

## IMPACT OF RICE RESIDUE MANAGEMENT OPTIONS AND FERTILIZERS ON YIELD AND YIELD ATTRIBUTES OF WHEAT (*TRITICUM AESTIVUM* L.)

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**Abstract:** A field experiment was conducted at research farm, KVK, Panipat, CCS Haryana Agricultural University, Hisar during the *rabi* season 2018-19 and 2019-20 with the objective to study the impact of rice residue management options and fertilizer doses on productivity of wheat. The treatments applied to wheat consist of four rice residue management practices (R<sub>1</sub>: Residue removal, R<sub>2</sub>: Residue Burning, R<sub>3</sub>: Residue Incorporation and R<sub>4</sub>: Residue Retention and direct seeding of wheat with happy seeder into standing rice stubbles) in main plot and different doses of NPK fertilizers (F<sub>1</sub>: Control, F<sub>2</sub>:100% N + 50% Recommended dose of P&K, F<sub>3</sub>:100% N + 75% RD of P&K, F<sub>4</sub>: 100% N 75% RDF+ Waste decomposer and F<sub>5</sub>:100% Recommended dose of NPK fertilizer) in sub main plot. The grain and straw yield of wheat follow the trend: Removal>Retention>Burning>Incorporation during 2018-19 and Retention>Burning>Removal>Incorporation during 2019-20. The growth, yield and yield attributes of wheat (*viz.* number of tillers/row length, grains per spike) was observed significantly higher under residue removal and 100% NPK fertiliser doses treatment during 2018-19 and under residue retention and 100% NPK fertiliser doses treatment during 2019-20. However test weight of grains was recorded higher under the retention treatment during both the years of study. There was no saving of fertilizers with residue management practices; however under burning condition, the wheat yield observed under 100 % RDF was statistically at par with 75% PK + 100% N treatment. Retention of rice straw and wheat sowing with happy seeder can be a better option for rice straw management under rice –wheat cropping system.

**Keywords:** Wheat, Residue management, Yield attributes

### INTRODUCTION

Rice-wheat is a dominant cropping system for food security, employment, income and livelihood for millions of people. Current practices involve intensive tillage for both crops and removal of all crop residues, which cause the depletion of nutrients and reduction in soil fertility. Crop residue management (residue retention as surface mulch and incorporation) is considered substitute of conventional practices for solving the problems related to water, labour, energy resources and sustainability of RW system (Jat *et al.*, 2017). Management of rice straw in fields is a serious problem (Gupta *et al.*, 2010; Chauhan *et al.*, 2012) in rice based cropping system and farmers generally follow the legally banned practice of in situ burning of paddy straw. Since inferior quality of rice residue, scarcity of labour for manual harvesting, use of combine harvester, timeliness in operation and cleaning of fields etc. are the major reason behind burning of residue. In quantitative terms, about 80% of rice straw produced is being burnt annually in just 3 to 4 weeks during October-November in between the rice harvest and wheat sowing. Crop residues are source of plant nutrients and addition of them to soil help in replenish of soil nutrients. About 25% of N&P, 50% of S and 75% of K uptake by cereals

crops are retained in crop residue and making residue viable source of nutrient. Rice vegetative parts at maturity contain about 40% N, 30-35% P, 80-85% K and 40-50% S, respectively (Dobermann and Fairhurst, 2002). Each ton of rice straw contains approximately 5.5 kg N, 2.3 kg P<sub>2</sub>O<sub>5</sub>, 15-20 kg K<sub>2</sub>O, 1.2kg S, 3-4 kg Ca, 1-3 kg Mg and 40-70 kg Si. Rice straw also contains micronutrients such as Zn (96 g ha<sup>-1</sup>), Fe (777 g ha<sup>-1</sup>), Mn (745 g ha<sup>-1</sup>), Cu (42 g ha<sup>-1</sup>), B (55 g ha<sup>-1</sup>) and Mo (4 g ha<sup>-1</sup>) as well as 400 kg of carbon, which are lost due to burning leading to huge amount of plant nutrient losses (Throat *et al.*, 2015). Addition of residue into soil directly and indirectly affected the crop performance and yield in many ways and results are varied according to the practices involving for residue management. Incorporated residue of either rice or wheat released nutrients slowly after decomposition during the crop growth period and cope with the nutrient requirement cycle of crop and resulted in better crop growth, establishment and dry matter production. The short time interval between the rice harvest and wheat sowing along with the additional field preparation charges poses challenge with the incorporation of rice residue. The incorporation of crop residue can have adverse effect on following crop although in some studies the negative effect of incorporation diminished after few initial years (Kharb *et al.*,

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2004). This negative effect on yield can result from immobilization of soil and fertilizer nitrogen during the early stages of decomposition of residue because of high C:N ratio, resulting nitrogen deficiency in succeeding crop (Pathak *et al.*, 1997). There are several reports showing similar and positive effect of residue management practices viz; burning, removal or incorporation on rice and wheat yields (Bijay Singh *et al.* 2008; Kahloon *et al.*, 2012, Dotaniya 2013; Dhillon 2016 and Iqbal *et al.*, 2017). While others recorded significantly lower yields of both rice and wheat with the incorporation of crop residues as compared to removal or burning of residue (Beri *et al.*, 1995; Kharb *et al.* 2004; Gupta *et al.*, 2007 and 2009). Keeping these points in view experiment was conducted to study the effect of residue management options on yield and yield attributes of wheat crops under rice wheat cropping system.

## MATERIALS AND METHODS

### Experimental site and weather conditions

Field conducted during *Rabi*, 2018 on the permanent plots at research farm of CCS Haryana Agricultural University, Krishi Vigyan Kendra Panipat, Haryana to study the effect of crop residue management options and fertilizer levels on performance of succeeding wheat yield under rice - wheat cropping system. The experimental sites is located at 29°39'N latitude and 76°97'E longitude at the mean sea elevation of 219 m in north-west part of India. The experimental site has sub-tropical and sub-humid climate characterized by hot desiccating winds of average velocity during summer and moderate to severe cold in winter. The average annual rainfall in the area is around 700 mm which is received mainly (around 80%) during the period from July to September. The temperature may rise up to 45 °C during summer season and often dips up to 5 °C during the winter months of December and January, respectively. The soil of experimental site was sandy loam, *Typic Ustocherpt* having alkaline pH (8.0) and EC value 0.35 dSm<sup>-1</sup>. The soil organic carbon content was medium (0.62%) having low available nitrogen (124 kg ha<sup>-1</sup>), high available phosphorus (38.0 kg ha<sup>-1</sup>) and medium available potassium (186 kg ha<sup>-1</sup>).

### Treatment details

The treatments applied to wheat consist of four residue management options (R<sub>1</sub>: Residue removal, R<sub>2</sub>: Residue Burning, R<sub>3</sub>: Residue Incorporation and R<sub>4</sub>: Residue retention and direct seeding of wheat with happy seeder into rice stubbles) and five levels of NPK fertilizers (F<sub>1</sub>: Control, F<sub>2</sub>: 100% N + 50% RD of P&K, F<sub>3</sub>: 100% N + 75% RD of P&K, F<sub>4</sub>: 100% N + 75% RD of P&K + Waste decomposer and F<sub>5</sub>: 100% R D of NPK fertilizer). These treatments were maintained in permanent plots in triplicate under split plot design keeping residue management in main plot and fertilizer levels in sub plots. Recommended dose of

fertilizers i.e. 150:60:60 (N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O) were applied through urea, DAP and MOP and whole amount of P and K was applied at the time of sowing while 50 % N was applied at the time of sowing and remaining 50% was applied at the time of first irrigation (25 DAS). Wheat variety HD-2967 was sown on 16<sup>th</sup> November and 30<sup>th</sup> October in the year 2018-19 and 2019-20 respectively. After the harvest of rice by combine harvester, the rice stubbles were completely removed with the help of sickle from the residue removal plots. In R<sub>2</sub> treatment, rice straw was burned in field and next day sowing of wheat was done after first ploughing of rotavator followed by broadcasting of seed and again ploughing by rotavator in removal, burning and incorporation plots, while in retention plots, the sowing was completed with the help of happy seeder in the standing rice stubbles. Wheat crop was harvested at about 2-3 cm above the ground level in the month of April, 2019 and 2020, respectively. **Plant observations**

The height of ten randomly selected plants was measured in each plot at the maturity of wheat crop. The heights were recorded from the soil surface to the tip of spike of wheat plant and then mean height was worked out. The total number of tillers and effective tillers per meter row length was counted before harvest of crop. Five years or spikes were randomly selected from tagged plants in each plot at harvest. These ears were threshed separately and counted total number of grain and their average was taken as the number of grains earhead<sup>-1</sup>. Randomly seed samples were taken from each plot and 1000 healthy seeds were counted and same were oven dried till constant weight and then test weight was recorded.

### Grain and straw yield

The wheat crop was harvested in the month of April with the help of sickle and biological yield of each plot was recorded by weighing the bundles by mechanical balance. Total bundles of each plot were threshed by small thresher and grain weight of each plot was recorded. Straw yield was obtained after subtracting the grain yield from the total biological yield of plot and finally grain and straw yield was expressed by converting the each plot yield in Q/ha.

### Statistical analysis

The data recorded during the study was statistically analysed by the methods of analysis of variance (ANOVA) as described by Panse and Sukhatme (1985) with the help of OPSTAT.

## RESULTS AND DISCUSSION

### Grain and straw yield of wheat

Different rice residue management options and fertilizers levels significantly affected the grain and straw yield of wheat during both years of experimentation. Wheat grain yield varied from 19.20 (R<sub>3</sub>x F<sub>1</sub>) to 62.10 q/ha (R<sub>1</sub>x F<sub>5</sub>) during 2018-19 and 18.99 (R<sub>3</sub>x F<sub>1</sub>) to 59.10 (R<sub>4</sub>x F<sub>5</sub>) q/ha during 2019-20,

respectively under various treatments combination. Significantly higher mean value of grain yield was reported under the residue removal (53.18 q/ha) treatment followed by residue retention (52.76 q/ha), residue burning (50.70 q/ha) and residue incorporation (47.54 q/ha) treatment during the year 2018-19 and increase grain yield under removal was about 5 and 6% over that of residue burning and residue incorporation and statistically at par with retention treatment. Similarly, straw yield of wheat varied from 26.9 ( $R_3 \times F_1$ ) to 96 q/ha ( $R_1 \times F_5$ ) and 27.10 ( $R_3 \times F_1$ ) to 85.73 q/ha ( $R_4 \times F_5$ ) during 2018-19 and 2019-20, respectively under different treatment combinations. During the year 2018-19, residue removal treatment recorded significantly higher mean yield (82.9 q/ha) of straw over the other treatment, This might be due to addition of residue by different method (burning, retention and incorporation) causes immobilisation of nutrient (N) during early stage of crop growth which resulted into lower yield as compared to removal treatment. However, during the year 2019-20, grain and straw yield followed different trend. Significantly higher grain yield was recorded under residue retention (51.29 q/ha) treatment followed by residue burning (48.94 q/ha), residue removal (45.65 q/ha) and residue incorporation (44.62 q/ha). This increase in grain yield was about 5, 7 and 12% higher than that of burning, removal and incorporation treatment respectively. During the year 2019-20, retention treatment recorded significantly higher mean straw yield (74.40 q/ha) followed by residue burning (72.86 q/ha), residue removal (70.99 q/ha) and residue incorporation (64.17 q/ha). The higher wheat yield under retention might be due to maintaining better temperature, moisture, weed suppression and less lodging due to untimely rain under the mulching condition of retention treatment. The result of present study was on line with the finding of other workers (Naresh *et al.*, 2011; Hariram *et al.*, 2013; Kharia *et al.*, 2017; Vinay *et al.*, 2019; Meena *et al.*, 2020). During both the year's residue incorporation having significantly lowers yield as compared to other treatments. It was might be due to immobilization of soil and fertilizer N during the early stages of decomposition, resulting in N deficiency to crop (Thuy *et al.*, 2008; Singh *et al.*, 2009). Among the fertilizer level treatments, Control plot recoded significantly lower (22.33 and 21.93 q/ha) mean grain yield and 100% RDF ( $F_5$ ) treatment recorded significantly higher (59.93 and 55.88q/ha) yield during both the years. Under fertilizers treatments, straw yield of wheat followed the similar trend as that of grain. Significantly higher (90.29 and 82.07 q/ha) straw yield recorded under  $F_5$  fertilizer treatment over  $F_4$ ,  $F_3$ ,  $F_2$  and  $F_1$  during both the years. Interaction of both the factor having non-significant effect on grain yield of wheat during both the years but straw yield significantly affected by treatments combination during 2018-19 but non-

significantly during 2019-20. Kurmavanshi *et al.* (2018) also reported higher yield of wheat under full doses of NPK fertilizer without effecting soil fertility. Dotaniya *et al.* (2013) reported higher grain yield of wheat with N@150 and K @ 60 kg/ha under residue incorporation treatment. Data also revealed that yield obtained during 2018-19 was higher than the yield obtained during 2019-20. This might be due to unfavorable weather condition, abrupt variation in rainfall during the second year. The wheat yield under residue burning treatment was found higher than that of residue incorporation during both the years due to increase in mineral form of nutrient in soil present in the ash left after burning. In the present study about 2-6 kg of N, 1-3 kg of P and 39-71 kg of K was added in mineral form after burning of rice straw. Effect of waste decomposer on wheat yield (grain + straw) was non-significant during both the year; however, extent of increase in wheat yield was more in residue incorporation and residue burning treatments as compared to removal and retention. Data also showed that under residue burning condition of rice straw, wheat yield at  $F_3$  (75%PK+100%N) treatment was statistically at par with the  $F_5$  (100%RDF).

#### **Growth and yield attributes of wheat**

Yield attributes of wheat during both the years was significantly affected by different crop residue management and fertilizers treatment. Plant height of wheat was significantly affected by different treatment combination during both the years. Mean plant height was varied from 91.74 to 98.16 cm (2018-19) and 87.48 to 94.66 cm (2019-20) under residue management treatment and from 82.95 to 99.8 cm (2018-19) and 81.02 to 96.2 cm (2019-20) under different fertilizer treatment during both the cropping years. Interaction of both the factor showed non-significant effect on plant height during the year 2018-19, 2019-20, respectively. However, Maximum plant height was observed under  $R_1 \times F_5$  (103cm, however, minimum observed under  $R_3 \times F_1$  (81 cm) during 2018-19. While during 2019-20, maximum plant height was recorded under  $R_4 \times F_5$  (98.8cm) and minimum observed under  $R_3 \times F_1$  (78.5cm) level of interactions. Among the residue management treatments, removal treatment recorded significantly higher mean value (92 and 49) of effective number of tillers and number of grain per spike over the other treatment during 2018-19, however, during the year 2019-20, retention treatment recorded significantly higher mean values (92.72 and 48) of effective tillers and number of grain per spike.  $R_3 \times F_1$  level of interaction recorded minimum values of effective number of tillers and number of grain per spike of during both years over the other treatments combinations. Similarly higher values of effective number of tillers and number of grain per spike were observed with  $R_1 \times F_5$  during 2018-19 and  $R_4 \times F_5$  during 2019-20, respectively. Significantly higher mean values of effective tillers and number of grain

per spike were recorded with RDF (F<sub>5</sub>) as compared to other fertilizer treatments during both the year. Interaction of both factors had non-significant effect on number of effective tillers and number of grain per spike of wheat during first as well as second years. Test weight of grain followed the reverse trend during 2018-19 and higher value during both the years reported under R<sub>4</sub> treatment. Mean values of test weight was varied from 41 to 43.12g and 39.88 to 42.68g under residue management treatment and from 38.70 to 44.13g and 37.20 to 43.05g under different fertilizer treatments during the year 2018-19 and 2019-20, respectively. Interaction of both the factor showed non-significant effect on test weight of wheat during both the years of study and higher values (44.6g, 44.2g) of test weight were recorded under R<sub>4</sub>X F<sub>5</sub> level of interaction and lower values (37.4g, 35.9g) recorded under R<sub>3</sub>X F<sub>1</sub> level of interaction during 2018-19 and 2019-20, respectively. The result revealed that plant height, number of effective tillers and number of grains per spike was significantly higher under removal (R<sub>1</sub>) treatment during 2018-19 and retention (R<sub>4</sub>) treatment during 2019-20 than other treatment. However, test weight was recorded higher under retention treatment during both the year. This was might be due to better crop microclimate, root development and enhanced photosynthesis due to broad leaf size resulted bold grain size. This result was on line with the finding of Kumar *et al.* (2018) which recorded higher yield attributes under happy seeder (retention) as compared to other residue management practices. Kharia *et al.* (2017) also recorded significantly higher yield attributes viz., 1000 grain weight, spike length, grain weight per spike and grains per spike under ZTW+R (zero tillage in wheat with rice straw retained as mulch)

than that of ZT/CT with no straw. Keeping rice residue and rice huskas mulch increase grain and straw yield in wheat crop due to better hydrothermal regime, increased soil water availability, root weight density, root length density, spike density, number of grains spike<sup>-1</sup>, 1000 grain weight, grain weight and aboveground biomass yield (Hariram *et al.*, 2013, Kharia *et al.*, 2017). However under present study the yield attributes were lower under residue incorporation treatments. The higher value of yield attributes under 100% RDF (F<sub>5</sub>) application was due to more quantity of available nutrient present in soil. However under control treatment, lower values of yield attributes was due to scarcity of available form of nutrient in soil.

### CONCLUSION

It may be concluded that the incorporation of rice residue significantly decreased but removal of residue produced higher yield. Retention of rice straw with happy seeder was a better option for rice straw management as it also improved the soil fertility in addition to yield. While burning of crop residue produced significantly higher yield than incorporation during both the years. But it is not eco-friendly and organic carbon content is lost. Waste decomposer were not so effective for managing rice straw and it slightly enhanced the rate of decomposition and nutrient status of soil. The highest yield observed with 100% RDF under all residue management practices and fertilizer cannot be saved by incorporation and retention practices. However, under burning condition, wheat yield observed at 100% RDF was statistically at par with 75%PK+100 N.

**Table 1.** Effect of residue management options and fertilizers on grain yield (q/ha) of wheat

2018-19						
Residue management	Fertilizer					Mean
	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	
R <sub>1</sub>	24.00	58.40	60.60	60.70	62.10	<b>53.16</b>
R <sub>2</sub>	22.60	56.20	58.00	58.40	58.50	<b>50.74</b>
R <sub>3</sub>	19.20	52.50	55.10	55.60	57.40	<b>47.96</b>
R <sub>4</sub>	23.50	58.00	60.20	60.40	61.70	<b>52.76</b>
Mean	<b>22.33</b>	<b>56.28</b>	<b>58.48</b>	<b>58.78</b>	<b>59.93</b>	
CD (0.05)	Residue management (R) = 1.62, Fertilizer doses (F) = 1.07 F at same level of R = NS, R at same level of F = NS					
2019-20						
Residue management	Fertilizer					Mean
	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	
R <sub>1</sub>	22.01	52.40	54.20	54.30	55.10	<b>47.60</b>
R <sub>2</sub>	21.70	54.00	56.00	56.40	56.50	<b>48.92</b>
R <sub>3</sub>	19.90	50.31	52.00	52.50	53.40	<b>45.62</b>

<b>R<sub>4</sub></b>	25.00	56.10	58.00	58.23	59.10	<b>51.29</b>
<b>Mean</b>	<b>21.93</b>	<b>52.95</b>	<b>55.00</b>	<b>54.71</b>	<b>55.88</b>	
<b>CD (0.05)</b>	Residue management (R) = 0.96, Fertilizer doses (F) = 1.06 F at same level of R = NS, R at same level of F = NS					

**Table 2.** Effect of residue management options and fertilizers on straw yield (q/ha) of wheat crop

<b>2018-19</b>						
<b>Residue management</b>	<b>Fertilizers</b>					<b>Mean</b>
	<b>F<sub>1</sub></b>	<b>F<sub>2</sub></b>	<b>F<sub>3</sub></b>	<b>F<sub>4</sub></b>	<b>F<sub>5</sub></b>	
<b>R<sub>1</sub></b>	36.0	92.5	94.4	95.6	96.0	<b>82.9</b>
<b>R<sub>2</sub></b>	34.3	90.3	91.2	91.7	92.5	<b>80.0</b>
<b>R<sub>3</sub></b>	26.9	75.6	77.9	78.3	74.4	<b>67.6</b>
<b>R<sub>4</sub></b>	34.0	90.3	91.9	92.1	94.3	<b>80.5</b>
<b>Mean</b>	<b>32.6</b>	<b>86.9</b>	<b>88.6</b>	<b>89.3</b>	<b>90.3</b>	
<b>CD (0.05)</b>	Residue management (R) = 1.80, Fertilizer doses (F) = 1.46 F at same level of R = 3.07, R at same level of F = 3.16					
<b>2019-20</b>						
<b>Treatment</b>	<b>F<sub>1</sub></b>	<b>F<sub>2</sub></b>	<b>F<sub>3</sub></b>	<b>F<sub>4</sub></b>	<b>F<sub>5</sub></b>	<b>Mean</b>
<b>R<sub>1</sub></b>	32.80	78.18	80.93	80.96	82.10	<b>70.99</b>
<b>R<sub>2</sub></b>	32.18	81.56	83.04	83.19	84.32	<b>72.86</b>
<b>R<sub>3</sub></b>	29.10	72.23	74.66	75.72	78.14	<b>65.97</b>
<b>R<sub>4</sub></b>	36.25	81.34	84.21	84.46	85.73	<b>74.40</b>
<b>Mean</b>	<b>32.08</b>	<b>77.83</b>	<b>80.21</b>	<b>80.83</b>	<b>82.07</b>	
<b>CD (0.05)</b>	Residue management (R) = 1.89, Fertilizer doses (F) = 1.37 F at same level of R = NS, R at same level of F = NS					

**Table 3.** Effect of residue management options and fertilizers on Plant height (cm) of wheat crop

<b>2018-19</b>						
<b>Residue management</b>	<b>Fertilizer</b>					<b>Mean</b>
	<b>F<sub>1</sub></b>	<b>F<sub>2</sub></b>	<b>F<sub>3</sub></b>	<b>F<sub>4</sub></b>	<b>F<sub>5</sub></b>	
<b>R<sub>1</sub></b>	85.5	99	101.1	102.4	102.8	<b>98.16</b>
<b>R<sub>2</sub></b>	83.4	96.7	97.7	98.3	99.2	<b>95.06</b>
<b>R<sub>3</sub></b>	81.1	92.3	94	95.2	96.1	<b>91.74</b>
<b>R<sub>4</sub></b>	81.8	96.8	98.4	98.6	101.1	<b>95.34</b>
<b>Mean</b>	<b>82.95</b>	<b>96.2</b>	<b>97.8</b>	<b>98.62</b>	<b>99.8</b>	
<b>CD (0.05)</b>	Residue management (R) = 2.89, Fertilizer doses (F) = 2.26 F at same level of R = NS, R at same level of F = NS					
<b>2019-20</b>						
<b>R<sub>1</sub></b>	80.8	92.5	94.1	94.3	96.6	<b>91.66</b>
<b>R<sub>2</sub></b>	81	93.9	95.6	95.7	98.1	<b>92.86</b>
<b>R<sub>3</sub></b>	78.5	87.7	89.4	90.5	91.3	<b>87.48</b>
<b>R<sub>4</sub></b>	83.8	95.2	97.1	98.4	98.8	<b>94.66</b>
<b>Mean</b>	<b>81.02</b>	<b>92.32</b>	<b>94.05</b>	<b>94.72</b>	<b>96.2</b>	
<b>CD (0.05)</b>	Residue management (R) = 2.12, Fertilizer doses (F) = 2.09 F at same level of R = NS, R at same level of F = NS					

**Table 4.** Effect of residue management options and fertilizers on effective number of tillers of wheat crop

2018-19						
Residue management	Fertilizers					
	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	Mean
R <sub>1</sub>	66	103	107	107	110	<b>99</b>
R <sub>2</sub>	62	99	102	102	103	<b>94</b>
R <sub>3</sub>	54	93	97	98	99	<b>88</b>
R <sub>4</sub>	65	103	106	107	109	<b>98</b>
Mean	<b>62</b>	<b>99</b>	<b>103</b>	<b>104</b>	<b>105</b>	
CD (0.05)	Residue management (R) = 4.4, Fertilizer doses (F) = 1.99 F at same level of R = NS, R at same level of F = NS					
2019-20						
Treatment	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	Mean
R <sub>1</sub>	59	93	96	96	97	<b>88</b>
R <sub>2</sub>	61	96	99	100	102	<b>92</b>
R <sub>3</sub>	50	87	91	92	93	<b>83</b>
R <sub>4</sub>	62	97	100	101	104	<b>93</b>
Mean	<b>58</b>	<b>93</b>	<b>97</b>	<b>97</b>	<b>99</b>	
CD (0.05)	Residue management (R) = 3.2, Fertilizer doses (F) = 2.6 F at same level of R = NS, R at same level of F = NS					

**Table 5.** Effect of residue management options and fertilizers on number of grain per spike of wheat crop

2018-19						
Residue management	Fertilizers					
	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	Mean
R <sub>1</sub>	43	50	51	51	51	<b>49</b>
R <sub>2</sub>	42	48	49	49	50	<b>48</b>
R <sub>3</sub>	41	46	47	48	48	<b>46</b>
R <sub>4</sub>	41	48	49	49	51	<b>48</b>
Mean	<b>42</b>	<b>48</b>	<b>49</b>	<b>49</b>	<b>50</b>	
CD (0.05)	Residue management (R) = 1.70, Fertilizer doses (F) = 2.16 F at same level of R = NS, R at same level of F = NS					
2019-20						
Treatment	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	Mean
R <sub>1</sub>	41	47	48	48	49	<b>47</b>
R <sub>2</sub>	40	48	48	49	50	<b>47</b>
R <sub>3</sub>	40	46	46	47	47	<b>45</b>
R <sub>4</sub>	42	49	50	50	51	<b>48</b>
Mean	<b>41</b>	<b>47</b>	<b>48</b>	<b>49</b>	<b>49</b>	
CD (0.05)	Residue management (R) = 1.20, Fertilizer doses (F) = 1.19 F at same level of R = NS, R at same level of F = NS					

**Table 6.** Effect of residue management options and fertilizers on test weight (g) of wheat crop

2018-19						
Residue management	Fertilizers					
	F <sub>1</sub>	F <sub>2</sub>	F <sub>3</sub>	F <sub>4</sub>	F <sub>5</sub>	Mean
R <sub>1</sub>	39.4	42.5	43.2	43.1	44.3	<b>42.5</b>

<b>R<sub>2</sub></b>	38.4	42.4	43.1	43	44	<b>42.18</b>
<b>R<sub>3</sub></b>	37.4	41	42	42	42.6	<b>41</b>
<b>R<sub>4</sub></b>	39.6	43	44.2	44.2	45.6	<b>43.32</b>
<b>Mean</b>	<b>38.7</b>	<b>42.23</b>	<b>43.13</b>	<b>43.08</b>	<b>44.13</b>	
<b>CD (0.05)</b>	Residue management (R) = 1.41, Fertilizer doses (F) = 1.47 F at same level of R = NS, R at same level of F = NS					
<b>2019-20</b>						
<b>Treatment</b>	<b>F<sub>1</sub></b>	<b>F<sub>2</sub></b>	<b>F<sub>3</sub></b>	<b>F<sub>4</sub></b>	<b>F<sub>5</sub></b>	<b>Mean</b>
<b>R<sub>1</sub></b>	36.6	40.7	42.2	42.7	43	<b>41.04</b>
<b>R<sub>2</sub></b>	37.1	41.8	42.6	42.7	43.3	<b>41.5</b>
<b>R<sub>3</sub></b>	35.9	39.9	40.7	41.2	41.7	<b>39.88</b>
<b>R<sub>4</sub></b>	39.2	42.8	43.4	43.8	44.2	<b>42.68</b>
<b>Mean</b>	<b>37.2</b>	<b>41.3</b>	<b>42.23</b>	<b>42.6</b>	<b>43.05</b>	
<b>CD (0.05)</b>	Residue management (R) = 1.47, Fertilizer doses (F) = 1.08 F at same level of R = NS, R at same level of F = NS					

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