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Yield Stability and Soil Fertility in Sorghum-Wheat Sequence over Years

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ABSTRACT

An experiment conducted on sorghum-wheat sequence for six years showed the stable yield levels for both the crops and the soil fertility was maintained. The economical dose for sorghum and wheat was found to be $N_{80}P_{40}K_0$ and $N_{80}P_{40}K_{40}$ respectively, implying the possibility of reduction in recommended dose in both the crops.

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INTRODUCTION

Large quantities of fertilizers are continuously needed for sustaining higher yields in a crop sequence. Rational use of costly chemical fertilizers is strictly envisaged to fetch maximum crop yields from sequential cropping system without losing soil fertility.

Present investigation was attempted in order to pinpoint an optimum NPK dose for a given crop sequence viz., sorghum-wheat on Vertisol.

MATERIALS AND METHODS

A long term field experiment on sorghum-wheat crop sequence on Vertisol under A.I.C Agronomic Research Project, at Punjabrao Krishi Vidyapeeth, Akola (M.S.) was in progress. The data for a period of six years (1984-85 to 1989-90) is utilized in this paper. The experiment was laid out with 18 combinations consisting of three levels of N (40, 80 and 120 kg ha^{-1}), three levels of P (0, 40 and 80 kg P_2O_5 ha^{-1}) and two levels of K (0 and 40 kg K_2O ha^{-1}) fitted in $3^2 \times 2$ factorial partially confounded design with three blocks in a replication having an absolute control in each block. There were four replications. Selected treatments were picked up for drawing out broad conclusions.

The data for grain yields and fertility status of the soil (organic carbon content, available N, P, K) were recorded.

RESULTS AND DISCUSSION

Grain yield

The data pertaining to grain yield (Table 1) revealed that the mean cumulative yield (1984-85 to 1989-90) of sorghum was lower than the initial year where it was higher in wheat.

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TABLE 1

Mean cumulative yield (q ha^{-1}) and linear regression coefficients in sorghum-wheat crop sequence.

Treatment	*Initial yield level (84-85)*	*Mean cumulative yield (89-90)*	*Linear regression coefficient*	*Initial yield level (84-85)*	*Mean cumulative yield (89-90)*	*Linear regression coefficient*
0-0-0	5.09	4.90	0.0723	2.23	3.70	0.1909
80-0-0	23.23	16.29	-0.6117	03.91	8.06	0.3889
80-40-0	30.23	24.74	0.2566	14.83	15.33	0.1611
80-40-40	33.20	24.13	-0.5377	17.17	17.65	0.8340
120-0-0	15.90	13.68	0.2703	4.67	7.01	0.2324
120-80-0	34.71	27.92	0.0206	15.66	17.52	0.9411
120-80-40	37.49	30.45	-0.3117	18.81	19.17	0.8540
C. D. at 5%	8.77	5.59	0.81	3.57	2.79	0.36

The crop sequence, sorghum-wheat involves both cereal crop which are heavy feeders of nutrients. Further, there was continuous addition of only chemical fertilizers. Hence, the deterioration in subsequent yields might have been caused as organic matter was not applied during the course of investigation. There were seasonal fluctuations in yields.

Soni *et al.* (1988) observed very little scope of reducing or skipping any amount of nitrogen, phosphorus and potassium either for rice crop or to the wheat crop. Anonymous (1985) also reported decline in yield in sorghum-wheat sequence in three locations. They observed small improvement or stable yields in four locations in similar type of experimentation mentioned in this paper.

The data, further, revealed that 80 kg N ha^{-1} (80-0-0) was more productive than 120 kg N ha^{-1} (120-0-0) for the sequence. Application of NPK was favourable than NP application. Higher doses of NPK had resulted in producing comparatively higher yield in both the crops of the sequence.

Anonymous (1985) also reported that an optimum dose of NPK for all the seven locations was found to be lower than the recommended dose (120:80:40) for each crop in sorghum-wheat sequence.

Monetary returns for the sequence represented in Table 2 revealed that highest returns were received with $N_{120}P_{80}K_{40}$ combination in both the crops. However, highest cost benefit ratios (4.24 and 4.62) were observed with $N_{80}P_{40}K_0$ and $N_{80}P_{40}K_{40}$ combinations in sorghum and wheat respectively.

Cumulative effects

The data represented in Table 1, revealed that the cumulative effects of different treatment combinations were significant for sorghum-wheat sequence.

TABLE 2

Economics of sorghum-wheat crop sequence.

Treatments N- P_2O_5 - K_2O	*Mean cumulative yield*	*Response (q ha^{-1})*	*Value of produce (additional)*	*Cost of fertilizer*	*Net profit (Rs. ha^{-1})*	*C. B. ratio*	*Mean cumulative yield*	*Response (q ha^{-1})*	*Value of produce (additional)*	*Cost of fertilizer*	*Net profit (Rs. ha^{-1})*	*C. B. ratio*
			Sorghum						**Wheat**			
0-0-0	4.90	–	–	–	–	–	3.70	–	–	–	–	–
80-0-0	16.29	11.39	18.11	386	1425	3.69	8.06	4.36	1199	386	813	2.11
80-40-0	24.74	19.84	3155	602	2553	4.24	15.33	11.63	3198	602	2596	4.31
80-40-40	24.13	19.23	3058	683	2375	3.48	17.65	13.95	3836	683	3153	4.62
120-0-0	13.68	8.78	1396	578	818	1.42	7.01	3.31	910	578	332	0.57
120-80-0	27.92	23.02	3660	1010	2650	2.62	17.52	13.82	3801	1010	2791	2.76
120-80-40	30.45	25.55	4062	1091	2791	2.72	19.17	15.47	4254	1091	3163	2.90

Nutrient prices (Rs. kg^{-1})

N = 4.82

P = 5.40

K = 2.03

Crop prices (Rs. kg^{-1})

Sorghum - 1.59

Wheat - 2.75

TABLE 3

Average nutrient/response for six years (1984-85 to 1989-90).

Crops	Yield increase (q ha^{-1}) due to					Response grain (kg^{-1}) nutrient application				
	N		P		K	N		P_2O_5		K
	80	120	40	80	40	80	120	40	80	40
Sorghum	11.39	9.08	3.45	13.94	2.53	14	8	21	17	6
Wheat	4.36	3.31	7.27	10.51	1.65	5	3	18	13	4

Though the combinations $N_{120}P_{80}K_{40}$ resulted in highest grain yield in both the crops, the combination $N_{120}P_{80}K_0$ was comparatively economical as it saved 40 kg K_2O but still remained at par with $N_{120}P_{80}K_{40}$ in yield performance.

While considering the nutrient response over years, it was clear from the data in Table 3 that both the cereal crops gave more response to lower levels of N and P. Both the crops responded to potash application. It was prominently seen that sorghum was more responsive to fertilizers than wheat.

Evaluation for changes in yield

For evaluation of decline or increase in grain yield in sequence over years, linear regression coefficients were calculated. Highest positive and negative linear regression coefficients were recorded at $N_{120}P_0K_0$ and $N_{80}P_0K_0$ treatments respectively for sorghum. Negative coefficients were also observed in $N_{80}P_{40}K_{40}$ and $N_{120}P_{80}K_{40}$ combinations in sorghum. This variation might be due to favourable season for sorghum in 1989-90, where general yield levels were comparatively higher.

The values of linear regression coefficients were positive for wheat crop. The data revealed that the highest value (0.9411) was obtained for $N_{120}P_{80}K_0$ combination which was followed by $N_{120}P_{80}K_{40}$.

Fertility status of the soil

The fertility status of the soil before sowing of sorghum in 1984-85 and after harvest

TABLE 4

Changes in soil fertility.

Treatments N-P_2O_5-K_2O (kg ha^{-1})	*Available** O. C. (%)	*Available** N (kg ha^{-1})	*Available** (P_2O_5 (kg ha^{-1})	*Available** K_2O (kg ha^{-1})
0-0-0	0.35	310	36	316
80-0-0	0.49	351	38	349
80-40-0	0.47	339	37	327
80-40-0	0.49	367	38	330
120-0-0	0.47	307	31	313
120-80-0	0.44	358	41	360
120-80-40	0.45	314	39	349

* After harvest of rabi 1989-90.

Initial fertility status : Organic carbon 0.46%.
Available N P_2O_5 and K_2O (kg ha^{-1})
(125, 15 and 355 respectively)

of wheat in 1989-90 is shown in Table 4. Organic carbon content in the soil was slightly raised in most of the treatments. However, appreciable changes were not observed as organic matter was not incorporated through out the span of investigation. Available N content was found to increase with continuous addition of N to both the crops. There was also increase in control plots which indicated the release of N from parent materials.

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