



Effect of agro waste decomposer on growth, yield and economics of wheat crop (*Triticum aestivum* L.)

Gaurav Nishad¹, Mahendra Kumar Singh¹, Abhinandan Singh², Piyush Kumar Singh³, Deepak Kumar¹, Prashant Narayan¹, Amit Chaurasia¹ and Anand Singh^{1,*}

¹Soil Science & Agricultural Chemistry, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh, India

²Agronomy, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh, India

³Agricultural Statistics, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh, India

Corresponding author email: singhanand10795@gmail.com

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ABSTRACT

A field experiment was laid out in randomized block design with seven treatments and three replications during Rabi 2024–25 at the Agronomy Research Farm, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh, to assess the effect of agro waste decomposer on growth, yield and economics of wheat crop (*Triticum aestivum* L.). The growth and yield attributes were found superior under T₆(75% rice residue retention + Microbial Decomposer @ 7.5 L ha⁻¹ + water spray@ 1000 L ha⁻¹ at 10 DAI) followed by The treatment T₆ (75% rice residue retention + Microbial Decomposer @ 7.5 L ha⁻¹ + water spray@ 1000 L ha⁻¹ at 10 DAI) proved superior, with maximum yield of grain (45.08 q ha⁻¹), straw (64.80 q ha⁻¹) and biological yield (109.87 q ha⁻¹), with respective increases of 24.08%, 17.54% and 20.13% over control. Economically, T₆ recorded the highest net return (100349.33 ha⁻¹) and B:C ratio (2.10). It is concluded that 75% rice residue retention combined with microbial decomposer and water spray (T₆) is the most productive and economically viable practice for wheat cultivation under the agro-climatic conditions of Ayodhya, Uttar Pradesh.

Keywords: Argo waste decomposer, Rice residue retention, Wheat, Microbial Decomposer

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop in the world after rice. It belongs to the Poaceae (grass) family and is grown in both temperate and subtropical regions. Wheat can grow in a wide range of temperatures. It requires about 600–900 mm of rainfall per year and grows best in sandy loam or loam soils that have good structure and can hold a moderate amount of water. Uttar Pradesh is the top wheat producer in India, with an area of 9.6 mha, producing 362.4 lakh tonnes, and a productivity of 3776 kg ha⁻¹. At present the crop residue management is a major concern and rice residue is one of the highest residue

productive crop which are potential source of organic carbon and plant nutrients to enhance the soil organic matter dynamics, nutrient cycling and soil physical environment and it can be a good source of nutrient in soil for wheat crop production. Rice residue contains around 0.7% N, 0.23% P and 1.75% K and it is also an important source of micronutrients such as Zinc and also rich in Silicon (Goswami *et al.*, 2020).

Many ecologically friendly substitutes for burning are provided by rice residue management. To lessen this harmful behavior, the Indian government has encouraged activities like composting, applying biochar, and producing biogas.

Additionally, adding extra nitrogen to the soil together with rice waste speeds up breakdown, improving soil health and crop output. Another practical strategy is to apply rice waste as surface mulch, which controls soil temperature and inhibits the growth of weeds. Furthermore, the conversion of rice residue into manure is made easier by the Pusa decomposer, an affordable and easily accessible bio-decomposer created in India (Zaidi *et al.*, 2021).

In addition to polluting the air, burning agricultural debris destroys the soil's top layer and robs fields of vital nutrients. Farmers can use this bio-decomposer to keep some of the stalks and roots in the field, where they will naturally break down and add nutrients to the soil. For every hectare of land, this method helps save many tons of nutrient-rich residue in the form of compost. A technology or product that may successfully address the issue of stubble burning is required, as it adds to soil and air pollution and raises the AQI levels in the NCR area. The Indian Agricultural Research Institute (IARI) has offered a remedy to this issue. In addition to organic carbon, burning one tonne of rice straw releases 5.5 kg of nitrogen, 2.3 kilogram of phosphorus, 25 kg of potassium, and 1.2 kg of sulfur. In the form of gaseous and particulate emissions, burning eliminates about 80–90% of the nitrogen, 25% of the phosphorus, 20% of the potassium, and 50% of the sulfur found in agricultural residues (Bhatt *et al.*, 2016; Romasanta *et al.*, 2017).

ICAR-IARI, New Delhi, developed Pusa bio-decomposer, an environmentally beneficial residue burning solution. A one-hectare area only requires four capsules (Rs. 50). Eight distinct strains of fungus were used in its manufacture. The bio-decomposer accelerates the organic stubble's natural breakdown, increasing the fertility and productivity of the soil. Agricultural waste can be broken down and converted into organic manure by the applied bio decomposer. By collecting particular fungal strains that are able to produce the essential enzymes needed for the bio-degradation process, the decomposers are created in the form of capsules. Stopping the unpleasant practice of stubble burning can be accomplished more effectively, economically, and efficiently by using a Pusa bio-decomposer. It is also quite useful and simple to use. By keeping all the above facts, the present investigation was carried out as field trial.

MATERIALS AND METHODS

Experimental Site and Soil Properties

The field experiment was conducted during *Rabi* season 2024-25 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh (26.5° N latitude and 82.12° E longitudes; altitude 113 m above MSL). The site has a sub-tropical climate with mean weekly maximum and minimum temperatures ranging from 36.9°C (April) to 4°C (December), relative humidity between 53.7–80.4%. The experimental soil was silty loam in texture (Bouyoucos Hydrometer Method) having pH-8.42, Electrical conductivity EC (0.30 dS m⁻¹), Organic carbon (0.32%) [Walkley and Black 1934], available nitrogen (152.8 kg ha⁻¹) [Subbiah, and Asija 1956], Olsen-P (13.40 kg ha⁻¹) [Olsen *et al.*, 1954], available potassium (211.92 kg ha⁻¹) [Hanway, and Heidel, 1952] and Actinomycetes (18.67 cfu g soil⁻¹), Bacteria (19.37 cfu g soil⁻¹), Fungi (17.33 cfu g soil⁻¹).

Experimental design and treatments

A field experiment was laid out in randomized block design with seven treatments and three replications. The seven treatments viz. T₁- Control (No crop residue), T₂ 100% rice residue retention+Microbial Decomposer@7.5 L ha⁻¹), T₃ 75% rice residue retention +Microbial Decomposer @7.5 L ha⁻¹), T₄ 50% rice residue retention + Microbial Decomposer@7.5 L ha⁻¹, T₅-100% rice residue retention +Microbial Decomposer@ 7.5 Litha⁻¹+waterspray @1000 L ha⁻¹ at 10 days after inoculation (DAI), T₆-75%riceresidue retention + Microbial Decomposer@7.5 L ha⁻¹+ water spray@1000 litre ha⁻¹at 10 days after inoculation (DAI), T₇-50%riceresidue retention + Microbial Decomposer@ 7.5 L ha⁻¹+ water spray@1000 litre ha⁻¹ at 10 days after inoculation (DAI), were comprised in randomized block design replicated as three times. Wheat variety Kanchan was sown at 22.5 × 10 cm crop geometry with a seed rate of 100 kg ha⁻¹.

Seed treatment was done by Carboxin 2.5 g kg⁻¹ seeds followed by drying of treated seeds under shade for two hours. Thereafter, the seeds were sown in plots as per respective treatments. The data collected of different parameters were subjected to appropriate statistical analysis under RBD by following Duncan's multiple range test (DMRT), with a

probability threshold of 0.05, was used to do a one-way analysis of variance to evaluate the means and differences among the values of all the parameters. variance through Duncan's multiple range test (DMRT), with a prob-ability level of 0.05.

RESULTS AND DISCUSSION

Effect of rice residue retention and agro-waste decomposer on growth attributes of wheat

The data related to growth attributes are presented in Table 1 revealed that all the growth parameters differ significantly under various treatments. The maximum plant height (111.20 cm), number of tillers (305.00 m⁻²), and dry matter accumulation (1064.43 g m⁻²) was recorded under T₅ (100% rice residue retention + microbial decomposer @ 7.5 L ha⁻¹ + water spray @ 1000 L ha⁻¹ at 10 DAI) while minimum plant height (88.15), tillers m⁻² (238.67), and dry matter accumulation (903.47 g m⁻²) under T₁ (Control-No crop residue).

The plant height under T₅ was increased by 26.15% while tillers m⁻² and dry matter accumulation increased by 27.79% and 17.82%, respectively over the control which shows a clear importance of residue management. All the growth attributes were statistically *at par* under treatment T₆ (75% residue retention + microbial decomposer + water spray) over T₅ and produced 20.14%, 15.63%, and 14.20% higher plant height, number of tillers m⁻², and dry matter accumulation, respectively, over the control treatment. The increase rate of residue decomposition due to maintenance of moisture, better nutrient availability, higher soil organic matter content, and increased microbial activity may be the reasons for the highest plant height, tiller number,

and dry matter buildup under residue retention combined with microbial decomposer and water spray. Crop development was improved by adequate moisture from water spray, which further enhanced microbial activity and nutrient uptake (Singh *et al.*, 2020; Singh *et al.*, 2021).

Effect of rice residue retention and agro-waste decomposer on yield attributes of wheat

The yield-attributing characters of wheat showed significant improvement due to residue retention and microbial decomposer application (Table 2). The treatment T₅ produced the highest spike length (11.50 cm), number of grains spike⁻¹ (56.00), and grain weight spike⁻¹ (1.787 g), which were significantly superior to most of the treatments.

Compared with the control, and increment was analysed in spike length by 35.24%, grains spike⁻¹ by 55.56%, and grain weight spike⁻¹ by 46.12% under T₅ (100% rice residue retention + microbial decomposer @ 7.5 L ha⁻¹ + water spray @ 1000 L ha⁻¹ at 10 DAI). The treatment T₆ recorded spike length of 10.20 cm, 52.33 grains spike⁻¹, and grain weight spike⁻¹ of 1.68 g, representing increases of 19.95%, 45.37%, and 37.37%, respectively, over the control.

Improved nutrient availability due to improved breakdown of rice residues may be the cause of the significant increase in yield attributes under T₂ and T₆. This would promote crop growth and increases assimilate output. Improved grain filling and formation were probably caused by increased photosynthetic efficiency and nitrogen intake. Following inoculation, a water spray may have produced favourable moisture conditions for microbial activity and quicker breakdown. Higher

Table 1. Effect of rice residue retention and agro waste decomposer on growth attributes of wheat.

Treat-ments	Details	Plant height (cm)	Number of tillers (m ²)	Dry matter accumulation (g m ⁻²)
T ₁	Control (No crop residue)	88.15 ^d	238.67 ^c	903.47 ^c
T ₂	100% rice residue retention + Microbial Decomposer@7.5Llitha ⁻¹	100.24 ^{abc}	262.67 ^{bc}	993.37 ^{abc}
T ₃	75% rice residue retention + Microbial Decomposer@7.5Llitha ⁻¹	97.19 ^{bcd}	246.33 ^{bc}	959.13 ^{abc}
T ₄	50% rice residue retention + Microbial Decomposer@7.5Llitha ⁻¹	93.10 ^{cd}	241.67 ^{bc}	938.33 ^{bc}
T ₅	100% rice residue retention + Microbial Decomposer@7.5Llitha ⁻¹ + waterspray@1000 litre ha ⁻¹ at 10 days after inoculation (DAI)	111.20 ^a	305.00 ^a	1064.43 ^a
T ₆	75% rice residue retention + Microbial Decomposer@7.5 Lit ha ⁻¹ + water spray@1000 litre ha-1 at 10 days after inoculation (DAI)	105.90 ^{ab}	276.00 ^{ab}	1031.70 ^{ab}
T ₇	50% rice residue retention + Microbial Decomposer@7.5 Lit ha ⁻¹ + water spray@1000 litre ha ⁻¹ at 10 days after inoculation (DAI)	102.17 ^{abc}	267.33 ^{bc}	1018.00 ^{ab}

Table 2. Effect of rice residue retention and agro waste decomposer on yield attributes and yield of wheat.

Treat-ment	Details	Spike length (cm)	number of grain spike ⁻¹	grain weight spike ⁻¹	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Biological yield (qha ⁻¹)
T ₁	Control (No crop residue)	8.503 ^d	36.000 ^d	1.223 ^c	36.333 ^c	55.130 ^c	91.460 ^c
T ₂	100% rice residue retention + Microbial Decomposer@7.5Litha ⁻¹	9.500 ^{bcd}	46.667 ^{bc}	1.577 ^{ab}	40.293 ^{abc}	59.160 ^{abc}	99.453 ^{abc}
T ₃	75% rice residue retention + Microbial Decomposer@7.5Litha ⁻¹	9.200 ^{bcd}	44.000 ^c	1.410 ^{bc}	42.880 ^{ab}	62.250 ^{ab}	105.130 ^{ab}
T ₄	50% rice residue retention + Microbial Decomposer@7.5Litha ⁻¹	9.000 ^{cd}	41.000 ^{cd}	1.280 ^c	38.077 ^{bc}	57.180 ^{bc}	95.253 ^{bc}
T ₅	100% rice residue retention + Microbial Decomposer@7.5Lit ha ⁻¹ +water spray@1000 litre ha ⁻¹ at 10 days after inoculation (DAI)	11.500 ^a	56.000 ^a	1.787 ^a	44.577 ^a	64.450 ^a	109.027 ^a
T ₆	75% rice residue retention + Microbial Decomposer@7.5 Lit ha ⁻¹ + water spray@1000 litre ha ⁻¹ at 10 days after inoculation (DAI)	10.200 ^b	52.333 ^{ab}	1.680 ^a	45.077 ^a	64.797 ^a	109.877 ^a
T ₇	50% rice residue retention + Microbial Decomposer@7.5 Lit ha ⁻¹ + water spray@1000 litre ha ⁻¹ at 10 days after inoculation (DAI)	9.700 ^{bc}	50.000 ^b	1.630 ^{ab}	43.253 ^{ab}	62.583 ^{ab}	105.840 ^{ab}

grain formation may also have resulted from improved spike growth and longer spikes under these treatments. Therefore, integrated residue retention in conjunction with water spray and microbial decomposer demonstrated advantageous for enhancing wheat yield features (Patyal *et al.*, 2022; Mishra *et al.*, 2024).

Effect on yield of wheat

The data presented in Table 2 revealed that the grain, straw and biological yield of wheat differ significantly under various treatments. The maximum grain yield was recorded under T₆ (45.08 q ha⁻¹), which was statistically *at par* with T₅ (44.58 q ha⁻¹). Compared with the control (36.33 q ha⁻¹), grain yield increased by 24.06% under T₆ and by 22.68% under T₅.

The maximum straw yield was observed under T₆ (64.80 q ha⁻¹), followed closely by T₅ (64.45 q ha⁻¹). These treatments increased straw yield by 17.53% and 16.90%, respectively, over the control. Likewise, biological yield was highest under T₆ (109.88 q ha⁻¹), followed by T₅ (109.03 q ha⁻¹), representing increases of 20.14% and 19.20%, respectively, compared to T₁. The grain, straw and biological yield followed an increasing trend like T₁<T₄<T₂<T₃<T₇<T₅<T₆.

The higher productivity under T₅ and T₆ may be due to improved soil fertility and nutrient availability throughout the crop growth period. The beneficial effects of residue retention on soil organic matter

accumulation and microbial proliferation further contributed to increased crop productivity.

Effect on economic of wheat production under various treatments

Economic analysis indicated substantial benefits from residue retention and decomposer application (Table 3). The maximum gross return (₹ 148,188.92 ha⁻¹), net return (₹ 89,997.33 ha⁻¹), and B ratio (1.55) were recorded under T₆. Compared with the control, gross returns increased by 22.28%, net returns by 40.75%, and B ratio by 38.39%.

The treatment T₅ ranked second, recording gross returns of ₹ 146,768.42 ha⁻¹, net returns of ₹ 88,576.83 ha⁻¹, and a B ratio of 1.52. These values represented increases of 21.11%, 38.53%, and 35.71%, respectively, over the control treatment.

The significant increase in grain and straw yields led higher net returns and profitability, even though the cost of cultivation was slightly higher under residue-retained treatments due to the expense of microbial decomposer and water spraying. The results show that using microbial decomposer technology in conjunction with residue retention is a commercially and ecologically sound method of producing wheat. These finding are in conformity with the research findings of Kumar *et al.* (2022); Singh *et al.* (2020); Romasanta *et al.* (2017).

CONCLUSION

On the basis of the above study, it can be concluded that, rice residue retention, microbial

Table 3. Effect of rice residue retention and agro waste decomposer economic of wheat crop.

Treat-ment	Details	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio (Rs/Rs)
T ₁	Control (No crop residue)	57246.59	121186.33	63939.74	1.12
T ₂	100% rice residue retention + Microbial Decomposer @ 7.5Lit ha ⁻¹	57891.59	133207.33	75315.74	1.30
T ₃	75% rice residue retention + Microbial Decomposer @7.5Lit ha ⁻¹	57891.59	141334.00	83442.41	1.44
T ₄	50% rice residue retention + Microbial Decomposer @7.5Lit ha ⁻¹	57891.59	126643.92	68752.33	1.19
T ₅	100% rice residue retention + Microbial Decomposer @ 7.5Lit ha ⁻¹ + water spray @1000liter ha ⁻¹ at 10 days after inoculation (DAI)	58191.59	146768.42	88576.83	1.52
T ₆	75% rice residue retention + Microbial Decomposer @ 7.5 Lit ha ⁻¹ + water spray @ 1000liter ha ⁻¹ at 10 days after inoculation (DAI)	58191.59	148188.92	89997.33	1.55
T ₇	50% rice residue retention + Microbial Decomposer @7.5 Lit ha ⁻¹ + water spray @ 100liter ha ⁻¹ at 10 days after inoculation (DAI)	58191.59	142439.33	84247.74	1.45

decomposer application, and water spray greatly enhanced wheat growth, yield, and economic return. Growth and yield were significantly improved by Treatment T₅ (100% rice residue retention + Microbial Decomposer @ 7.5 L ha⁻¹ + water spray @ 1000 L ha⁻¹ at 10 DAI). The highest grain yield, straw yield, biological yield, gross return, net return, and benefit-cost ratio were obtained by Treatment T₆ (75% rice residue retention + Microbial Decomposer @ 7.5 L. ha⁻¹ + water spray @ 1000 L ha⁻¹ at 10 DAI).

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