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Nutrient Management for Rice - Barley Cropping System Using Soil Test Target Yield Equation in Village Persiya, Block- Naugarh, District Chaundauli (U.P)

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Abstract

A field experiment was conducted during the year 2015-16 to study the nutrient management based on soil test to achieve the target yield of rice - barley and their effect of soil nutrient status for Barley-rice cropping system. The target yield of barley grain are (T_4-40 and T_5-45 q/ha) with 3.78% deviation and target yield of rice are (T_4-45 and T_5-50 q/ha) were achieved with application of 100% NPK based on ST-TY based along with 2 t/ha Farm Yard Manure (FYM). FYM were applied only in barley crop. The highest system productivity (98.20 q/ha) and benefit-cost ratio (4.27) was also recorded higher with application 100% NPK based on ST-TY based along with 2 t/ha FYM. The nutrient uptake by crops and soil nutrients status were higher after three year of Barley-rice cropping sequence when NPK were applied with FYM. Hence, combination of inorganic and organic (FYM) fertilizer could achieve target yield and maintain the soil fertility status.

Keyword: Economics, Barley, Nutrient management, Nutrient uptake, STCR, Yield etc.

Introduction

Balanced fertilizer application in a cropping system is pre-requisite for sustainable production system as well as appropriate soil nutrient resilience. With the development of high yielding and fertilizer responsive varieties of almost all crops escalated the indiscriminate use of fertilizers thus increases cost of cultivation and environment pollution. Hence, need based estimation of N, P and K correlating their requirement with specific target yield depending on their native soil status may fit to balanced application of NPK fertilizers. The 'target yield equation' (TYE) is considered as a soil and fertilizer based precision farming strategy to meet nutrient demands for a specified yield (Balasubramanian *et al*., 1999). However, application of N, P and K fertilizer on soil test target yield (ST-TY) based may meet the productivity but it has negative impact on soil health, hence, integrated nutrient management *i.e.* combination of inorganic and organic in rice - barley cropping system help to enhance the Barley and rice productivity while maintaining the soil health (Ghosh, 2008). Keeping this view in mind the experiment was conducted to achieve the target yield of barley and rice and their effect of soil nutrient status for rice - barley cropping system.

Materials and Methods

The experiment was conducted at village - Persiya, Block- Naugarh, District Chaundauli (U.P.) rice - barley cropping system during 2015-16. The soil of experimental field of Rice was sandy loam with pH 6.4, EC 27.5 dSm^{-1}, Organic carbon 0.50 % and available N, P and K 162.07, 11.24 and 190.38 kg/ha, respectively. The soil of experimental field of Barley was Alluvial (Inceptisols) with pH 7.0, EC 0.30 dSm^{-1}, Organic carbon 0.71 % and available N, P and K 180.00, 16.50 and 170.00 kg/ha, respectively. Doses of N, P_2O_5 and K_2O calculated on soil test basis by using following equations:

For rice (Regar and Singh, 2014)

FN=4.40T-0.49 SN-0.34ON

FP= 1.53T-1.14 SP-0.09OP

FK=2.92T-0.35 SK-0.11OK

For Barley (Singh *et al*., 2014)

FN=4.53T-0.40 SN-0.19ON

FP=1.09T-0.19 SP-0.06OP

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FK=3.25T-0.38 SK-0.031OK

Where, T= Yield target; FN, FP and FK is fertilizer N, P_2O_5 and K_2O (kg/ha), respectively; SN, SP and SK are available N P and K of soil (kg/ha) and ON, OP and OK are available N P and K of farm yard manure (%), respectively.

Five nutrient management practices viz. T_1- Control, T_2- Farmer's Practices of barley fertilizer *i.e.* for barley 80 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha and for rice 100 kg N, 35 kg P_2O_5 and 35 kg K_2O/ha, T_3 - GRD (General recommended Dose) N P and K, 120,55, 55, T_4- 100 % NPK on ST-TY (Target for barley - 40 q/ha and for rice- 45 q/ha), T_5-100 % NPK on ST-TY (Target yield for barley 45 q/ha and for rice 50 q/ha), FYM were tested in randomized block design with three replications for barley only in T_4 and T_5. barley variety 'RD2050' was sown in the Second week of November and rice variety 'Aman' was transplanted in Second week of June with recommended package and practices. The grain yield in barley crop and grain yield of rice crop was recorded after harvesting of crop. Soil and plant samples were collected and harvest were dried, processed and analyzed for available N by alkaline permanganate method, available P by Olsen's method and available K by flame photometer following standard procedures (Jackson, 1973). The economics in term of benefit cost ratio was also calculated at price prevailing in nearest market.The fibre yield of barley, grain yield of rice, and other parameters of nutrient dynamics were subjected to standard analysis of variance (ANOVA) and treatment differences were tested following tests of least significant difference (LSD) at statistical significance level of PdŠ 0.05 (Gomez and Gomez, 1984).

Results and Discussion

Barley and Rice grain yield and system productivity

The target yield of barley (45 q/ha) was achieved with 3.7% deviation (Table 1) with application of 100%NPK based on Soil Test Target Yield (ST-TY) equation along with 2t/ha of FYM (T_5). The 100% NPKapplication on ST-TY achieved only 103.77 % of target barley grain yield. The higher barley target yield (45 q/ha) has achieved by treatments. The target yield of rice (50 q/ha) was also achieved with T_5 the higher target yield achieved by treatments, however, 100% NPK based on ST-TY.104.00% of this target yield. The integration of inorganic with organic (FYM) was ensured the achievement of target yield of Barley and rice and only inorganic (N, P and K) did not achieve the target yield in both barley and rice. Balanced nutrition to soil, through integration of both organic and chemical nutrient sources appears to be essential. It provides adequate nutrients to crop uptake which promotes barley and rice growth and subsequent development of yield attributes lead to higher yield (Singh and Singh, 2014; Parihar, *et al.,* 2015). Target yield was achieved exactly, showing a slight deviation from the grain yield was might be due to unavailability of the full amount of applied nutrients to the plant as estimated to achieve the targeted yield. One possibility is that release of nutrients from applied fertilizer occurs spontaneously; however, subsequent uptake by plant is not taking place concurrently. Thus, entire amount of applied fertilizers could not have been up took due to lack of synchronization of its release with its absorption by plant, accounting for uncontrolled label losses (Singh, *et al.,* 2014; Singh, *et al.,* 2015).The system productivity and benefit cost ratio was significantly (PdŠ0.05) higher in T_4 and T_5, where FYM were integrated with ST-TY based application of NPK compared to T_1, T_2 and T_3 treatments (Table 1). The combination of inorganic and organic resulted in higher productivity of Barley/mesta and rice was also reported by Ray, *et al.* (2000) in barley-rice -wheat cropping system, and Singh, *et al.* (2011) in mesta-rice cropping system.

Table 1: Barley yield, rice yield, percent achievement of target yield, system productivity and benefit-cost ratio under barley-rice cropping system

Treatments	Barley yield (q/ha)	% achievement of Barley target yield	RiceYield (q/ha)	% achievement of rice target yield	System Productivity (q/ha)	B:C Ratio
T_1	17.10	42.75/38.00	17.20	37.77/34.00	34.30	-
T_2	25.50	56.25/50.00	26.30	57.77/52.00	51.80	B=1.68R=2.34
T_3	32.40	81.0/72.00	39.00	86.88/78.20	71.40	B=2.90R=4.59
T_4	39.95	99.50	44.80	98.20	84.70	B=3.69R=6.60
T_5	46.70	103.77	51.50	104.00	98.20	B=4.27R=6.73
LSD (P=0.05)	1.84		1.68		3.52	

Table 2: Nutrient uptake and available nutrients status in soil after the barley-rice cropping system

Treatments	Nutrient uptake by Barley crop (kg/ha)			Nutrient uptake by rice crop (kg/ha)			Available nutrient Status after One year of cropping (kg/ha)		
	N	P	K	N	P	K	N	P	K
Initial soil status							212.02	21.20	187.20
T_1	28.00	5.22	24.81	30.05	13.05	21.05	210.20	20.01	186.02
T_2	66.10	36.11	58.81	85.05	40.20	53.20	220.60	24.05	195.20
T_3	79.10	47.50	68.10	90.05	44.20	60.40	232.60	26.06	201.10
T_4	90.60	50.10	71.00	98.50	48.10	66.42	241.50	29.06	210.50
T_5	104.50	59.60	78.10	106.50	56.00	78.60	260.50	32.60	218.60
LSD (P=0.05)	1.64	0.84	2.80	1.68	1.33	1.03	2.00	0.53	1.72

Nutrients uptake and its status in soil

The higher nutrient uptake (104.50 N, 59.60 P and 78.10 K kg/ha) by barley and (106.50 N, 56.00 P and 78.60 K kg/ha by rice crop were recorded under T_5 and which was found significantly (Pd" 0.05) superior to other treatments (Table 2). The higher uptake of nutrients under T_5 which was might be due to higher application ofnutrients along with FYM. Available nutrient statuswas also higher in T_4 and $T_5$where FYM was applied.When we apply FYM in soil the entire amount of its NPK constituent was not made available at a time in one season; rather, a gradual release took place over a period of years. It has been reported that that only 25% to 30% N, 60% to 70% P and 75% K could be made available from applied FYM in first season rice, and the remainder being available in subsequent years (Gaur *et al*., 1984). Hence, comparatively less yield deviation under integrated nutrient management was attributed to slow but sustained release of nutrients and due to improvement in humic substances in soil, whichin turn promotes the soil NPK status.

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