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Effect of Nutrients and Rice Residue Management on Performance of Growth and Yield of Wheat

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ABSTRACT: This study was conducted during *rabi* season of 2020-21 and 2021-22 at CRC Farm SVPUAT, Meerut, to evaluate the effect of rice residue management and nutrient management on wheat The significantly maximum dry matter accumulation (gm^{-2}) of wheat were recorded with bio-decomposer treated residue as compare over to residue removal at 60, 90 DAS and at harvest respectively. The mean maximum dry matter accumulation (gm^{-2}) of wheat was recorded with 125% RDF + Growth Regulator over as compare to 75% RDF +10t FYM at 30, 60, 90 DAS and at harvest respectively. The crop growth rate ($g\ m^{-2}$) of wheat was recorded with bio-decomposer treated residue over as compare to residue removal at 30-60, 60-90 DAS and 90 DAS to at harvest respectively. The mean maximum crop growth rate ($g^{-}m^{-2}\ day^{-1}$) of wheat were recorded with 125% RDF + Growth Regulator over as compare to 75% RDF + 10t FYM at 30-60, 60-90 DAS and 90 DAS to at harvest respectively. The significantly maximum grain yield 50.03 q ha^{-1} registered with bio-decomposer treated residue. The application of 125% RDF + Growth Regulator grain yield 52.84 q ha^{-1} over water spray 75% RDF +10t FYM.

Keywords: Rice residue management, nutrient management, growth, wheat yield.

INTRODUCTION

According to estimates from the United States Department of Agriculture, the world's wheat production will be around 792.40 million tones in 2020–21, making it the most widely grown cereal (2021). In India, 31.76 million hectares of wheat will be grown during the rabi season in 2020–21. With an average national productivity of 3424 kg/ha, wheat production reached 108.75 million tonnes (Anonymous 2021). It has a good nutritional profile with 12.1% protein, 1.8% lipids, 1.8% ash, 2.0% added sugar, 6.7% pentose, and 59% starch as well as a good source of vitamins, minerals, and nicotinic acid (Agam *et al*., 2017). The most common and nutrient-dense cropping system in India's Indo-Gangetic Plains is rice (*Oryza sativa* L.) and wheat (*Triticum aestivum* L.). A large portion of the 2.5 million farmers who participate in the current rice-wheat cropping system in northwestern India burn an estimated 23 million metric tones of rice stubble in October and November to prepare their fields for the ensuing wheat crop (Anonymous, 2017). Along with a significant reduction in soil fertility brought on by burning residue (Prasad *et al.,* 1999), the resulting air pollution affects not only farmers and their families, but the seasonal meteorological conditions allow smoke to blanket a large area, affecting millions of lives in cities and villages downwind (Mishra & Shibata 2012; Vijayakumar *et al.*, 2016). The availability of the major nutrients it contains the elements nitrogen (N), phosphorus (P) and potassium (K). According to previous reported studies, chemical fertilizers provided the above essential nutrients to the soil, but long-term application had negative effects on the physical and nutritional properties of the soil (Das *et al*., 2017). Keeping soil fertile and balanced through the addition of organic and inorganic fertilizer inputs is one of the most important actions to ensure food security and sustainably increase crop productivity. Growth retardants are chemical substances that have the potential to alter structural or vital processes within the plant by modifying hormone balance in order to increase yield, improve quality, or facilitate harvesting, particularly in cereals (Zhang *et al*., 2017). Lodging preventers (plant height retardants) are generally antagonistic to gibberellin and act by altering their metabolism (Peake *et al.*, 2014). The goal of this study was to look at the effects of crop residue and nutrient management practices on wheat growth and yield in a rice-wheat cropping system.

MATERIAL AND METHODS

This field experiment was carried out at the Crop Research Centre campus of Sardar Vallabhbhai Patel University of Agriculture and Technology in Meerut, Uttar Pradesh, during the Rabi seasons of 2020-21 and 2021-22. The soil at the experimental site was sandy loam, with low organic carbon (0.44%) and available nitrogen (210.12 kg ha^{-1}) and medium available phosphorus (15.87 kg ha^{-1}) and potassium (265.15 kg ha^{-1}) and pH (7.89). The experiment used a split plot design and included four crop residue management practices and five nutrient management practices. The experiment used a split plot design and included four crop residue management practices and five nutrient management practices. The main plot employed four residue management practices: residue removal (RR), residue burning (RB), urea treated residue (5% urea) (UTR), and bio-decomposer treated residue (BTR). There are five nutrient management strategies: 100% recommended fertilizer (RDF) (N_1), 75% RDF + 10 t FYM (N_2), 75% RDF + 10 t FYM + growth regulator (Chlormequat chloride @ 0.2% + Tebuconazole @ 0.1%) (N_3), 125% RDF (N_4), and 125% RDF + Growth Regulator (Chlormequat chloride @ 0.2% + Tebuconazole @ 0.1%) (N_5) in a subplot and replicated three times. The recommended nutrient dose was 150:75:65 kg N:P:K ha^{-1}. Before sowing, the entire amount of phosphorus and potassium was applied. Nitrogen was applied in three stages: 50% as a basal, 25% during tillering, and 25% during panicle emergence. The experiment was carried out under irrigated conditions and was irrigated 5 times at various crop stages. HD 3226 crop variety seed sown on November 15th, 2020 and November 18th, 2021 with a row spacing of 22.5 cm. The observation recorded dry matter accumulation (g m^{-2}) randomly plants were cut close to the ground from each plot from one-meter row length the various places at 30, 60, 90, and at harvest in each plot was cut from sample site. Samples would be sun dried first, then oven dried at 74º C until a constant weight is achieved. After drying, the samples were weighed to determine dry weight, which was then converted to gm^{-2}. Crop growth rate (g m^{-2} day^{-1}) is the rate of dry matter accumulation rate per unit of land area, normally expressed in grams per square meter of land area per day (g m^{-2} day^{-1}). It was calculated using the following formula.

$$\text{Crop Growth Rate} = \frac{W2-W1}{t2-t1}$$

W_1 and W_2 are the plant dry weights at the start and end of the interval, at time t_1 and t_2, respectively.

The net plot's grain yield ($q.ha^{-1}$) was threshed, and the grains obtained were winnowed, cleaned, and weighed. The yield was measured in kg $plot^{-1}$ and converted to qha^{-1}. The experiment data was subjected to statistical analyses of Split Plot Design as proposed by Cochran and Cox (1970) and used online Programmer, Computer Section, CCS HAU, Hisar software developed by O.P. Sheoran.

RESULTS AND DISCUSSION

The current findings revealed that residue management and nutrient management have a significant impact on wheat growth and grain yield (Table 1). The dry matter accumulation (g m^{-2}) increased as crop age increased up to harvest. Wheat dry matter accumulation in rice residue management was significantly influenced at 60, 90 DAS, and harvest stage. The mean maximum dry matter accumulation of wheat with bio-decomposer treated residue was 53.06, 285.02, 798.06 and 1085.39 g m^{-2} when compared to residue removal (47.27, 248.81, 696.68 and 947.18 g m^{-2}) at 30, 60, 90 days after sowing, and at harvest respectively. During these growth stages, however, residue management with urea treated residue produced statistically similar dry matter accumulation as bio-decomposer treated residue. The study's findings are consistent with those of Timalsina *et al.* (2021) Wheat nutrient management also had a significant impact on dry matter accumulation (g m^{-2}). The mean maximum dry matter accumulation (g m^{-2}) of wheat was recorded with 125% RDF + growth regulator (54.89, 285.51, 799.43 and 1083.69) over 75% RDF + 10 tone FYM (48.38, 261.86, 733.21 and 997.069) at 30, 60, 90 days after sowing, and at harvest, respectively However, during these growth stages, nutrient management with 75% RDF + 10t FYM + growth regulator produced statistically comparable dry matter to 125% RDF + growth regulator. Crop growth rate (g-m^{-2} day^{-1}) increased as crop age increased up to 60-90 DAS, but crop growth rate (g-m^{-2} day^{-1}) decreased from 90 DAS to harvest. Wheat residue management had a significant influence on crop growth rate (g $^{-2}$ day^{-1}). The mean crop growth rate (g-m^{-2} day^{-1}) of wheat was higher with bio-decomposer treated residue (7.77, 16.82 and 5.22) than with residue removal (6.65, 14.72 and 4.55) at 30-60, 60-90 and 90 days after sowing to harvest, respectively. However, during these growth stages, residue management with urea treated residue produced statistically higher crop growth rates (g m^{-2} day^{-1}) than bio-decomposer treated residue. The findings of this study are consistent with those of Timalsina *et al*. (2021). Wheat nutrient management also had a significant impact on crop growth rate (g m^{-2} day^{-1}). The mean maximum crop growth rate (g m^{-2} day^{-1}) of wheat was recorded with 125% RDF + growth regulator (7.68, 16.85 and 5.16) and over as compared to 75% RDF +10 t FYM (7.11, 15.52, and 7.79) at 30-60, 60-90, and 90 days after sowing to harvest, respectively, However, during these growth stages, nutrient management with 75% RDF +10 t FYM + growth regulator produced statistically similar crop growth rates (g m^{-2} day^{-1}) to 125% RDF + growth regulator. Because the primary nutrients (nitrogen, phosphorus, and potassium) are known to be essential components for cell division and elongation, using both organic and inorganic nutrient sources in tandem with their maximum availability results in increased plant growth. Increased availability of these nutrients may increase the photosynthetic area of plants, resulting in a higher buildup of dry matter. The findings of the study are consistent with those of Fliessbach *et al.* (2007); Joergensen *et al*. (2010); Leifeld *et al*. (2009).

The residue management had a significant impact on wheat grain yield (qha^{-1}). When compared to residue removal, the mean maximum yield (qha^{-1}) of wheat with bio-decomposer treated residue was (50.03) and (44.77) higher. However, when compared to the residue bio-decomposer, the wheat crop grown with urea-treated residue produced statistically equal grain yield (qha^{-1}). The study's findings agree closely with those of Fliessbach *et al*. (2007); Joergensen *et al*. (2010); Leifeld *et al*. (2009).

Wheat grain yield (qha^{-1}) was also significantly influenced by nutrient management. In comparison to 75% RDF + 10 tone FYM, the mean maximum wheat grain yield (qha^{-1}) was recorded with 125% RDF + growth regulator (52.84) and (46.00). However, during these growth stages, the fertilized with 75% RDF + 10 t FYM + growth regulator produced statistically higher grain yield (qha^{-1}) than the fertilized with 125% RDF + growth regulator. Higher dry matter accumulation and yield with the combined application of organic and inorganic fertilizer than with chemical fertilizer alone may be the cause of this increase in crop productivity. Many other researchers have reported similar findings, claiming that combining chemical and organic sources increased crop productivity (Manna *et al*., 2003; Kumar *et al.*, 2019).

Table 1: Effect of nutrients and rice residue management on Dry matter accumulation (g m^{-2}) Crop Growth Rate (g $^{-2}$ day^{-1}) and Grain Yield (qha^{-1}) of wheat (pooled data of 2 year).

Treatment	Dry matter accumulation (g m^{-2})				Crop Growth Rate (g $^{-2}$ day^{-1})			Grain Yield (qha^{-1})
	30 DAS	60 DAS	90 DAS	At harvest	30-60 DAS	60 -90 DAS	90 DAS -At harvest	
Rice Residue management								
RR- Residue Removal	47.27	248.81	696.68	947.18	6.65	14.72	4.55	44.77
RB- Residue Burning	50.40	268.78	752.54	1023.15	7.27	15.88	4.92	48.42
UTR- Urea Treated Residue	52.64	282.55	791.15	1075.70	7.66	16.67	5.17	49.83
BTR - Bio-decomposer Treated Residue	53.06	285.02	798.06	1085.39	7.77	16.82	5.22	50.03
SE m ±	1.07	4.22	11.82	16.00	0.10	0.27	0.07	1.02
CD (P=0.05%)	NS	14.89	41.71	56.45	0.38	0.95	0.26	3.61
Nutrient management								
N_1-100% RDF (150: 75:60 kg N.P.K.)	50.43	262.56	735.17	999.83	7.07	15.52	4.81	46.00
N_2-75%RDF +10tone FYM	48.38	261.86	733.21	997.06	7.11	15.48	4.79	45.64
N_3-75% RDF +10 t FYM+ Growth Regulator	48.31	261.92	733.39	996.48	7.12	15.49	4.78	49.74
N_4 -125% RDF	54.71	284.58	796.83	1087.22	7.66	16.77	5.28	47.08
N_5-125% RDF + Growth Regulator	54.89	285.51	799.43	1083.69	7.68	16.85	5.16	52.84
SE m ±	*1.37*	*6.93*	*19.42*	*21.60*	*0.18*	*0.39*	*0.37*	*1.35*
CD (P=0.05%)	*3.99*	*20.07*	*56.20*	*62.52*	*0.54*	*1.15*	*NS*	*3.93*

CONCLUSION

The findings of this study showed that cultivating wheat with residue bio-decomposer treated residue and 125% RDF + growth regulator resulted in a significant increase in growth and yield. As a result, it is concluded that residue management, including the use of a residue bio-decomposer, and nutrient management of 125% RDF + growth regulator, can be recommended as a long-term strategy for increasing wheat productivity and profitability.

FUTURE SCOPE

Residue management and the use of bio-decomposer treated residue, as well as nutrient management of 125% RDF + Growth Regulator, are suggested as a sustainable strategy for increasing dry matter and grain yield.

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