P ₆₀ K ₄₀		C.D. at 5%
				N ₄₀	N ₈₀	P ₂₀ over N ₄₀	P ₄₀ over N ₈₀	K ₂₀ over N ₄₀ P ₂₀	K ₄₀ over N ₈₀ P ₄₀	N ₄₀ P ₂₀ K ₄₀	N ₈₀ P ₄₀ K ₄₀	N ₄₀ P ₂₀ K ₄₀	N ₈₀ P ₄₀ K ₄₀	N ₁₂₀ P ₆₀ K ₄₀	N ₁₂₀ P ₆₀ K ₄₀	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1977-78																
J-18	I	9	21.47	1.28	6.27	8.72	1.49	0.62	2.59	2.90	0.70	3.83	36.61	34.68	-1.02	3.22
J-24	I	9	23.66	3.46	5.66	8.92	-0.44	1.61	2.64	3.41	2.59	4.04	39.26	38.75	-1.16	2.76
1978-79																
J-18	I	5	20.28	0.92	4.40	6.48	2.96	2.00	0.16	3.32	2.92	3.44	30.36	30.20	0.72	2.61
	II	5	15.06	0.24	1.02	1.77	1.76	2.15	1.01	1.94	1.12	2.69	20.52	20.60	-0.04	1.11
	III	5	16.48	0.76	3.92	5.64	1.96	1.88	0.12	3.64	2.48	3.04	25.28	25.48	0.80	2.61
	IV	5	31.78	-1.94	1.12	8.00	2.60	3.68	-1.56	2.98	-1.38	0.56	38.78	36.08	-3.62	3.93
1979-80																
J-18	I	10	20.49	0.06	1.34	1.42	2.48	2.00	2.86	-0.40	0.32	1.00	25.77	25.37	0.06	1.81
	III	8	15.79	0.52	2.29	4.35	0.58	1.08	0.49	1.16	0.60	1.90	22.52	21.82	0.48	1.43
	IV	10	19.43	0.62	1.30	2.86	1.46	1.36	0.16	0.60	1.64	3.70	26.15	25.83	0.54	2.05
Mean																
	I	33	21.59	1.44	4.33	6.22	1.48	1.52	2.32	2.10	1.44	2.97	33.10	33.29	-0.47	
	II	5	15.06	0.24	1.02	1.77	1.76	2.15	1.01	1.94	1.12	2.69	20.52	20.60	-0.04	
	III	13	16.05	0.61	2.92	4.84	1.11	1.38	0.35	2.11	1.32	2.34	23.58	23.23	0.60	
	IV	15	23.55	-0.23	1.24	4.57	1.84	2.13	-0.41	1.39	0.64	2.65	30.36	29.25	-0.85	
District mean of trials		66	20.45	0.81	3.09	5.24	1.53	1.68	1.21	1.93	1.20	2.75	29.65	28.93	-0.31	
NICBR for District mean				1:-0.05	1:0.78	1:1.01	1:2.43	1:0.70	1:-0.09	1:10.0	1:2.43	1:4.20	1:1.04	1:0.98		

1979-80, the responses were significant and identical for all the levels of $P_2 O_5$ in Zone-I. Looking to the arithmetic mean of the district over all the years. There was an increasing trend of response of phosphorus upto P_{40} over N_{80} . Application of only P_{20} over N_{40} with a net incremental cost benefit ratio of 1:2.43 was advantageous. These results correspond to the finding of Malik *et al.* (1972).

Response of potassium over N and P

In 1977-78, the response to K application was significant for 'J-18' variety only at K_{60} over $N_{120}P_{60}$. However, in the case of variety 'J-24' it was significant at K_{20} over $N_{40}P_{20}$ as well as at K_{60} over $N_{120}P_{60}$. In 1978-79, it was significant and identical at all the levels of K in Zone-I. In Zone-II, the response was significant which was higher at K_{60} over $N_{120}P_{60}$ than K_{40} over $N_{80}P_{40}$ but at par with K_{20} over $N_{40}P_{20}$. In Zone-III, the response was significant and identical at K_{60} and K_{20} over respective NP levels. The response was

not significant for Zone-IV. In 1979-80 the response of K_{60} over $N_{120}P_{60}$ only was significant in Zone-III and IV. Looking to the arithmetic mean responses of the zones and the district mean, it was observed that the response was the highest at K_{60} over $N_{120}P_{60}$ (with net incremental cost benefit ratio of 1:4.2) followed by K_{20} over $N_{40}P_{20}$ and K_{40} over $N_{80}P_{40}$.

Response of Zinc

On the whole, the response of zinc was not significant during investigation periods as more number of trials were laid out on the soils having medium or high status of Zn (Table 3). However, when the results were tabulated on the basis of zinc status of different soil groups, the soils having low status of Zn showed 7 per cent increase in response which was 210 kg/ha. However, in 1978-79 there was 6.3 per cent increase in yield by application of $ZnSO_4$ @ 25 kg/ha over $N_{120}P_{60}K_{60}$ with a response of 192 kg/ha. The mean Bray's per cent yield was 100 and 105 during 1977-78

TABLE 3

Response to Zn application of wheat (mean of experiments in each group) low, medium and high.

Year	Sr. No.	No. of villages i.e. expts.	Average yield kg/ha			Per cent response yield	Bray's per cent yield	Zn content (ppm)			Zn uptake kg/ha		
			N ₀ P ₀ K ₀	N ₁₂₀ P ₆₀ K ₆₀	N ₁₂₀ P ₆₀ K ₆₀ Zn ₂₅			N ₀ P ₀ K ₀	N ₁₂₀ P ₆₀ K ₆₀	N ₁₂₀ P ₆₀ K ₆₀ Zn ₂₅	N ₀ P ₀ K ₀	N ₁₂₀ P ₆₀ K ₆₀	N ₁₂₀ P ₆₀ K ₆₀ Zn ₂₅
1977-78	1	Low-2	1570	3440	3650	7	95	23	27	29	36	91	104
	2	Medium-3	2140	3180	3207	1	100	29	30	33	63	97	106
	3	High-13	2393	3991	3802	—	105	30	29	33	72	117	127
1978-79	1	Low-8	1930	2928	3120	6.3	94	25	26	31	48	77	96
	2	Medium-6	1427	2083	2017	—	104	25	26	28	37	55	56
	3	High-6	2678	3628	3203	—	112	31	26	30	82	94	96

and 104 and 112 during 1978-79 in medium and high groups, respectively, suggesting negative response to Zn application. In general, the grain yield response was marked in low group of soils. These results corroborate the finding of Agrawala *et al.* (1980).

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