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Short Note

Response of maize - wheat cropping system to NPK in low hills of Himachal Pradesh

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Abstract

An on-farm experiment was conducted in sub-tropical low hills zone of Himachal Pradesh to study the response of major plant nutrients in maize-wheat cropping sequence. Five treatments *viz*. control, N, NP, NK and NPK at recommended rates to the component crops were evaluated at seventeen locations for the two consecutive cropping seasons of 2007-08 and 2008-09. Results of the study revealed that application of recommended dose of NPK resulted in significantly higher grain yield of maize and wheat, maize equivalent yield, gross return and net return over rest of the treatments. Recommended NPK resulted in 85% and 53% higher maize grain equivalent yield and INR 30150 and INR 24626 more net return over control and recommended N, respectively. The response in terms of kg grain per kg of nutrient applied was higher for applied phosphorus (20.85 kg maize grain euivalent) followed by potash (19.19) and nitrogen (5.69).

Key words: Maize-Wheat, Cropping Sequence, Nutrients.

In Himachal Pradesh 84% of the cropped area is rain fed. In this area, maize-wheat is the most important cropping sequence. In the sub-montane and low hills zone-1, this sequence occupies an area of 111780 ha as against 21600 ha under rice-wheat and 3740 ha by oilseed-pulses cropping systems. The productivity of the maize-wheat sequence is low which needs to be increased. The 57% of the farmers in the zone are marginal (< 1.0 ha) and 19% are small (1-2 ha) land holders. They follow traditional and subsistence farming and have low risk bearing capacity. The major constraint identified is the low use of fertilizers. In general, levels of nutrients applied are quite inadequate as is evident that in Himachal Pradesh, N, P_2O_5, K_2O use was 32.6, 9.2, 7.6 kg/ha, respectively (Anonymous 2004). Keeping in view these facts, under All India Coordinated Research Project on Cropping Systems the present study was conducted to determine the response of maize-wheat cropping system to NPK.

An on-farm investigation under All India Coordinated Research Project on Cropping Systems was carried out for 2 years (2007-2009) within NARP Zone-1 of Himachal Pradesh. In all 5 treatments (Table 2) were tested at 34 locations in Una, Hamirpur and Kangra districts during the two consecutive years. Each year the trials were conducted at 6 locations in Una at Kalruhi and Nandpur villages, 3 locations in Kangra at village Khabli (Tehsil Dehra), and 8 locations in Hamirpur at Rangas and Kohla villages.

Sowing and harvesting of the crops were done in the first to second fortnight of June and second fortnight of September for maize and first fortnight of November and second fortnight of April, respectively, for wheat each year. Recommended dose of N, P_2O_5, K_2O for maize was 90, 45, 30 and that for wheat was 80, 40, 40 kg/ha, respectively. Recommended package of practices were followed for rest of the management practices for individual crops in the cropping sequence.

The composite soil samples (0-15 cm) from each location were analyzed to determine the initial soil status in respect of soil pH (1:2.5) (Jackson,1967), available N (Subbiah and Asija,1956), P (Watanable and Olsen 1965), K (Merwin and Peech 1951) and organic C (Walkley and

Black, 1934) content.

The average annual precipitation recorded was 795 mm during 2007-08 and 1479 mm during 2008-09, respectively, whereas mean maximum and minimum temperature of the test sites varied from 28.9 to 29.1 ^{o}C and 16.2 to 16.9 ^{o}C, respectively, throughout the period of study.

Response of a component crop of the cropping sequence to the applied N was calculated by subtracting the yield under control from that under N treated plot, whereas response to applied P and K was calculated by subtracting, respectively, the yield of NK and NP treated plots from that of NPK treated plots. Same way cropping system response to a particular nutrient in terms of kg maize grain per kg nutrient applied was worked out by dividing the differences in maize equivalent yields from the respective treatments by the total amount of nutrient applied during *kharif* and *rabi.*

The soils were inceptisols having soil texture loamy sand to silty clay loam with pH 6.3 to 7.5, low to medium in respect of available nitrogen, and medium to high in respect of available phosphorus and potash content (Table 1).

A perusal of results on grain yield (Table 2) shows that application of N or its combination with P or K or both significantly increased the grain yield compared to that under control plots both in maize as well wheat during both the years of experimentation. The higher yields following the recommended application of NPK to the individual crops tended to increase the maize equivalent yield significantly over rest of the treatments. The recommended fertility level increased maize equivalent yield by about 88 and 83% over control and by about 53 and 54% over N only during 2007-08 and 2008-09, respectively. The increase in yield might be due to favorable influence on soil fertility and micro climatic conditions. These findings are in conformity with those obtained by Chaudhary *et al*. (2000 a&b); Sharma *et al*. (2007).

Table 1. Soil fertility status before the sowing of *kharif* crops

Village	pH	OC (%)	Available Nutrients (kg/ha)		
			N	P	K
Nandpur	7.5	0.57	238.9	26.1	145.6
Kalruhi	7.3	0.43	128.0	17.7	138.1
Khabli	6.7	0.91	243.2	53.0	283.7
Rangas	6.7	0.59	156.8	16.0	218.4
Kohla	6.3	0.63	188.8	23.0	262.6

Table 2. Treatment effects on yield (kg ha^{-1}) of maize-wheat cropping system

Treatment	2007-08			2008-09		
	Maize grain	Wheat grain	Maize equivalent	Maize grain	Wheat grain	Maize equivalent
Control	1841	1800	4611	1972	1828	4784
Recommended N for the component crop	2211	2233	5646	2281	2212	5685
Recommended NP for the component crop	2996	2871	7413	3030	2827	73769
Recommended NK for the component crop	2836	2620	6867	2892	2632	6941
Recommended NPK for the component crop	3550	3329	8672	3731	3273	8766
LSD (P=0.05)	168	117	675	137	128	497

Recommended dose (kg/ha), Maize-90:45:30 and Wheat-80:40:40

The highest maize and wheat yield following recommended dose of nutrients (NPK) fetched highest mean gross (INR76884) and net return (INR 47602) over rest of the treatments. On an average, the recommended NPK increased the gross and net return by INR 35674 and INR 30150 per ha over control and INR 27165 and INR 24626 per ha over N alone, respectively (Table 3). Similarly highest B:C was obtained from the plots applied recommended NPK. In fact, net returns and B: C followed the trend as was observed for maize equivalent yield. When NP and NK were compared, it was found that application of NP proved better than NK which revealed greater response to phosphorus application.

In general highest response was obtained to applied phosphorus followed by applied potash and nitrogen in both the crops during both the years of study. Similarly cropping system response (kg maize grain/kg nutrient applied) of maize-wheat crop sequence was also highest to applied P followed by K and N (Table 4). On an average, the response of maize–wheat cropping system in terms of maize grain equivalent yield/kg nutrient was: 5.69 kg grain/kg N applied, 20.85 kg grain/kg P applied and 19.19 kg grain/kg K applied. This was in line with our earlier findings (Sharma *et al*. 2007). The lowest response to applied N may be due to the fact that it is subjected to more losses as compared to P and K.

Table 3. Treatment effects on economics of maize-wheat cropping system

Treatment	Returns (INR/ha)						B:C Ratio		
	Gross			Net					
	2007-08	2008-09	Mean	2007-08	2008-09	Mean	2007-08	2008-09	Mean
Control	40259	42162	41210	16501	18404	17452	0.69	0.77	0.73
Recommended N for the component crop	49307	50131	49719	22564	23388	22976	0.84	0.87	0.85
Recommended NP for the component crop	64236	65298	63267	35474	36536	36005	1.23	1.27	1.25
Recommended NK for the component crop	60125	61488	60806	33042	34405	33723	1.22	1.27	1.25
Recommended NPK for the component crop	75987	77781	76884	46705	48499	47602	1.59	1.66	1.63
LSD(P=0.05)	2370	2598	-	2370	2598	-	0.08	0.09	-

Table 4. Response of maize-wheat cropping system to applied nutrients

Crop	Response (kg grain/kg nutrient applied)								
	N			P_2O_5			K_2O		
	2007-08	2008-09	Mean	2007-08	2008-09	Mean	2007-08	2008-09	Mean
Maize	4.11	3.43	3.77	16.66	17.64	17.15	19.64	21.87	20.75
Wheat	5.41	4.80	5.11	16.83	15.69	16.26	10.56	15.69	13.12
Maize Equivalent	6.09	5.29	5.69	21.00	20.69	20.85	17.70	20.69	19.19.

The findings of the present investigation envisaged the positive impact of combined application of all the three basic (NPK) nutrients at recommended rates to the component crops in increasing their yield and thus the total productivity of rain fed maize-wheat cropping sequence in sub-montane and low hills sub-tropical zone of the State.

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