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Effect of paddy straw management practices on productivity and profitability of Wheat (*Triticum Aestivum* L.) crop

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Abstract
An experiment was conducted during *Rabi* season 2019-20 and 2020-21 at Student instructional Farm, A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). To study the effect of paddy straw management practices on productivity and profitability of Wheat (*Triticum aestivum* L.) crop. The experiment was laid out in Randomized Block Design (RBD) with four replications and thirteen treatments. The result revealed that, among the different paddy straw management practices, treatments consisting T_{11}-NPK + Paddy straw + Extra N (30 kg ha^{-1}) + nutrient mobilizing microbial consortium registered maximum grain yield (48.25 q ha^{-1} and 50.12 q ha^{-1} during 2019 and 2020, respectively), straw yield (60.55 q ha^{-1} and 62.10 q ha^{-1} during 2019 and 2020, respectively), and harvest index (45.03% and 45.06% during 2019 and 2020 respectively,), similarly the maximum net return (Rs. 81060 ha^{-1}) with higher B:C ratio (1.84) was observed with this treatments.

Keywords: Paddy straw, grain yield, straw yield, economics

Introduction
Wheat (*Triticum aestivum* L.) is the most important cereal crop for the majority of the world's population. Wheat belongs to family Poaceae (Gramineae). It is the most staple food of about two billion people (36% of the world population). World-wide wheat provides nearly 55% of the carbohydrates and 20% of food calories consumed globally. In India the area of wheat was 29.14 m ha^{-1} having production of 102.19mt and productivity 3507 Kg ha^{-1} (Agricultural Statistics at a Glance 2019) [1]. The rice-wheat cropping system is widely adopted in north India. This cropping system covers about 24.0 m ha in China, India, Pakistan, Nepal, and Bangladesh, and zinc (Zn) deficiency is widely spread in the rice-wheat belts of all these countries (Shivay, *et al.* 2008) [10]. In this system, the management of paddy straw in fields is a severe problem (Yadvinder-Singh, *et al.*, 2010) [15], and farmers generally follow the legally banned practice of burning paddy straw in their fields after combine harvesting. The problem is more severe in irrigated agriculture, particularly in the mechanized rice-wheat system of north-western India, where combine harvesters are used for the coarse rice varieties. Burning has led to a significant reduction in the microbial population of bacteria, fungi, and actinomycetes, along with phosphate/potassium solubilizing microbes and cellulose degraders. Microbial populations and enzymatic activities involved in biomass recycling failed to recover even after two months which would have reduced the potential productivity of microbial-driven processes over a period of continuous burning of both rice and wheat. Hence, for the restoration of soil fertility and higher production, there is an urgent need to look for another option like, crop residue incorporation into the soil. Incorporating rice straw can play an essential role in maintaining soil productivity by recycling N, building up soil organic matter, and improving the physical properties of the soil. However, the incorporation of rice straw may result in immobilization of the fertilizer-N and a reduction in the N supply for plants. Lower wheat yields compared to wheat with no rice straw incorporated (Yadvinder-Singh, *et al.*, 1988; Toor and Beri, 1991) [15, 13]. Nitrogen immobilized in crop residue rematerializes later in the season. In south-east Australia, where temperatures are relatively low and there are long fallow periods, it has been recommended to incorporate stubble six months before seeding the next crop to avoid early N deficiencies associated with immobilization (Bacon, *et al.*, 1989) [3]. However, soil from Punjab was amended with rice straw and incubated under moist aerobic conditions at 28◦C. During the first nine days, soil and fertilizer-N were rapidly

immobilized, followed by N mineralization (Toor and Beri, 1991) [13]. Keeping the above facts in view, the present investigation was to evaluate the effect of effect of paddy straw management practices on productivity and profitability of Wheat.

Materials and methods

An experiment was conducted during *Rabi* season 2019-20 and 2020-21 at Student instructional Farm, A.N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experimental soil having silty loam in texture pH (1:2.5) 8.24, electrical conductivity (EC) 0.32dS m^{-1}, organic carbon 0.31%, available N 148.40 $kgha^{-1}$, P 10.60 $kgha^{-1}$ and K 257.0 kg ha^{-1}. All treatments were randomly allocated and replicated three times in a randomized block design was adopted for the experimentation. The experiment was comprised with thirteen treatments *viz.* T_1-Control, T_{-2}-NPK, T_3-NPK + Paddy straw, T_4-NPK + Paddy straw + Extra N (20 kg ha^{-1}), T_5-NPK + Paddy straw + Extra N (25 kg ha^{-1}).,T_6-NPK + Paddy straw + Extra N (30 kg ha^{-1}.), T_7-NPK + Paddy straw + FYM, T_8-NPK + Paddy straw + microbial consortium for nutrient mobilization, T_9-NPK + Paddy straw + Extra N (20 kg ha^{-1}.) + nutrient mobilising microbial consortium, T_{10}-NPK + Paddy straw + Extra N (25 kg ha^{-1}.) + Nutrient mobilising microbial consortium T_{11}-NPK + Paddy straw + Extra N (30 kg ha^{-1}.) + nutrient mobilising microbial consortium, T_{12}-NPK + microbial consortium for nutrient mobilization, T_{13}-NPK+ Paddy straw + FYM + nutrient mobilising microbial consortium. The recommended dose of NPK was applied through urea, DAP and muriate of potash, respectively. The rice variety PBW-373 was taken as a test crop. Threshed grains were separated out manually and grains were sun dried to moisture of 14% before recording their weight. Straw yield was recorded by subtracting the weight of grains from the weight of each net plot. Harvest index of each plot was calculated with the help of following formula:

Harvest index (%) = Grain yield (q ha^{-1})/Total biological yield (qha^{-1}) ×100

The data recorded on various parameters were subjected to statistical analysis following analysis of variance technique and were tested at 5% level of significance to interpret the significant differences.

Results and Discussion

Effect of paddy straw management practices on Yield of wheat crop

Data concerning the grain yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}), and harvest index as influenced by various rice straw management practices have been presented in Table 1

The maximum grain yield (48.25 q ha^{-1} and 50.12 q ha^{-1} during 2019 and 2020, respectively) were recorded with treatment T_{11} - NPK + Paddy straw + Extra N (30 kg ha^{-1}) + Microbes, which were closely followed by T_6- NPK + Paddy straw + Extra N (30 kg ha^{-1}), but significantly higher to all those treatments containing 120 kg N ha^{-1}*viz.*T_2- NPK, T_3-NPK + Paddy straw, T_7- NPK + Paddy straw + FYM, T_8-NPK + Paddy straw + Microbes, T_{12}-NPK + Microbes and T_{13}- NPK+ Paddy straw + FYM + Microbes, but found non-significant with all those treatments which have extra doses of nitrogen of 20-30 kg N ha^{-1}*viz.* T_4 NPK + Paddy straw + Extra N (20 kg ha^{-1}.), T_5-NPK + Paddy straw + Extra N (25 kg ha^{-1}), T_6- NPK + Paddy straw + Extra N (30 kg ha^{-1}), and T_9-NPK + Paddy straw + Extra N (20 kg ha^{-1}) + Microbes. On increasing doses of nitrogen from 120-140 kg, N ha^{-1} with or without microbial culture grain yield was increased but differences were found non-significant. On increasing, nitrogen doses from 120 to 140 kg N ha^{-1} yield were significantly increased 9.48% by and 9.71% in the treatments T_3 and T_4, during 2019 and 2020, respectively. An increase of 5.63% and 6.82% during 2019 and 2020, respectively, on increasing nitrogen doses from 140 to 150 kg N ha^{-1} with microbial culture in the treatments T_9 and T_{11}, while there were an increase of 5.14% and 6.68% during 2019 and 2020, respectively on increasing nitrogen doses from 140 to 150 kg N ha^{-1} without microbial culture observed in the treatments T_4 and T_6. The minimum grain yield (23.75 q ha^{-1} and 24.50 q ha^{-1}) was observed in the control (T_1) during both years of investigation.

The maximum straw yield (60.55 q ha^{-1} and 62.10 q ha^{-1} during 2019 and 2020, respectively) were observed with treatment applying T_{11} - NPK + Paddy straw + Extra N (30 kg ha^{-1}.) + Microbes, which closely followed by T_6>T_{10}> T_5> T_9>T_4, and statistically significantly higher to all those treatments containing 120 kg N ha^{-1} *viz.*T_2- NPK, T_3-NPK + Paddy straw, T_7-NPK + Paddy straw + FYM, T_8-NPK + Paddy straw + Microbes, T_{12}-NPK + Microbes and T_{13}-NPK+ Paddy straw + FYM + Microbes, On increasing doses of nitrogen from 120-140 kg N ha^{-1} with or without microbial culture straw yield were increased but differences between found non-significant. On increasing nitrogen doses from 120 to 140 kg N ha^{-1} yield was significantly increased by 9.57% and 9.79% in the treatments T_3 and T_4, during 2019 and 2020, respectively. An increase of 6.41 and 7.96% during 2019 and 2020, respectively, on increasing nitrogen doses from 140 to 150 kg N ha^{-1} with microbial culture in the treatments T_9 and T_{11}, while there were an increase of 6.15% and 6.64% during 2019 and 2020, respectively on increasing nitrogen doses from 140 to 150 kg N ha^{-1} without microbial culture observed in the treatments T_4 and T_6. The minimum straw yield (33.75 q ha^{-1} and 34.11q ha^{-1}) was observed in control (T_1) during both years of investigation.

Highest harvest index (45.03% and 45.06% during 2019 and 2020 respectively, was recorded with the T_7-NPK + Paddy straw + FYM followed by T_{13}-NPK + Paddy straw + FYM + Microbes, while the lowest value of harvest index was recorded in absolute control T_1 (41.30% and 41.80%) respectively during both year of investigation. Crop residues could be better managed, this would directly improve crop yields by increasing soil nutrient availability, decreasing erosion, improving soil structure, and increasing soil water holding capacity. Crop residue management is agronomically beneficial and environmentally friendly. The benefit derived out of compost, crop residue or compost + crop residue in addition to chemical fertilizer might be due to decrease in loss of applied nutrients and release of nutrients as a result of decomposition process resulting in more availability to the corp. Such a possibility had been reported by Kumar and Prasad (2008), Singh and Yadav (2006), Rajkhowa and Borah (2008), Bhattacharjee *et al.* (2013) and Dhar *et al.* (2014) [7, 11, 9, 4, 5]. Application of nutrient mobilizing microbial consortium cause more vigorous and extensive root system of crop leading to increased vegetative growth means for more efficient sink formation and greater sink size, greater carbohydrate translocation from vegetative plant parts to the grains and higher dry matter accumulation during grain filling period. It also increased biological efficiency of crop plants and enhanced the level of soil enzymes activities and promoted the recycling of soil nutrients in the ecosystem, improve the absorptive power of cations and anions present on soil particle and that may be released slowly during the crop growth and improvement in soil structure to existence of favorable nutritional environment under the influence of organic liquid manures which had a positive effect on vegetative and reproductive growth which ultimately led to realization of higher values for growth attributes leading to higher yield of crop. Moreover, the IAA and GA present in nutrient mobilizer when applied as foliar spray could have created stimuli in the plant system and increased the production of growth regulators in cell system and the action of growth regulators in plant system ultimately stimulated the necessary growth and development. Similar finding also reported by Patel *et al.* (2021) [8] in pearl millet.

Economic analysis of wheat crop on basis of average of both years as influenced by different paddy straw management practices

Data pertaining to economics of wheat crop as influenced by various paddy straw management practices are presented in the table 2.

Cost of cultivation

The data showed that average cost of cultivation varied mainly due to variation in cost of inputs required for various paddy straw management practices. The cost of cultivation varied from Rs. 37118 ha^{-1} to 47199 ha^{-1}. The maximum cost of cultivation (Rs. 47199 ha^{-1}) was incurred in the treatment T_{13}-NPK + Paddy straw + FYM + Microbes closely followed by T_7-NPK + Paddy straw + FYM whereas, the lowest cost of cultivation of system (Rs. 37118 ha^{-1}) was associated with T_1–Control. The data showed that treatment with additional doses of Nitrogen along with nutrient mobilizer provided less cost of cultivation than treatment having combine application of RDF along with FYM and nutrient mobilizer. Cost of cultivation was higher in FYM used treatments as compared to chemical fertilizer used plots because of higher cost of FYM and additional labour required for its application.

Gross return

The Gross return varied from Rs. 63174 to 125083 ha^{-1}. The data showed that maximum average gross return (Rs. 125083 ha^{-1}) was obtained in the treatment T_{11}-NPK + Paddy straw + Extra N (30 kg ha^{-1}) + Microbes, closely followed by T_{10}-NPK + Paddy straw + Extra N (25 kg ha^{-1}) + Microbes, whereas, the lowest gross return of system (Rs. 63174 ha^{-1}) was associated with T_1–Control.

Net return

The Gross return varied from Rs. 26056 to 81060 ha^{-1}. The data showed that maximum average net return (Rs. 81060 ha^{-1}) was obtained in the treatment T_{11}-NPK + Paddy straw + Extra N (30 kg ha^{-1}) + Microbes, closely followed by T_{10}-NPK + Paddy straw + Extra N (25 kg ha^{-1}) + Microbes, whereas, the lowest Net return of system (Rs. 26056 ha^{-1}) was associated with T_1–Control. Additional nitrogen doses along with nutrient mobilizer obtained higher net return because of higher productivity.

Benefit cost ratio

The data regarding to average benefit cost ratio are clear from the data that maximum average benefit cost ratio (1.84) was obtained with treatment T_{11}-NPK + Paddy straw + Extra N (30 kg ha^{-1}) + Microbes, followed by T_{10}- NPK + Paddy straw + Extra N (25 kg ha^{-1}) + Microbes. Among the various paddy straw management practices, additional doses of nitrogen with nutrient mobilizer proved to be more profitable than other paddy straw management practices applied alone either as organic sources or as chemical fertilizers. The minimum benefit cost ratio (0.70) was associated with T_1–Control. Similar finding was also reported by Arshadullah *et al.* (2012), Singh *et al.,* (2020) and Hammad *et al.,* (2020) [2, 20, 6] different paddy straw management practices on productivity and yield attributes of wheat and result found that the average higher net returns and benefit: cost ratio.

Conclusion

It can be concluded that application of NPK + Paddy straw + Extra N (30 kg ha^{-1}) + nutrient mobilizing microbial consortium recorded grain yield, straw yield, harvest index considered to be most effective for sustainable wheat production and profitability over other treatments and may be opted for getting higher benefit: cost ratio.

Table 1: Effect of paddy straw management practices on yield of wheat crop

S. No.	Treatments	Yield (q ha^{-1})					
		Grain		Straw		Harvest Index (%)	
		2019	2020	2019	2020	2019	2020
T_1	Control	23.75	24.50	33.75	34.11	41.30	41.80
T_2	NPK @120:60:40	40.75	41.24	50.10	51.24	44.85	44.59
T_3	NPK + Paddy straw	41.37	42.04	51.20	52.01	44.69	44.70
T_4	NPK + Paddy straw + Extra N (20 kg ha^{-1}.)	45.29	46.12	56.10	57.10	44.67	44.68
T_5	NPK + Paddy straw + Extra N (25 kg ha^{-1}.)	46.05	47.60	57.22	58.25	44.59	44.97
T_6	NPK + Paddy straw + Extra N (30 kg ha^{-1}.)	47.62	49.20	59.55	60.78	44.43	44.74
T_7	NPK + Paddy straw + FYM	43.95	44.40	53.65	54.13	45.03	45.06
T_8	NPK + Paddy straw + Microbes	42.45	43.90	52.15	53.77	44.87	44.95
T_9	NPK + Paddy straw + Extra N (20 kg ha^{-1}.) + Microbes	45.68	46.92	56.90	57.52	44.53	44.93
T_{10}	NPK + Paddy straw + Extra N (25 kg ha^{-1}.) + Microbes	46.85	48.88	58.74	60.20	44.37	44.81
T_{11}	NPK + Paddy straw + Extra N (30 kg ha^{-1}.) + Microbes	48.25	50.12	60.55	62.10	44.35	44.66
T_{12}	NPK + Microbes	41.02	41.85	50.54	51.88	44.80	44.65
T_{13}	NPK+ Paddy straw + FYM + Microbes	44.20	45.20	54.60	55.14	44.74	45.05
SEm±		1.28	1.34	1.54	1.69	0.99	0.82
CD (P=0.05)		3.85	4.02	4.62	5.07	NS	NS

Table 2: Economic analysis of wheat crop on basis of average of both years as influenced by different paddy straw management practices

S. No.	Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
T_1	Control	37118	63174	26056	0.70
T_2	NPK @120:60:40	43099	104029	60930	1.41
T_3	NPK + Paddy straw	43099	105856	62757	1.46
T_4	NPK + Paddy straw + Extra N (20 kg ha^{-1}.)	43382	116033	72651	1.67
T_5	NPK + Paddy straw + Extra N (25 kg ha^{-1}.)	43452	118765	75313	1.73
T_6	NPK + Paddy straw + Extra N (30 kg ha^{-1}.)	43523	123013	79490	1.83
T_7	NPK + Paddy straw + FYM	46699	111751	65052	1.39
T_8	NPK + Paddy straw + Microbes	43599	109386	65787	1.51
T_9	NPK + Paddy straw + Extra N (20 kg ha^{-1}.) + Microbes	43882	117483	73601	1.68
T_{10}	NPK + Paddy straw + Extra N (25 kg ha^{-1}.) + Microbes	43952	121629	77676	1.77
T_{11}	NPK + Paddy straw + Extra N (30 kg ha^{-1}.) + Microbes	44023	125083	81060	1.84
T_{12}	NPK + Microbes	43599	105150	61551	1.41
T_{13}	NPK+ Paddy straw + FYM + Microbes	47199	113738	66539	1.41

References

1. Agricultural Statistics at a Glance Government of India Ministry of Agriculture and Farmers Welfare Department of Agriculture, Cooperation and Farmers Welfare Directorate of Economics and Statistics, 2019.
2. Arshadullah M, Ali A, Hyder SI, Khan AM. Effect of wheat residue incorporation along with N starter dose on Rice yield and Soil health under saline sodic soil. The journal of animal & plant Science. 2012;22(3):753-757.
3. Bacon PE, Hoult EH, McGarity JW, Alter D. Crop growth and nitrogen transformations in wheat (Triticum aestivum L.) planted after wetland rice (*Oryza sativa* L.). Biol. Fertil. Soils, 7, 263-268.
4. Bhattacharjee B, Saha N, Debnath A, Sen S, Roy SS, Mukherjee D. In situ management of rice stubble in relation to soil nitrogen statusvis-à-vis performance of wheat crop in an Entisol. American-Eurasian Journal of Agricultural & Environment Science. 2013;13(7):943-956.
5. Dhar D, Datta A, Basak N, Paul N, Badole S, Thomas T. Residual effect of crop residues on growth, yield attributes and soil properties of wheat under rice-wheat cropping system. Indian Journal of Agricultural Research. 2014;48(5):373-378.
6. Hammad HM, Khaliq A, Abbas F, Farhad W, Fahad S, Aslam M, *et al.* Comparative effects of organic and inorganic fertilizers on soil organic carbon and wheat productivity under arid region. Communications in soil science and plant analysis. 2020;51(10):1406-1422.
7. Kumar V, Prasad RK. Integrated effect of mineral fertilizers and green manure on crop yield and nutrient availability under rice-wheat cropping system in calciorthents. Journal of the Indian Society of Soil Science. 2008;56(2):209-214.
8. Patel SP, Author C, Vala YB. Effect of Panchagavya and Jeevamrut on growth, yield attributes and yield of summer pearl millet. ~105~ The Pharma Innovation Journal. 2021;12:105-109. http://www.thepharmajournal.com
9. Rajkhowa DJ, Borah D. Effect of rice (*Oryza sativa*) straw management on growth and yield of wheat (Triticum Aestivam). Indian Journal of Agronomy. 2008;53(2):112-115.
10. Shivay YS, Kumar D, Prasad R. Relative Efficiency of zinc sulfate and zinc oxide–coated urea in rice–wheat cropping system. Communications in soil science and plant analysis. 2008;39(7-8):1154-1167. DOI: 10.1080/00103620801925869
11. Singh, R, Yadav DS. 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.
12. Singh V, Singh Dhillon GS, Singh Sidhu PS. Effect of various rice residue management practices on performance of wheat in southwestern region of Punjab. Journal of Pharmacognosy and Phytochemistry. 2020;9(3):958-962.
13. Toor GS, Beri V. Extent of fertilizer N immobilized by the application of rice straw and its availability in soil. Bio resource Technol. 1991;37:189-191.
14. Yadwinder-Singh, Gupta RK, Singh J, Singh G, Singh G, Ladha JK. Placement effects on rice residue decomposition and nutrient dynamics on two soil types during wheat cropping in rice-wheat systems in northwestern India. Nutrient Cycling in Agro ecosystems. 2010;88:471-480.
15. Yadvinder-Singh, Bijay-Singh, Maskina MS, Meelu OP. EVect of organic manures, crop residues and green manure (Sesbania Aculeata) on nitrogen and phosphorus transformations in a sandy loam at field capacity and under waterlogged conditions. Biol. Fertil. Soils. 1988;6:183-187