Original Research Article

Impact of rice residue management practices on growth and productivity of wheat (*Triticum aestivum* L.)

ABSTRACT

An experiment was conducted during Rabi season 2020-21 at Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) to evaluate the effect of different nutrient management practices on growth and yield attributes of wheat. The experiment consisting of 11 treatments, T_1 (Control); T_2 (chemical fertilizers @ 100% RDF); T_3 (chemical fertilizers @ 75% RDF); T_4 (T_3 + paddy straw); T_5 (T_3 + paddy straw + microbial decomposer @ 100 ml/plot); T_6 (T_3 + paddy straw + microbial decomposer @ 250 ml/plot); T_7 (T_3 + paddy straw + microbial decomposer @ 500 ml/plot); T_8[T_3 + (PSB + Mycorrhiza) @ 50 ml/plot]; T_9[T_3+ (PSB + Mycorrhiza) @ 100 ml/plot]; T_{10}[T_3 + paddy straw + microbial decomposer @ 250 ml/plot + (PSB + Mycorrhiza) @ 50 ml/plot]; T_{11}[paddy straw + microbial decomposer @ 250 ml/plot + (PSB + Mycorrhiza) @ 50 ml/plot) were laid down in triplicate plots in Randomized block design (RBD).Wheat variety PBW-373 was taken as test crop. The results revealed that the application of chemical fertilizers @ 75% RDF paddy straw + microbial decomposer @ 250 ml/plot + (PSB + Mycorrhiza) @ 50 ml/plot (T_{10}) recorded significantly higher growth attributes *viz.* Plant height dry matter accumulations, leaf area index, and yield attributes *viz.* number of grains per spike, weight of spike, test weight, grain yield, straw yield also biological yield along with harvest index.

Keywords: Paddy straw, chemical fertilizer, Mycorrhiza, Microbial decomposer

1. INTRODUCTION

Wheat (Triticum aestivum L.) is the most widely grown crop across the globe and is the second most important food crop in India (after rice), occupying about 27 million hectares of area and contributing about 34% of the total food grain production in India. Wheat constitutes about 20% of all human calories and protein intake throughout the world (Shiferaw *et al*., 2013). Excessive use of chemical fertilizers harms the biological power of soil which must be prevented as transformations of all the nutrients are negotiated by soil micro flora. An optimum soil microorganism population must be maintained in the soil for higher nutrient use efficiency. No single source of plant nutrients can meet the entire nutrient need of crops in modern agriculture, rather they need to be used in an integrated manner following a management technology that is appropriate, economically viable, and socially acceptable and ecologically sound (Finck, 1998). The use of microbial inoculants as bio fertilizers and/or antagonists of phytopathogens provide a promising alternative to chemical fertilizers and pesticides. Bacteria inhabiting plant roots and influencing plant growth positively by any direct or indirect mechanism (s) are referred to as Plant Growth Promoting Rhizobacteria (Kloepper, 1993). Plant growth promoting rhizobacteria are commonly used as inoculants for improving the growth and yield of agricultural crops, however screening for the selection of effective PGPR strains is of critical importance. PGPR activity has been reported in strains belonging to several genera such as *Azotobacter, Azospirillum, Pseudomonas, Acetobacter, Burkholderia* and *Bacillus* (Kloepper, 1993; Khalid *et al*., 2004). On the other hand incorporation of crop residues is reported to increase the organic C and nutrient contents of soils and to increase crop yields (Hooker *et al.,* 1982; Bhatnagar *et al*., 1983). However, inhibition of plant growth due to immobilization of nutrients (Rao and Mikkelsen, 1976) and toxicity due to organic acids produced from decomposing residues in cooler regions are problems associated with crop residue incorporation. The present study was undertaken to study the effects of residue management practices on the growth and yield of wheat crop.

2. MATERIALS AND METHODS

An experiment was conducted during Rabi season 2020-21 at Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar, Kumarganj, Ayodhya (U.P.) to evaluate the effect of different nutrient management practices on growth and yield attributes of wheat. The soil was partially reclaimed sodic soil with silt loam texture slightly alkaline in reaction (pH 8.22) with low available nitrogen (147.16 kg ha^{-1}), medium in available phosphorus (14.36 kg ha^{-1}), and high in available potassium (257.28 kg ha^{-1}).The experiment consisting of 11 treatments T_1; T_2 (chemical fertilizers @ 100% RDF); T_3 (chemical fertilizers @ 75% RDF); T_4 (T_3 + paddy straw); T_5 (T_3 + paddy straw + microbial decomposer @ 100 ml/plot); T_6 (T_3 + paddy straw + microbial decomposer @ 250 ml/plot); T_7 (T_3 + paddy straw + microbial decomposer @ 500 ml/plot); T_8[T_3 + (PSB + Mycorrhiza) @ 50 ml/plot]; T_9[T_3+ (PSB + Mycorrhiza) @ 100 ml/plot]; T_{10}[T_3 + paddy straw + microbial decomposer @ 250 ml/plot + (PSB + Mycorrhiza) @ 50 ml/plot]; T_{11}[paddy straw + microbial decomposer @ 250 ml/plot + (PSB + Mycorrhiza) @ 50 ml/plot) were laid down in triplicate plots in Randomized block design (RBD).Wheat variety PBW-373 was taken as test crop. The straw management practices were imposed one month before sowing of the wheat crop, except the straw mulch treatment, which was applied on the soil surface just after sowing of wheat. In case of incorporation, rice straw was chopped into small pieces and incorporated into the soil with spades up to a depth of 20 cm. The rice straw which was used as mulch in the wheat crop, was incorporated as such in the same plot during the following rice crop. In all the straw management practices (except straw mulch) straw or animal manure were applied and mixed thoroughly with the soil up to a depth of 20 cm. After this, the field was irrigated to field capacity and kept as such for one month before sowing of wheat. At the time of sowing, the soil was again mixed thoroughly. Nitrogen was applied as urea. Uniform doses of P and K at the rate of 60 and 40 kg ha^{-1}, respectively, were applied in all the plots for wheat and rice. The fertilizers were applied in rows along-side the seed at time of sowing of wheat. Nitrogen was applied in three splits. The seed rate of wheat used was 100 kg ha^{-1}, whereas, rice seedlings were transplanted at a spacing of 20 x 15 cm. All the standard cultural practices were followed during wheat periods. In each year, wheat was given three irrigations, *viz.* first at crown root initiation, second at late jointing and third at late flowering stage. The plant height (cm) and tiller count (No. m^{-2}) were recorded at 30 day interval and at harvest and are presented in the form of graphs. The yield attributes viz., number of spikes (m^{-2}), spike length, grains per spike (No.), grain weight per spike (g) and 1000-grain weight were recorded at harvest. Biological (bundle weight) and grain yield was recorded from the net plot size and expressed as q ha^{-1}. Straw yield was calculated by subtracting the grain yield from biological yield. Harvest index was calculated by dividing the grain yield with biological yield (grain + straw). Statistical analysis was done as per randomized block design (Gomez and Gomez, 1984) and treatment means were compared at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 GROWTH ATTRIBUTES

Plant height, in grain crops, indicates the effect of various nutrients on plant metabolism. Data pertaining to plant height of wheat recorded at 30, 60, 90 DAS and at harvest stage has been presented in Table-1 Based on the data, the growth rate increased gradually with a slow rate up to 30 DAS followed by a rapid increase in growth recorded till 90 DAS, which further increased till harvest stage. A successive increase in Plant height was observed which appeared relatively slower after 90 DAS till the harvest stage. On the basis of data presented in table 1, it was found that beyond 30 DAS, the effect of different treatments on plant height have been observed to be statistically significant at all the following stages of crop growth till harvest. At 60 DAS , 90 DAS and at harvest stage, the maximum plant height was recorded in treatment T_{10} [RDF @ 75% of full dose + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)]. The second best treatment, T_7, comprising of 75% RDF + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot} was found to be at par with T_2 [RDF 100%], T_6 [75% RDF + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot], and T_9 which were further significantly superior over rest of the treatments. Treatment T_1 (Control) produced lowest plant height at all the stages of crop growth. Plant height may have increased in response to the combined application of organic and inorganic fertilizers due to improved macronutrient and micronutrient availability. The quick conversion of produced carbohydrates into protein and subsequent increase in the quantity and size of developing cells, which ultimately leads to higher plant height of wheat, are the causes of the enhancement in plant height with increasing dose of organic manure. The findings of Sarwer *et al.* (2008), who claimed that the application of organic manures in conjunction with mineral fertilizers increased plant development, are consistent with these results. Findings on growth characteristics of wheat reported by Kale *et al.* (2015) support the results obtained in this study.

The data for dry matter accumulation at different stages of crop growth as affected by the applied treatments is presented in Table 2. Based on the data, it was observed that dry matter accumulation increased gradually with crop age advancement with a very slow increase up to 30 days followed by a faster rate from 30 days till maturity of the crop. At 60, 90 DAS and at harvest stages the dry matter accumulation was found maximum in T_{10} (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza). Value for DMA in T_{10} was significantly higher than T_7 (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 500mL per Plot) recorded maximum dry matter accumulation g/m^2 followed by T_2 (RDF 100%) and T_6 which were at par with each other but significantly better than the rest of the treatments. The lowest value of dry matter accumulation g/m^2 was obtained with the T_1 (control) treatment. Similar results were reported by El-Temsah *et al.* (2014).

The data on leaf area index for different treatments at 30, 60 and 90 DAS have been presented in the Table-3. The data indicate that leaf area index during initial stage was rather slow and thereafter, increased rapidly from 30 to 60 DAS followed by a decline afterwards indicating that between 30 to 60 DAS of the crop, the grand growth period line is observed. The data suggests that with increasing nutrient supply there has been a successive increase in leaf area index. Although nutrients are an essential component of plants, they have a significant impact on every growth parameter (number of tillers, dry matter accumulation, etc.) due to their balancing effect on the compatibility of various nutrients in soil solution, which leads to greater uptake and utilisation of all crucial nutrients. The physical characteristics of soil that were enhanced by the addition of organic matter are strongly related to tilling. This is consistent with past research by Singh *et al.* (2011).

3.2 YIELD AND YIELD ATTRIBUTES

The maximum number of grains spike^{-1} (38.8) was found with the treatment T_{10} (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza). Number of grains spike^{-1} recorded in Treatments T_7 (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 500mL per Plot), T_2 (RDF 100%) and T_6 were at par with each other but were found to be significantly higher over rest of the treatments. A similar trend was observed with the grain weight spike^{-1}. The maximum grain weight spike^{-1} (1.59 g) was found with treatment T_{10}. Values for grain weight spike^{-1} recorded for T_7, T_2 and T_6 were at par with each other and were found to be significantly higher over rest of the treatments. Lowest number of grain weight spike^{-1} (1.38 g) was found with treatment T_1 (control). The data pertaining to test weight (1000-grain weight) presented in table-4 and revealed that test weight of wheat grain was not significantly affected by various treatments. Yield attributes are the resultant of vegetative growth which thereby determines plant yield. The number of grains per spike and test weight are major contributing characters governing the yield. The number of grains per spike and test weight increase upon addition of nutrients in the form of NPK which further increases upon supplementation with organic sources such as FYM and decomposing microbes or nutrient mobilizing microorganisms. The results are in conformity with the findings of Sharma and Singh, 2011.

3.3 Yield

The data for grain yield of wheat crop as affected by different treatments have been presented in Table 5. The yield was recorded highest (51.40 qha^{-1}) with the treatment T_{10} (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza) which was found to be at par with Treatments T_7 (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot) recorded higher yield (49.20qha^{-1}), T_2 (RDF 100%) and T_6. These treatments were significantly superior to rest of the treatments. The lowest yield was recorded (29.80qha^{-1}) with T_1 (control) treatment. Application of nutrients in the form of RDF has caused a general improvement in plant growth causing increase in grain and straw yield. Significant increase in yield parameters in this study corroborates the findings of Pandey *et al.* (2009).

The data presented in Table 5 revealed that the straw yield was affected by various treatments. The straw yield was recorded significantly higher (76.15 qha^{-1}) with T_{10} (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100 ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza) which was at par with T_7 (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot) recorded highest straw yield (73.00 qha^{-1}), T_2 (RDF 100%) and T_6. Whereas the lowest straw yield (47.80 qha^{-1}) was recorded with T_1 (control) treatment. Similar results of increase in yield parameters upon nutrient fortification and supplementation with organic inputs were reported by Singh *et al.* (2006) and Pandey *et al.* (2009).

The biological yield is (G+S) in (q ha^{-1}) presented in Table 5 revealed that the biological yield was significantly affected by various treatments. The maximum biological yield (127.55q ha^{-1}) was obtained under the treatment T_{10} (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza). Among the treatments T_7 (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot) recorded maximum biological yield (122.20q ha^{-1}) followed by T_2 (RDF 100%) and T_6. The minimum biological yield (77.60q ha^{-1}) was recorded in T_1 (control) treatment. Similar findings have been reported by Sheykhbaglou *et al*. (2010).

The information regarding the impact of appropriate doses with properly formulated soil and grain on the wheat harvest index makes this clear. It was noted that the harvest index for wheat ranged from 38.40 to 40.30% (Table-5). These results back up Rahimi's findings (2012).

4. Conclusion-

From the above it may be concluded that, application of T_{10} (T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250 mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza) considered to be most effective for sustainable wheat production and residue management practices.

5. References

Bhatnagar, V. K., Choudhary, T. N. & Sharma, B. R. Effect of tillage and residue management on properties of two coarse textured soils and yield of irrigated wheat and groundnut. Soil Tillage Research 1983: 3:27-37.

El-Temsah, M.E., Fergany, M.A. and El-Habbal, M.S. Effect of Sowing Date on Dry Matter Accumulation and Nitrogen Partitioning Efficiency of Some Wheat Cultivars. *Asian Journal of Crop Science.* 2014: 6: 150-157.

Finck, A. Integrated nutrient management an overview of priencpals, probles and possibilities. *Annals of Arid Zone.* 1998:37: 1-24.

Gomez KA, Gomez AA. Statistical Procedure for Agricultural Research. 2nd 680p. Wiley, N. York, USA. 1984.

Hooker, M. L., Herron, G. M. & Penas, P., Effect of residue burning, removal and incorporation on irrigated cereal yields and soil chemical properties. Soil Science Society of America Journal 1982:46:122-126.

Kale ST, Kadam SR, Gokhle DN, Waghmare PK. Response of wheat varieties to different levels of fertilizer on growth and yield under late sown condition. Int. J. of Agri. Sci. 2015; 11(1):77-80.

Khalid, A., Arshad, M., and Zahir, Z.A. Screening plant growth promoting rhizobacteria for improving growth and yield of wheat. *J Appl Microbiol.* 2004:96(3): 473–480.

Klepper, B., Development and growth of crop root system. In: Hatfield, J.L. and B.A. Stewart (eds.). Limitations to plant root growth. Springer-Verlag, Germany. 1992:p. 1-25.

Kloepper, J.W. Plant growth-promoting rhizobacteria as biological control agents. In: Metting FB Jr (ed) Soil micrcrobial ecology-applications in agricultural and environmental management. Dekker, New York, 1993: pp. 255-274.

Kumar P, Pannu RK, Khokhar SK. Effect of organic sources of nutrition and irrigation levels on growth and yield of wheat (Triticum aestivum L.). Int. J. Life Sci. Bt. & Pharm. Res. 2012; 1(4):178-186.

Pandey, A.K., Gaind, S., Ali, A. and Lata. Effect of Bioaugmentation and Nitrogen supplementation on composting of paddy straw. *Biodegradation.* 2009: 20: 293-306.

Rahimi, A. Effect of potassium and nitrogen on yield and yield components of dry land wheat in Boyerahmad Region of Iran. *Annals Biol. Research*, 2012:3 (7): 3274-3277.

Rao, D. N. & Mikkelsen, D. S., Effect of rice straw incorporation on rice plant growth and nutrition. Agronomy Journal 1976:68:752-755.

Sarwar, G. H., Schmeisky, N., Hussain, S., Muhammad, M., Ibrahim, and Safdar, E. Improvement of soil physical and chemical properties with compost application in rice-wheat cropping system *Pak. J. Botany.* 2008:40(1): 275-282.

Sharma, S. N. and Singh R. N. Seed rate and weed management on yield and nutrient uptake of wheat (Triticum aestivum). *Indian J. Agricultural Sciences* 2011:81 (12): 1174–1179.

Sheykhbaglou, R., Sedghi, M., Shishevan, M.T. and Seyed-Sharifi, R. Effects of nano iron oxide particles on agronomic traits of soybean. *Notulae Scientia Biologicae.* 2010: 2(2): 112-113.

Shiferaw, B., Smale, M., Braun, H.J., Duveiller, E., Reynolds, M., and Muricho, G. Crops that feed the world 10. Past successes and future challenges to the role played by wheat in global food security. *Food Security.* 2013:5: 291-317.

Sidhu, B. S. and V. Beri, Effect of crop residue management on the yields of different crops and soil properties. Biol. Wastes, 2008: 27: 15-27.

Singh, C. M., Sharma, P. K., Kishor, P., Mishra, P. K., Singh, A. P., Verma, R., Raha, P., Impact of integrated nutrient management on growth, yield and nutrient uptake by wheat (Triticum aestivum L.). *Asian J. Agricultural Research*. 2011: 5(1):76-82.

Singh, R. and Yadav, D.S. Effect of rice (*Oryza sativa*) residue and nitrogen on performance of wheat (*Triticum aestivum*) under rice-wheat cropping system. *Indian Journal of Agronomy*. 2006:51(4): 247-250.

S. No.	Treatments	Plant height (cm)			
		30 DAS	60 DAS	90 DAS	At harvest
T1	Control	23.40	56.40	62.00	63.00
T2	RDF (100%) [N, P_2O_5, and K_2O @ 120:60:60 Kg/ha respectively]	24.60	68.70	81.00	82.60
T3	RDF (75%) [N, P_2O_5, and K_2O @ 90:45:45 Kg/ha respectively]	23.70	61.00	72.00	73.40
T4	T_3 + Paddy Straw @ 5 t ha^{-1}	23.90	61.30	72.30	73.80
T5	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 100mL per plot	24.00	61.90	73.00	74.50
T6	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot	24.40	64.70	76.40	77.90
T7	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot	24.60	68.80	81.20	82.80
T8	T_3 + Nutrient mobilizer consortium @ 50 mL / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	24.20	62.40	73.60	75.00
T9	T_3 + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	24.30	64.20	75.80	77.40
T10	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	24.80	70.50	83.20	84.90
T11	Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	23.80	58.40	67.20	68.50
SEm (±)		1.11	1.38	1.61	2.08
CD (P =0.05)		NS	3.92	4.76	6.17

Table 1. Effect of treatments on plant height at various growth stages of wheat crop

Table- 2: Effect of treatments on dry matter accumulation of wheat crop

S. No.	Treatments	Dry matter accumulation (m^{-2})			
		30 DAS	60 DAS	90 DAS	At harvest
T1	Control	62.80	429.00	660.00	776.00
T2	RDF (100%) NPK@ 120:60:60 Kg/ha (as N, P_2O_5 and K_2O) respectively	64.00	667.20	1026.35	1207.50
T3	RDF (75%) NPK @ 90:45:45 Kg/ha respectively	64.80	544.20	837.25	985.00
T4	T_3 + Paddy Straw @ 5 t ha^{-1}	65.60	567.70	873.46	1027.60
T5	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 100mL of Formulation per plot	66.40	592.00	910.75	1071.50
T6	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot	68.00	634.50	976.20	1148.50
T7	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot	67.60	675.15	1038.70	1222.00
T8	T_3 + Nutrient mobilizer consortium @ 50 mL / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	64.80	610.50	939.25	1105.00
T9	T_3 + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	66.80	629.60	968.60	1139.50
T10	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	68.80	704.70	1084.20	1275.50
T11	Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	64.00	494.20	760.20	894.50
SEm (±)		2.48	20.36	43.62	40.98
CD (P =0.05)		NS	7.05	128.69	120.90

Table 3: Effect of different treatments on leaf area index at various growth stages of the wheat crop

S. No.	Treatments	Leaf area index		
		30 DAS	60 DAS	90 DAS
T1	Control	1.57	3.75	3.90
T2	RDF (100%) N, P_2O_5, and K_2O @ 120:60:60 Kg/ha respectively	1.60	4.90	5.15
T3	RDF (75%) N, P_2O_5, and K_2O @ 90:45:45 Kg/ha respectively	1.62	4.35	4.58
T4	T_3 + Paddy Straw @ 5 t ha^{-1}	1.64	4.40	4.60
T5	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 100mL of Formulation per plot	1.66	4.42	4.65
T6	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot	1.70	4.62	4.85
T7	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot	1.69	4.91	5.15
T8	T_3 + Nutrient mobilizer consortium @ 50 mL / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	1.62	4.46	4.70
T9	T_3 + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	1.67	4.58	4.82
T10	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	1.72	5.02	5.28
T11	Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	1.60	3.88	4.10
SEm±		0.06	0.21	0.18
CD (P =0.05)		NS	0.63	0.52

Table 4: Effect of different treatments on yield contributing characters of wheat.

S. No.	Treatments	No. of effective tillers (m^2)	No. of grains /spike	Weight of spike	Test Weight (g)
T1	Control	236.00	35.00	1.38	36.00
T2	RDF (100%) N, P_2O_5, and K_2O @ 120:60:60 Kg/ha respectively	346.00	38.00	1.55	37.00
T3	RDF (75%) N, P_2O_5, and K_2O @ 90:45:45 Kg/ha respectively	287.00	37.40	1.50	36.55
T4	T_3 + Paddy Straw @ 5 t ha^{-1}	298.00	37.50	1.51	36.70
T5	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decompo-ser consortium @ 100mL of Formulation per plot	307.00	37.60	1.53	37.01
T6	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot	331.00	37.80	1.54	36.90
T7	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot	348.00	38.20	1.56	37.05
T8	T_3 + Nutrient mobilizer consortium @ 50 mL / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	319.00	37.70	1.53	36.80
T9	T_3 + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	329.00	37.80	1.54	36.86
T10	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	357.00	38.80	1.59	37.10
T11	Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot (containing 10^8 propagules or sfu mL^{-1} of formulation (PSB + Mycorrhiza)	264.00	36.20	1.44	36.30
SEm±		10.67	1.73	0.06	1.31
CD (P =0.05)		31.47	5.11	0.17	3.88

Table 5: Effect of treatments on yield of wheat crop

S. No.	Details	Yield (q ha^{-1})			Harvest index (%)
		Grain	Straw	Biological	
T1	Control	29.80	47.80	77.60	38.40
T2	RDF (100%) N, P_2O_5, and K_2O @ 120:60:60 Kg/ha respectively	48.60	72.15	120.75	40.25
T3	RDF (75%) N, P_2O_5, and K_2O @ 90:45:45 Kg/ha respectively	39.20	59.30	98.50	39.80
T4	T_3 + Paddy Straw @ 5 t ha^{-1}	41.00	61.76	102.76	39.90
T5	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decom. Consort. @ 100mL of Formulation per plot	42.80	64.35	107.15	39.94
T6	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decom. Consort.@ 250mL of Formulation per Plot	46.20	68.65	114.85	40.23
T7	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium@ 500mL per Plot	49.20	73.00	122.20	40.26
T8	T_3 + Nutrient mobilizer consortium @ 50 mL/ Plot	44.20	66.30	110.50	40.00
T9	T_3 + Nutrient mobilizer consortium @ 100ml/Plot	45.80	68.15	113.95	40.19
T10	T_3 + Paddy Straw @ 5 t ha^{-1} + Microbial Decomp. Consort. @ 250mL of Form. per Plot + Nutrient mobilizer consortium @ 100ml / Plot	51.40	76.15	127.55	40.30
T11	Paddy Straw @ 5 t ha^{-1} + Microbial Decomposer consortium @ 250mL of Formulation per Plot + Nutrient mobilizer consortium @ 100ml / Plot	34.70	54.75	89.45	38.79
SEm±		2.06	2.35	3.68	1.84
CD (P =0.05)		6.07	6.94	10.87	NS