

Effect of Integrated Nutrient Management on Growth and Yield of Wheat (*Triticum aestivum* L.) Under Rice–Wheat Cropping System

PRAVIN PRAKASH*, GAURAV MAHAJAN AND SAVITA JANGDE

*Department of Plant Physiology, Institute of Agricultural Sciences, Banaras Hindu University
 Varanasi 221005, India*

E-mail : prakashpbhu@gmail.com

**Correspondence*

Abstract

In the field experiment conducted effect of integrated nutrient management in wheat after rice in rice-wheat cropping system was evaluated. Plots supplied with total nutrient requirement in the form of 50% of recommended fertilizer through inorganic source + 50% of through organic source (FYM) found to be significantly better over control in term of all growth characters, yield attributes and yield. Application of 50% of RF + 50% of N through FYM recorded 23% higher grain yield over the control.

Key words : Crop residue, FYM, GM, INM, Rice-wheat system.

Among the various factors contributing to the productivity of wheat, fertilizers have played a pivotal role. It is estimated that wheat accounts for one fourth of total fertilizer consumption in the country (1). Even with the application of recommended dose of fertilizers, yield potential of different crops has reached to plateau because soil health has deteriorated and especially the organic matter has depleted. The organic matter content of the vast majority of Indian soils is well below 1%. To maintain fertility and productivity of soil at sustainable level, long duration use of organic manure is quite essential and also their use improve soil fertility and physical properties of soil. However, organic manures cannot substitute NPK requirement of crop since the nitrogen requirement is very high and availability of organic manure especially in FYM is not sufficient. To combat this problem, use of inorganic sources with organic sources is probably a nice way to keep up sustained food production. Keeping these in view the present investigation was carried out.

Methods

Field trials on wheat after rice crop were conducted at Varanasi (latitude 25°18' N, longitude 83°03' E and altitude 128.93 m above mean sea level) during 2007-08. The soil was sandy clay loam, low in avail-

able N (200 kg/ha) medium in organic carbon (0.44%), available P (16.2 kg/ha) and available K (240 kg/ha) with pH 7.8 and EC (0.19 ds/m). In rice-wheat system, the same field was pre-irrigated in the last week of November 2007. It was ploughed twice and planked. The HUW 234 wheat was sown in lines 22.5 × 10 cm spacing in 16 December 2007. The crop was raised following the recommended practices except fertilization which was done based on the treatments. The treatments include T₁ : control, T₂ : 50% of RF, T₃ : 50% of RF to rice crop and 100% RF to wheat crop, T₄ : 75% of RF, T₅ : 100% of RF, T₆ : 50% of RF + 50% of N through FYM, T₇ : 75% of RF + 25% of N through FYM, T₈ : 50% of RF + 50% of N through crop residue (CR), T₉ : 75% of RF + 25% of N through CR, T₁₀ : 50% of RF + 50% of N through green manuring (GM), T₁₁ : 75% of RF + 25% of N through GM and T₁₂ : Farmers practice i.e. 80 kg N + 40 kg P₂O₅ + 20 kg K₂O/ha through fertilizer for rice and 80 kg N + 40 kg P₂O₅ + 20 kg K₂O/ha through fertilizer for wheat crop. The same treatments were allocated in same plots as in preceding rice crop. All treatments were allocated in plots of 11 m × 6 m and replicated 4 times in randomized block design. The crop was harvested on 18 May, 2008. Application of organic manures and crop residues was made before sowing of crop as per required treatment. The application rates of manures and crop residues were decided to supply same quantities of N/

Table 1. Effect of integrated nutrient management on growth and physiological characters of wheat crop. Where, T₁ : control, T₂ : 50% of RF, T₃ : 50% of RF to rice crop and 100% RF to wheat crop, T₄ : 75% of RF, T₅ : 100% of RF, T₆ : 50% of RF + 50% of N through FYM, T₇ : 75% of RF + 25% of N through FYM, T₈ : 50% of RF + 50% of N through CR, T₉ : 75% of RF + 25% of N through CR, T₁₀ : 50% of RF + 50% of N through GM, T₁₁ : 75% of RF + 25% of N through GM and T₁₂ : Farmers practice i.e. 80 kg N + 40 kg P₂O₅ + 20 kg K₂O/ha through fertilizer for wheat crop.

Treatments	Plant height (cm)	Tiller number/plant	Dry matter accumulation/plant (g)	Chlorophyll content (SPAD value)	Leaf area (cm ² /plant)	Leaf area index	Leaf area duration (days)
T ₁	54.15	3.50	15.95	24.70	327.50	1.46	38.60
T ₂	64.86	4.00	20.83	28.44	349.85	1.56	41.02
T ₃	69.10	4.31	23.20	32.23	355.00	1.62	43.33
T ₄	68.17	3.25	21.63	30.48	365.25	1.58	41.94
T ₅	73.10	4.56	25.53	36.05	392.25	1.74	46.77
T ₆	77.52	5.13	29.30	40.06	402.50	1.79	48.53
T ₇	75.45	5.00	28.15	37.98	393.38	1.75	47.20
T ₈	77.10	5.13	28.35	39.84	399.75	1.78	48.00
T ₉	74.30	4.94	27.55	36.78	393.75	1.75	47.25
T ₁₀	76.49	5.13	28.25	38.32	399.75	1.78	47.99
T ₁₁	73.03	5.00	27.18	38.89	391.00	1.74	46.80
T ₁₂	70.45	5.00	24.15	35.55	381.00	1.69	45.13
CD (<i>P</i> =0.05)	NS	0.96	1.22	3.12	11.01	0.05	4.36

ha. Out of recommended fertilizer dosages of NPK half N and full dose of P and K in the form of Urea, single super phosphate and muriate of potash respectively were applied at the time of sowing. Remaining nitrogen was top dressed in two equal splits. The SPAD-502, a hand chlorophyll meter was used for rapid and non-destructive estimation of extractable chlorophyll in leaves (2). It is a simple portable diagnostic tool that measures the greenness or relative chlorophyll content of leaves (3). Meters reading are given in Minolta Company defined SPAD (soil plant analysis development) values that indicate relative chlorophyll contents (4).

Results and Discussion

The application of balanced fertilization through organic and inorganic sources helped in increasing all the growth characters recorded over control (Table 1). Growth parameters viz., plant height, number of tillers per plant and dry matter accumulation were found maximum for treatment where need of nutrients to the crop was met both by organic and inorganic sources equally. This increased height and number of tiller may be due to increased nutrient uptake and also more build up of available NPK when different sources of nutrients was used (5, 6). The highest dry

matter accumulation at harvest was recorded for T₆ treatment which was 45.56% higher over the control. The higher value of dry matter accumulation with this INM might be due to better supply of all essential mineral nutrients in a balanced amount which resulted in better growth and development of plants (7).

Table 2 shows that almost all the physiological traits of wheat crop viz., SPAD, LA, LAI, LAD, AGR and CGR increased significantly with the integrated nutrient supply compared to fertilizer sources alone. 50% of RF + 50% of N through FYM (T₆) recorded significantly highest values for all physiological traits. Application of balanced nutrients increased the physiological characters significantly over no application (control) mainly due to their direct or indirect role in many physiological activities in plant (8).

The value of yield attributes, namely number of grains per ear, test weight (Table 2) increased significantly up to 50% of RF + 50% of N through FYM which might be due to direct role of nitrogen in seed growth and indirectly help in accommodating osmotic imbalances present during the final stages of seed filling (8, 9).

The application of T₆ increased the grain yield of wheat 23% over the control (Table 2). Among the balanced fertilization treatments T₆, T₇, T₈ and T₁₀ were significantly superior as compared to control but dif-

Table 2. Effect of integrated nutrient management on physiological characters, yield attributes and yield of wheat crop. Where, T₁ : control, T₂ : 50% of RF, T₃ : 50% of RF to rice crop and 100% RF to wheat crop, T₄ : 75% of RF, T₅ : 100% of RF, T₆ : 50% of RF + 50% of N through FYM, T₇ : 75% of RF + 25% of N through FYM, T₈ : 50% of RF + 50% of N through CR, T₉ : 75% of RF + 25% of N through CR, T₁₀ : 50% of RF + 50% of N through GM, T₁₁ : 75% of RF + 25% of N through GM and T₁₂ : Farmers practice i.e. 80 kg N + 40 kg P₂O₅ + 20 kg K₂O/ha through fertilizer for wheat crop.

Treatments	Absolute growth rate (g/day)	Crop growth rate (g/cm ² /day)	Number of grains/ear	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
T ₁	0.24	9.57	60.23	34.38	3.60	4.21
T ₂	0.21	9.52	61.93	36.45	3.84	4.29
T ₃	0.25	11.20	59.29	39.18	4.18	4.88
T ₄	0.22	10.14	61.96	38.50	3.80	4.25
T ₅	0.26	12.01	60.35	39.38	4.11	5.02
T ₆	0.31	13.93	63.63	40.43	4.70	4.72
T ₇	0.30	13.68	60.87	39.40	4.29	4.80
T ₈	0.29	13.09	62.85	40.23	4.61	4.83
T ₉	0.29	13.24	62.32	39.03	4.07	4.37
T ₁₀	0.29	13.34	63.14	40.00	4.31	4.46
T ₁₁	0.29	13.11	62.94	38.95	4.00	4.67
T ₁₂	0.27	12.09	62.08	38.08	3.81	4.21
CD (<i>P</i> = 0.05)	0.05	2.71	4.33	1.45	0.64	NS

ferred non-significantly among themselves. The straw yield production in wheat was found to be highest when total recommended dose of fertilizer was applied through inorganic sources (T₅). Even though the total nitrogen was the same in 50% of RF + 50% of N through FYM and 100% RF applied plots, higher yield was recorded in 50% of RF + 50% of N through FYM applied plots, probably due to more availability of nitrogen at critical stages of crop growth (10).

Thus it may be recommended that for sustained agricultural production the nutrient requirement of crop should be met equally by organic and inorganic sources.

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