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Crop response to plant nutrients in predominant cropping system of Mehsana district of Gujarat

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ABSTRACT

A field experiment was conducted at 24 farmers field in Mehsana district of North Gujarat Agro climatic zone of Gujarat among them 12 farmers falls under high productive block of Visnagar Taluka (Laxmipura, Savala- Ravlapura and Ganeshpura villages) and 12 farmers falls under low productive block of Kadi Taluka (Nandasan, Borisana and Ambaliyara villages) under On Farm Research Programme, SDAU, Jagudan with seven fertility levels were tried (T_1: Control, T_2: Only recommended dose of Nitrogen, T_3: recommended dose of Nitrogen and Phosphorus, T_4: recommended dose of Nitrogen and Potash, T_5: Recommended dose of Nitrogen, Phosphorus and Potash, T_6: Recommended dose of Nitrogen, Phosphorus and Potassium along with micronutrients (15 kg $MgSO_4$ in cotton and 25 kg Zn $SO_{4.7}H_2O$ in wheat) and T_7: Farmers Practices (*i.e* 132 +46 +00 in cotton and 112 +48 + 0, N:P:K in wheat crop), were evaluated in randomized block design with the consideration of farmers as a replications. The treatment T_6: Recommended dose of Nitrogen, Phosphorus and Potassium along with micronutrients (15 kg $MgSO_4$ in cotton and 25 kg ZnSo4 Zn SO_4 in wheat) recorded the significantly highest wheat equivalent yield during individual year and in pooled results also. The highest system productivity was recorded under the treatmentT_6 which was followed by T_5. The maximum Nutrient use efficiency was recorded when only recommended dose of nitrogen and potassium was applied to both the crops of sequences (T_4) Significantly highest net and gross profit of a sequence per ha was registered under T_6 followed by T5. Similarly m system profitability was also recorded maximum under the treatment T_6.

Key words: Fertilizer dose, nutrient use efficiency, system productivity, system profitability, and wheat equivalent yield

Normally, insufficiency of one plant nutrient limits the efficiency with which other plant nutrients are taken up, reducing crop yield. Unbalanced availability of nutrients can lead to mining of soil reserves for nutrients in short supply and to losses of plant nutrients supplied in excess. Lack of balance also encourages excessive uptake of the nutrients supplied in excess, decreasing the productivity of those nutrients. Unbalanced fertilization is an uneconomic waste of scarce resources. Nitrogen is the most important fertilizer element playing vital role in yield improvement of wheat and cotton and the element is frequently reported as deficient in agricultural soils (Islam, 1990). Abedi *et al.,* (2010) investigated wheat response to different levels of nitrogen fertilizer and stated that the highest wheat grain yield was achieved when the plants were fertilized with 160 kg N ha^{-1}. Recommended optimum dose of nitrogen and further increase in application resulted in

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increase of seed cotton yield (Varshney, 1979). Phosphorus is second only to nitrogen in importance as an essential crop nutrient. More than 80 % of soil P is unavailable for plant use (Batten, 1992). It is critical for plant growth, especially in the early jointing stages and for enhancing grain yield and yield components (Römer and Schilling, 1986).

In North Gujarat, the cotton-wheat rotation is the dominant cropping system. The productivity of cotton and wheat in North Gujarat has increased due to adoption of high yielding semi-dwarf varieties and application of greater doses of chemical fertilizers. Fertilizer application levels in many areas are now at or above recommended levels. There are reports of declining factor productivity*, i.e.,* a need for increasing recommended dose of fertilizers rates to maintain current yield levels. Therefore to find out the on-farm crop response to plant nutrients in predominant cotton – wheat cropping systems of Mehsana district and to understand the factors that may be affecting productivity as related to the RDF use on farmer's fields, we analyzed the four years data of fertilizer application experiment.

MATERIALS AND METHODS

A field experiment was conducted at 24 farmer's field in Mehsana district. Among them 12 farmer's falls under high productive block of Visnagar Taluka (Laxmipura, Savala- Ravlapura and Ganeshpura villages) and 12 farmers falls under low productive block of Kadi Taluka (Nandasan, Borisana and Ambaliyara villages) during kharif and rabi season of 2013-14 to 2016-17 under On Farm Research Programme, SDAU, Jagudan. The site has a semi-arid sub-tropical climate with severe hot summers and fairly cool winters. The annual average rainfall is 580 mm. The soil of the experimental site is sandy loam in texture. Seven fertility levels were tried (T_1: Control, T_2: Only recommended dose of Nitrogen, T_3: recommended dose of Nitrogen and Phosphorus, T_4: recommended dose of Nitrogen and Potassium, T_5: Recommended dose of Nitrogen, Phosphorus and Potassium, T_6: Recommended dose of Nitrogen, Phosphorus and Potassium along with micronutrients (15 kg $MgSO_4$ in cotton and 25 kg $ZnSO_4$ in wheat) and T_7: Farmers Practices (*i.e* 132 +46 +00 in cotton and 112 +48 + 0, N:P:K in wheat crop), were evaluated in randomized block design with the consideration of farmers as a replications (location). Urea, Di-ammonium phosphate and muriate of potash were use as source of fertilizers and fertilizers was applied based on RDF of both crops. (180 kg N/ha and 120-60-00 NPK kg/ha, respectively). Each year, cotton was sown in may- June with the 90 cm row spacing. After harvest of cotton, wheat was sown in November using 120 kg/ha seed rate with rows spacing of 22.5 cm. The varieties used for sowing was Bollgaurd – II and GW 496 of respective crop. The gross and net plot size were 135sq.mt and 105.3 sq.mt., respectively.

The system productivity of the cropping systems was computed by converting the yield of two crops into the wheat equivalent yield, based on the prevailing market price and dividing by the number of days per year that crops occupied the land in a particular system. As per treatments basal and top dressing of fertilizers were applied to both the crops. All the recommended practices were adopted as per nee of crops.

RESULTS AND DISCUSSION

System productivity

It is evident from the data presented in the table 1 and 2 that there was significant variation in equivalent yield among the cropping system due different treatments of applied fertilizers dose during all four years of the experiment and in

pooled results. The significantly highest wheat equivalent yield was recorded under the treatment T_6 during individual years as well as in pooled results (12900, 8022, 8986, 6979 and 9436 kg/ha, respectively). While significantly lowest wheat equivalent yield was recorded with the treatment T_1 in which no fertilizers was applied. In case of system productivity (kg/ha/day), it was highest (25.9 kg/ha/day) under the cotton- wheat cropping systems in which recommended dose of fertilizer along with micronutrients was applied (T_6) as compared to the other treatments of cropping system followed by T_5 (24.2 kg/ha/day), while lowest system productivity was recorded with the absolute control (12.1 kg/ha/day). From the data presented in the tasble-3, it can be seen that the treatment T_6 which received full dose of recommended fertilizers and 15 kg $MgSO_4$ in cotton and 25 kg $ZnSO_4$ in wheat gave significantly higher individual cotton crops yield and wheat crop yield, which was at par with treatment T_5 in which only recommended dose of fertilizers was applied to both the crops of sequence. However, the maximum nutrient use efficiency (kg/kg fertilizer applied) was recorded with T_7 (22.77 kg/ha/day) in which only recommended dose of nitrogen and potassium was applied to both the crops of sequences followed by treatment T_2 (22.14 kg/kg fertilizer applied), while lowest (18.50 kg/kg fertilizer applied) with full dose of recommended dose of fertilizers along with micronutrients (T_6) applied to the both the crops.

System profitability

Significantly the highest gross and net profit of a sequence were registered under T_6 (Rs 165132 per ha and Rs 83056 per ha) followed by T_5 (Rs 154517/ha and Rs 73368/ ha). Maximum system profitability (Rs. 227.6 ha per day) and BCR (2.01) were recorded in the treatment T_6 in which 100 % RDF along with micronutrient were applied followed by treatment T_5 (Rs. 201.0 ha per day and 1.90), whereas the lowest values of system profitability was found under absolute control (Rs. 21.1 ha per day).

CONCLUSION

It was concluded that for getting higher productivity and profitability of predominant cotton- wheat crop sequence farmers of both high and low productivity block of Mehsana district can applied recommended dose of fertilizers along with 15 kg $MgSO_4$ in cotton and 25 kg ZnSO4 in wheat crop.

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Table 1 Wheat equivalent yield, gross profit and net profit as influenced by different treatments of plant nutrients in predominant cropping system of Mehsana (Gujarat) (pooled of four years)

Treatment	2013-14			2014-15			2015-16			2016-17			Pooled		
	Wheat equivalent yield (kg/ha)	Gross profit of system (Rs/ha)	Net profit of system (Rs/ha)	Wheat equi. yield (kg/ha)	Gross profit of system (Rs/ha)	Net profit of system Rs/ha)	Wheat equivalent yield (kg/ha)	Gross profit of system (Rs/ha)	Net profit of system (Rs/ha)	Wheat equi. yield (kg/ha)	Gross profit of system (Rs/ha)	Net profit of system (Rs/ha)	Wheat equi. yield (kg/ha)	Gross profit of system (Rs/ha)	Net profit of system (Rs/ha)
T_1	5729	85936	8567	4055	70955	9313	4522	79127	10465	4197	73452	2391	4421	77368	7684
T_2	9115	136719	55240	5798	101471	35734	6350	111118	37515	6607	115625	39770	6642	116233	42065
T_3	10667	159998	73894	6619	115833	45721	7559	132278	53816	7586	132757	51662	7727	135216	56273
T_4	10751	161258	77937	6642	116238	48548	7414	129752	53655	7723	135152	57486	7749	135600	59406
T_5	12099	181490	93662	7552	132167	60102	8568	149948	69322	8826	154464	70386	8830	154517	73368
T_6	12900	193501	104334	8022	140391	67376	8986	157258	75904	9679	169376	84609	9436	165132	83056
T_7	10786	161791	77799	6707	117364	48213	7642	133734	56113	7192	125865	44973	7696	134689	56774
S. Em	262	3936	3926	91	1599	1599	117	2055	1941	129	2254	2327	93	1627	1612
CD	734	11007	10979	256	4473	4473	328	5745	5428	360	6302	6508	260	4549	4508
CV %	12.5	12.5	27.4	6.9	6.9	17.4	7.9	7.9	18.6	8.5	8.5	22.7	6.1	6.1	14.6

Table 2 System productivity, system profitability, nutrient use efficiency and economics as influenced by different treatments of plant nutrients in predominant cropping system of Mehsana (Gujarat) (pooled of four years)

Treatment	Pooled							
	Wheat equi. yield (kg/ha)	Gross profit of system (Rs/ha)	Net profit of system (Rs/ha)	Mean cost of cultivation (Rs/ha)	BCR	System productivity (kg/ha/day)	System profitability (Rs/ha/day)	Nutrient use efficiency (kg/kg)
T_1	4421	77368	7684	69684	1.11	12.1	21.1	-
T_2	6642	116233	42065	74169	1.57	18.2	115.2	22.14
T_3	7727	135216	56273	78943	1.71	21.2	154.2	19.32
T_4	7749	135600	59406	76194	1.78	21.2	162.8	20.94
T_5	8830	154517	73368	81149	`1.90	24.2	201.0	18.79
T_6	9436	165132	83056	82076	2.01	25.9	227.6	18.50
T_7	7696	134689	56774	77914	1.73	21.1	155.5	22.77
S. Em	93	1627	1612					
CD	260	4549	4508					
CV %	6.1	6.1	14.6					

Table 3 Seed cotton yield(kg/ha) and wheat yield(kg/ha) as influenced by different treatments of plant nutrients in predominant cropping system of Mehsana (Gujarat) (pooled of four years)

Treatment	2013-14		2014-15		2015-16		2016-17		Pooled	
	Cotton yield	Wheat grain yield	Cotton yield	Wheat grain yield	Cotton yield	Wheat grain yield	Cotton yield	Wheat grain yield a)	Cotton yield	Wheat grain yield
T_1	957	1976	972	1914	927	1873	790	1691	911	1863
T_2	1705	2725	1348	2647	1304	2647	1402	2257	1440	2569
T_3	2006	3175	1491	3103	1537	3108	1607	2585	1660	2993
T_4	2116	2986	1580	2934	1556	2948	1685	2516	1734	2846
T_5	2287	3566	1787	3377	1812	3366	1931	2865	1954	3294
T_6	*2403*	3873	1848	3632	1870	3567	2084	3243	2051	3579
T_7	2092	3155	1556	3054	1580	3076	1568	2342	1699	2906
S. Em	64	64	28	48	34	4	44	47	27	29
CD	180	180	77	136	95	130	124	132	75	82
CV %	16.3	10.3	8.9	8.1	11.0	7.7	13.7	9.7	8.1	5.0