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INFLUENCES OF ORGANIC MANURES AND RESIDUE INCORPORATION ON YIELD AND ECONOMICS OF WHEAT (*Triticum aestivum* L.)

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ABSTRACT

The addition of rice waste and dhaincha (*Sesbania*) green manure boosted plant development and considerably raised the wheat crop's grain yield, straw yield, biological yield, and harvest index. During the early years of the trial, residue assimilation had no discernible impact on wheat yield. However, with the treatment residue incorporation rather as residue burning and residue removal, a considerably greater grain yield, straw yield, biological yield, and harvest index was noted during the second year. However, during the second year of the trial, it was discovered that treatment standing stubble was statistically comparable to treatment residue removal and residue burning. Higher straw yield was achieved by the incorporation of residue, which may have been caused by improvements in organic matter, soil fertility, and the physical and biological health of the soil. Crop residue incorporation and green manuring also increased the increased monetary return and B: C ratio.
Keywords **:** Grain yield, Green manuring, Dhaincha, Benefit cost ratio, Wheat.

Introduction

The two most significant cereal crops worldwide are wheat (*Triticum aestivum* L.) and rice (*Oryza sativa* L.). Rice is India's most significant kharif crop, with an area of about 44.5 million ha and a production of 120 million tonnes. With an output of 97.5 million tonnes from an area of 29.1 million ha, wheat is the second most significant staple food crop after rice (Anonymous 2020). Crop leftovers are significant natural resources that are typically left over plant portions of crops after harvest and threshing. In addition to enhancing the ecological balance of the crop production system, crop residue recycling helps to transform excess farm waste into valuable goods to meet the nutrient requirements of crops. In the warm, semi-arid region of Jahrom in southern Iran, Ehsan *et al*. (2020) evaluated the impact of these conditions on winter wheat output and found that conservation tillage strategies and residue management are the key factors in crop productivity. The variables included two tillage systems–chisel plowing (T1) and moldboard plowing (T2) –along with three levels of nitrogen application–F1 (0 kg ha^{-1}), F2 (100 kg ha^{-1}), and F3 (150 kg ha^{-1}). Straw incorporation and burning of previous crop residue were also included. The outcome showed that chisel plowing, in conjunction with retained residue and 150 kg ha^{-1} nitrogen, can result in the maximum yield. Environmental pollution may result from the burning of crop residue and the usage of chemical fertilizers. In addition to chemical fertilizers, organic manures such as farm yard manure (FYM) and green manure (GM) would also contribute significantly to the quality of fragrant rice production as well as the preservation of soil fertility and health (Kumar *et al*., 2018). Basmati rice can be effectively cultivated with only green manure or by combining FYM and a little amount of chemical fertilizer. Even though they are more expensive solutions than chemical fertilizer, they boost soil organic carbon and the amount of N, P, and K that is readily available when compared to chemical fertilizer alone and help to ensure the sustainability of agriculture.

Materials and Methods

The current investigation was carried out in the Talwandi Sabo research farm of the University College of Agriculture, Guru Kashi University, over the course of two consecutive years (2019–20 and 2020–21). Talwandi Sabo is 213 meters above sea level and is situated at 29°-59'N latitude and 75°-4'E longitude. This tract is distinguished by a semi-arid zone with harsh winters and summers. While a high temperature of about 40.1 to 41.9 °C is not unusual in the summer, January and February can experience freezing temperatures and frost. The experiment was set up using a split-plot design, with four major plot treatments (green manuring choices, including Dhaincha inclusion 40DAS, 60DAS, FYM, and control) and four sub-plot treatments (residue incorporation, residue removal, and residue burning and standing stubble) replicate thrice. The experimental data was recorded on plant growth and development (Plant height (cm), Number of tillers / m row length, effective tillers, panicle length, number of grains/panicle, yield attributes and yield of rice during both the years of study.

Result and Discussion

Effect of crop residues and green manuring on grain yield, straw yield, biological yield and harvest index

Grain yield (q ha^{-1})

During the two study years shown in Table 1, green manuring had a considerable impact on wheat grain output. The highest grain yield (58.1 and 60.1 q ha^{-1}) was obtained by including dhaincha at 40 DAS, which was substantially greater than the yields produced by the control (50.4 and 50.1 q ha^{-1}) and by incorporating dhaincha at 60 DAS (51.8 and 55.2 q ha^{-1}) and FYM (52.5 and 54.8 q ha^{-1}) during the first and second years, respectively. However, during both study years, the grain yields of treatments dhaincha incorporation 60DAS and FYM were statistically comparable to one another. This may be attributable to an increase in soil fertility brought about by the integration of crop residue (in this case, rice) and green manuring with dhaincha, which in turn affected plant vigor and growth. The same results were also reported by Hrusikesh and Prasad, (2016), It was also said that adding Sesbania green manure to the soil enhanced wheat yield, plant height, and the quantity of shoots and dry matter accumulated per hill. During the two years of the trial, the control group's minimum grain yield was noted.

During the two years of the study, residue incorporation had a considerable impact on wheat grain yield. During the two years of the study, residue inclusion significantly increased grain yield compared to standing stubble, residue removal, and residue burning. Grain yield increased as a result of residue incorporation, which may be related to improvements in organic matter, soil fertility, and the physical and biological health of the soil. However, throughout the first year of the trial, residue removal and burning were statistically comparable. According to Aulakh *et al*. (2001), crop residue inclusion in a rice-wheat system is expected to increase soil organic matter while retaining high grain yields. As a result, crop residue incorporation into the soil can be extremely helpful in boosting crop production.

Straw yield (q ha^{-1})

During the two study years shown in Table 1, green manuring had a considerable impact on wheat straw yield. During both study years, a significantly higher straw yield was seen with the treatment dhaincha incorporation 40DAS than with residue burning and removal. However, during both research years, the treatment dhaincha incorporation 40DAS was discovered to be statistically comparable to the treatment dhaincha incorporation 60 DAS and FYM.

During the early years of the trial, residue assimilation had no discernible impact on wheat's ability to produce straw. However, compared to residue burning and residue removal, treatment residue incorporation resulted in significantly better straw yield during the second year. However, during the second year of the trial, it was discovered that treatment standing stubble was statistically comparable to treatment residue removal and residue burning. Higher straw yield was achieved by the incorporation of residue, which may have been caused by improvements in organic matter, soil fertility, and the physical and biological health of the soil. Similar findings were also reported by Singh and Sharma (2001), who found that the wheat-green manuring-rice sequence greatly increased plant height. During the two years of the study, the control group's minimum straw yield was noted. According to Aulakh *et al*. (2001), crop residue inclusion in a rice-wheat system is expected to increase soil organic matter while retaining high grain yields. As a result, crop residue incorporation into the soil can be extremely helpful in boosting crop production.

Table 1: Effect of crop residues, farm yard manure and green manuring on grain, straw, biological yield and harvest index of wheat

Treatments	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Biological yield (q ha^{-1})		Harvest index (%)	
	2019	2020	2019	2020	2019	2020	2019	2020
Green manuring								
Control	50.4	50.1	67.4	68.5	117.7	118.7	42.8	42.2
D_{40}	58.1	60.1	76.1	77.9	134.2	138.0	43.3	43.5
D_{60}	51.8	55.2	74.3	73.4	126.1	128.6	41.1	42.9
FYM_{25}	52.5	54.8	70.8	71.5	123.4	126.3	42.5	43.3
LSD (p=0.05)	1.9	3.4	5.5	4.8	5.9	5.6	NS	NS
Residue incorporation								
BR-W_{RI}	55.8	58.5	74.9	77.0	130.7	135.4	42.7	43.2
BR-W_{RR}	51.7	53.6	71.9	71.8	123.6	125.4	41.8	42.7
BR-W_{RB}	51.3	53.2	71.1	70.5	122.4	123.7	41.9	43.0
BR-W_{SS}	54.0	54.8	70.6	72.0	124.6	126.8	43.3	43.2
LSD (p=0.05)	1.4	1.5	NS	2.5	3.1	2.5	1.6	NS

Biological yield (q ha^{-1})

During the two study years shown in Table 1, green manuring had a considerable impact on the biological yield of wheat. Dhaincha incorporation at 40 DAS resulted in a significantly larger biological yield than control and all other treatments. However, during both research years, biological yield with the therapy dhaincha incorporation 60DAS was discovered to be statistically comparable to treatments FYM. This may be attributable to an increase in soil fertility brought about by the integration of crop residue (in this case, rice) and green manuring with dhaincha, which in turn affected plant vigor and growth. Arshadullah *et al*. (2012) similarly observed similar findings. According to Hrusikesh and Prasad (2016), the addition of Sesbania green manure enhanced plant height, the number of shoots per plant, and the amount of dry matter accumulated per hill in rice.

During the two years of the study, residue integration had a considerable impact on the biological yield of wheat.

Incorporating residue increases grain yield significantly compared to standing stubble, residue removal, and residue burning over the course of the two years of the study. Treatment residue burning had the lowest biological yield. Higher biological yield was produced by the incorporation of residue, which may have been caused by improvements in organic matter, soil fertility, and the physical and biological health of the soil. However, during both study years, the treatment standing stubble was discovered to be statistically comparable to the treatments residue removal and residue burning. Kharub *et al.* (2004) observed similar findings as well. Before planting wheat, rice straw was added to the soil, and *Sesbania bispinosa* was added before dredging rice.

Harvest index (%)

Green manuring had no discernible effects on wheat harvest index (%) during any of the two study years shown in Table 1. However, the treatment greatly altered the harvest index by incorporating residues. Treatment standing stubble was discovered to be statistically equivalent to residue incorporation, nevertheless. With the treatment residue burning, which was statistically equivalent to residue removal, the least harvest index was recorded.

Effect of crop residues, farm yard manure and green manuring on economics

Cost of cultivation

The information in Table 2 relevant to cultivation costs has been provided. In both years (2019-20 and 2020-21), FYM incorporation had the greatest cost of cultivation (Rs 80,886 and 81,956 ha^{-1}, respectively), followed by dhaincha incorporation 60 DAS (Rs 58,518 ha^{-1} in 2019-20 and 59,245 Rs ha^{-1} in 2020-21), and dhaincha incorporation 40 DAS (Rs 58225 and 59339 ha^{-1}). In 2019–20 and 2020–21, respectively, the control cost of agriculture was Rs. 55,945 ha^{-1} and Rs. 57,211 ha^{-1}.

During both study years, the treatment residue removal cost of cultivation was the greatest (Rs 68,467 and 70,130 income ha^{-1}), followed by residue incorporation (Rs 66544 and 68246 revenue ha^{-1}), and residue burning (Rs 62,743 and 63,676 income ha^{-1}). In 2019–20 and 2020–21, respectively, the treatment standing stubble had a minimum cost of cultivation of Rs. 55,820 and Rs. 55,708 per ha. Similar results were also reported by Priyanka Suryavanshi and Yashwant Singh (2019), who found that using hemp for green manuring offers the specific advantages of having greater yields, lower input costs, and higher income than using other methods. Overall, the use of green manuring along with FYM at a rate of 14 t ha^{-1} has increased yield while decreasing cost, which has improved net return and the B:C ratio. The highest B:C ratio was discovered in T_3 (2.56), followed by T_2 (2.39).

Gross return (Rs ha^{-1})

The condensed information about total gross income is shown in Table 2. Treatment dhaincha incorporation 40 DAS had the highest gross income over the course of both years, earning Rs 1,93,335 and Rs 2,14,276 per year, respectively. It was followed by treatment dhaincha incorporation 60 DAS, earning Rs 1,80,562 and Rs 1,96,553 per year, respectively, and FYM incorporation, earning Rs 1,79,439 and Rs 1,93,493 per year, respectively. In the treatment and control groups, the minimal gross income was 1, 68,921 and 1, 82,879 rupees per hectare per year, respectively.

During the first year (2019–20), the treatment residue removal had the highest gross income (1, 95,229 ha^{-1}), followed by residue incorporation (1, 80,930 ha^{-1}), standing stubble (1,77,045 ha–1), and residue burning (1,69,053 ha^{-1}), in that order. The treatment residue removal (Rs 2, 08,136 ha^{-1}) produced the highest gross return for the second year (2020–21), followed by residue incorporation (Rs 2, 03,165 ha^{-1}), standing stubble (Rs 1,95,823 ha^{-1}), and residue burning (Rs 1,79,777 ha^{-1}), in that order. Similar results were also reported by Priyanka Suryavanshi and Yashwant Singh (2019), who found that using hemp for green manuring offers the specific advantages of having greater yields, lower input costs, and higher income than using other methods. Overall, the use of green manuring along with FYM at a rate of 14 t ha^{-1} has increased yield while decreasing cost, which has improved net return and the B:C ratio. The highest B:C ratio was discovered in T_3 (2.56), followed by T_2 (2.39).

Net returns (Rs ha^{-1})

A short review at the data in Table 2 revealed that the dhaincha incorporation 40 DAS, which was much better than other treatments, recorded the maximum net return at Rs 1,35,110 revenue ha-1 and 1,54,928 income ha-1 in 2019–20 and 2020–21, respectively. Additionally, during the two research years, the minimal net return was reported in treatment FYM at Rs 98,553 income ha^{-1} and Rs 1, 11,537 income ha^{-1}, respectively.

During the first year of the study, the treatment residue removal had the highest net return (Rs 1, 26,762 ha^{-1}) followed by standing stubble (Rs 1, 21,225 ha^{-1}) residue incorporation (Rs 1,14,386 ha^{-1}) and residue burning (Rs 1,06,310 ha^{-1}). However, residue removal (Rs 1, 38,006 ha^{-1}), residue incorporation (Rs 1, 34,919 ha^{-1}) and residue burning (Rs 1, 16,101 ha^{-1}) produced the highest net return (Rs 1, 40,115 ha^{-1}).

B: C ratio

The crop's B:C ratio is the ratio of gross return to cultivation cost. The B:C ratio data reported in Table 2 showed that the treatment dhaincha incorporation 40DAS had the highest benefit cost ratio at 2:3, 2:6 in 2019-20 and 2020-21, which was significantly greater than all other treatments. During both years of investigation, the therapy FYM had the lowest B:C ratio at 1:2 and 1:3.

During both years, the treatment standing stubble had the highest benefit-cost ratio (2:1 and 2:5). During both years of research, the treatment residue burning was used to calculate the minimum benefit cost ration. Priyanka S. and Y. Singh (2019) found that green manuring with sunhemp offers the particular advantage of higher yield, lower input costs, and higher income over control. Overall, the combined effect of cost reduction and improved yield in treatment with green manuring application together with FYM application @ 14 t ha^{-1} has resulted in an increase in net return and B: C ratio. T_3 had the highest B: C ratio (2.56), followed by T_2 (2.39).

Table 2 : Effect of crop residues and green manuring on Economics

Treatments	Cost of cultivation (Rs ha^{-1})		Gross return (Rs ha^{-1})		Net return (Rs ha^{-1})		B:C	
	2019	2020	2019	2020	2019	2020	2019	2020
Green manuring								
Control	55,945	57,211	1,68,921	1,82,879	1,12,976	1,25,668	2.1	2.2
D_{40}	58,225	59,348	1,93,335	2,14,276	1,35,110	1,54,928	2.3	2.6
D_{60}	58,518	59,245	1,80,562	1,96,553	1,22,044	1,37,308	2.1	2.3
FYM_{25}	80,886	81,956	1,79,439	1,93,493	98,553	1,11,537	1.2	1.3
LSD (p=0.05)	329	1109	4246	4340	3961	3992	0.1	0.06
Residue incorporation								
BR-W_{RI}	66,544	68,246	1,80,930	2,03,165	1,14,386	1,34,919	1.7	2.0
BR-W_{RR}	68,467	70,130	1,95,229	2,08,136	1,26,762	1,38,006	1.8	1.9
BR-W_{RB}	62,743	63,676	1,69,053	1,79,777	1,06,310	1,16,101	1.7	1.8
BR-W_{SS}	55,820	55,708	1,77,045	1,95,823	1,21,225	1,40,115	2.1	2.5
LSD (p=0.05)	195	615	3463	2835	3441	2767	0.06	0.06

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Reference

Anonymous, (2020). ICAR Annual Report (2019-20). http://dare.nic.in/sites/default/files/AR-2019-20-English-Final.pdf.

Arshadullah, M., Arshad, A., Syed Ishtiaq, H., Imdad, A.M. and Badar-uz-Zaman (2012). Integrated effects of wheat residue and phosphorus application on rice productivity and soil health under salt affected soils. *Pak. J. Sci. Ind. Res. Ser. B: biol. Sci*., 58(3): 117-121

Aulakh, M.S., Khera, T.S., Doran, J.W. and Bronson, K.F. (2001). Managing crop residue with green manure, urea and tillage in a rice-wheat rotation. *Journal. Soil Science Society of A lIlerica,* 65(3) : 820-7

Ehsan, H. and Esmailpourb, M. (2020). The impacts of tillage and residue managements on wheat production in a semi-arid region of Iran. *Journal of the Saudi Society ofAgricultural Sciences,* 19(3): 225-232.

Hrusikesh and Prasad, (2016), Reported that green manuring in rice wheat cropping system, *Quartley Journal of Life Sciences,* 12 (4): 800-806.

Kharub, A.S., Sharman, R.K., Mongin, A.D., Chhoka, R.S., Tripathr, S.C. and Sharman, V.K. (2004). Effect of rice *(Oryza sativa)* straw removal, burning and incorporation on soil properties and crop productivity under rice-wheat *(Triticum aestivum)* system ., *Indian Jounal of Agricultural Sciences,* 74(6) : 295-299.

Kumar, R., Kumar, M. and Bharose, R. (2018). Effect of integrated nutrient management on yield, nutrient availability and soil health of basmati/aromatic rice (*Oryza sativa* L.) in Inceptisol of eastern Uttar Pradesh, *Journal of Pharmacognosy and Phytochemistry,* 7(6): 2669-2671.

Priyanka, S. and Singh, Y. (2019). Effect of in situ green manuring on rice yield and water productivity. *An International Refereed, Peer Reviewed & Indexed Quarterly Journal in Science, Agriculture & Engineering* 08: 279-281.

Singh,V.K. and Sharma, B.B. (2001). Productivity of rice (*Oryza sativa*) as influenced by crop diversification in wheat (*Triticum aestivum*)-nce cropping system on Mollisols of foothills of Himalayas. *Indian Journal of Agricultural Sciences*, 71(1): 5-8.