



## Effect of crop residue and various nutrient sources on microbial build up and productivity and profitability of wheat

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### Abstract

A field experiment was conducted during *Rabi* season 2020-21 to study the effect of crop residue and various nutrient sources on microbial build up and productivity and profitability of wheat in clay loam soil of Gharuan (Mohali). The experiment consisted of combinations of seven nutrient management practices *i.e.* inorganic nutrient management with crop residue (100% RDF), organic nutrient management with crop residue (VC@10t ha<sup>-1</sup>), integrated nutrient management with crop residue (VC @5t ha<sup>-1</sup> + 50% RDF), inorganic nutrient management without crop residue (100% RDF), organic nutrient management without crop residue (VC @ 5 t ha<sup>-1</sup>), integrated nutrient management without crop residue (VC@5 t ha<sup>-1</sup> + 50% RDF) and control. Results of the study revealed that integrated nutrient management (VC @5 t ha<sup>-1</sup> + 50% RDF) being statistically at par with inorganic nutrient management recorded the highest grain yield and straw yield over other nutrient management treatments. Treatments with crop residue showed better microbial count over treatments without crop residue. Integrated nutrient management with residue (VC @5t ha<sup>-1</sup> + 50% RDF) recorded the highest microbial count and higher yield attributing characters over other nutrient management treatments.

**Keywords:** crop residue, integrated, microbes, nutrient, wheat, yield

### Introduction

Wheat (*Triticum aestivum*) is second most important cereal crop in the world after rice and is one of the most important stable food crop. India is one of the main wheat producing country of the world after China. Crop residue management is a well-known and widely accepted practice for controlling various soil physical, chemical, and biological functions. Crop residues incorporate large number of nutrients in the soil for crop production and affect soil water movement, runoff, and infiltration (Sukamal *et al.*, 2020) [8]. Crop residue management favors greater microbial biomass and their activity near the soil surface and acts as reservoir for crop growth and development. Crop residue management is done by following various latest techniques using residue as green manure and to increase the microbial population in the wheat field as to increase the grain yield of the crop. Different fertilizer sources have different impact on crop growth and soil properties. Excessive use of chemical fertilizers causes damage to soil ecosystem. The growth of any crop depends on soil microorganism's population in soil. The better management and utilization of crop residue is essential for the improvement of soil microbial growth and crop productivity. Organic manures are composed of natural ingredient from plant parts such as leaves, peanut hulls and poultry droppings. Compost, a blend of plant debris broken down by natural processes is also considered a natural or organic fertilizer (Fazily *et al.*, 2021) [2]. Inorganic fertilizers on the other hand are manufactured from minerals or synthetic chemicals. Integrated nutrient management is a better approach for supplying nutrition to crops by including organic and inorganic sources of nutrients. INM enhances the availability of applied as well as native soil nutrients. Integrated nutrient management

means judicious and efficient use of minerals fertilizers, organic manures and bio fertilizers in an integrated manner, to get the maximum productivity and maintain soil fertility (Singh *et al.*, 2018) [7].

Microbe population is low due to lack of organic matter. Microbes are the workhorse of gardens. Microbes make nutrients in the soil available to plants in a form the plants can use. Microbes create nutrients; they provide disease resistance tolerate environmental stress. Microbe improves soil structure through decomposition of organic matter. The role of microbes in ecosystem and agricultural productivity in response to the different fertilizers is complicated and elusive. Microorganisms are useful in eliminating problems associated with the use of the chemical fertilizers and pesticides. It is the microbes that convert the NPK and minerals in the soil into a form our plants can use to grow and produce food for us. Microbe's population in soil is numerous as many as one billion of up to 13,000 species can reside in gram of soil. The farmers regularly use different forms of fertilizers and other organic manures to enhance productivity without considering the probable effects toxic or non-toxic to the soil microbes (Ojo *et al.*, 2015) [4].

### Materials and Methods

The field experiment was conducted during the *Rabi* season of 2020-21 at Experimental farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan, Mohali (Punjab) situated at 30.7° N latitude and 76.5° E longitude at an altitude of 309 meters above mean sea level. The area receives a moderate rainfall 700-800 mm per annum, of which 70-80% received during monsoon months from June to September. The soil of the experimental site was clay loam in texture and nearly neutral in reaction. The

experiment was laid out in randomized block design using three replications. The experiment consists of 7 treatments comprising of three with crop residue *i.e.* Inorganic nutrient management (recommended NPK + crop residue), organic nutrient management (Azotobacter 5 g kg<sup>-1</sup> seed + vermicompost 10 t ha<sup>-1</sup> + crop residue), integrated nutrient management (vermicompost 5 t ha<sup>-1</sup> + 50% of recommended dose of NPK+ crop residue ) and other three without crop residue *i.e.* Inorganic nutrient management (recommended NPK), organic nutrient management (Azotobacter 5 g kg<sup>-1</sup> seed + vermicompost 10 t ha<sup>-1</sup>), integrated nutrient management (vermicompost 5 t ha<sup>-1</sup> + 50% of recommended dose of NPK) and control. Wheat was sown with a row spacing of 22.5 cm. Wheat variety “Unnat PBW-343” was sown using seed rate of 100 kg ha<sup>-1</sup> in first week on well prepared seed bed in December, 2020. The recommended dose of NPK used in wheat crop was N: P<sub>2</sub>O<sub>5</sub>: K<sub>2</sub>O 120 : 60 : 40 kg ha<sup>-1</sup> half dose of nitrogen and whole K<sub>2</sub>O and P<sub>2</sub>O<sub>5</sub> were incorporated in soil, as per the treatments, as basal dose and remaining half dose of nitrogen was top dressed at tillering stage of the wheat crop. Nutrient content of vermicompost used was 1.5% N, 1.0% P and 0.6%K. The microbial analysis was done by taking soil samples from the treatment plots and analysing them using different nutrient broth medias and devices like autoclave, laminar air flow and incubators etc to find the count of microbes under different treatments.

## Results and Discussion

### Yield attributes of wheat

All the attributes of yield *viz.* spike length, number of grains per spike and 1000 grain weight were significantly influenced by different nutrient management treatments. But significantly highest spike length, number of grains per spike and 1000 grain weight was recorded with the application of VC @5 t ha<sup>-1</sup> + 50% RDF + crop residue being statistically at par with 100% RDF + crop residue. However, it was also statistically at par with VC @10 t ha<sup>-1</sup> + Azotobacter @5 g kg<sup>-1</sup> + crop residue in case of spike length. It produced 44.52 percent more spike length, 14.59 per cent more number of grains per spike and 18.40 per cent more 1000 grain weight over control.

### Yield of wheat

The highest grain yield was recorded with application VC @5 t ha<sup>-1</sup> + 50% RDF + crop residue and it remained statistically at par with 100% RDF + crop residue. It produced 85.20 per cent more grain yield compared to control where no nutrient was applied. It might be due to the fact that application of organic manures increased grain yield of wheat due to additional supply of major and micro nutrients in addition to large organic matter content which increased the microbial activity, improved physical and chemical properties of soil and result in better utilization of nutrients. Crop residue also increased the microbial activity and better nutrient availability. Similar results were also reported by (Kaur *et al*, 2018) [3] and (Patel *et al*, 2017) [6]. A perusal of data on straw yield of wheat presented in Table 5 revealed application of VC @5 t ha<sup>-1</sup> + 50% RDF + crop

residue significantly increased the straw yield of crops as compared to other treatments. However, it was also statistically at par with 100% RDF + crop residue and VC @10 t ha<sup>-1</sup> + Azotobacter @5 g kg<sup>-1</sup> + crop residue. This might be due to adequate quantities and balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favourable increase in yield attributing characters which ultimately led towards an increase in economic yield. Similar findings were also reported by (Pandey *et al*, 2009) [5].

### Microbial build up in wheat under different treatments

The different nutrient management practices did not significantly influence the microbial count in wheat crop. However, the data revealed that higher microbial count was found in vermicompost @10 t ha<sup>-1</sup> + crop residue closely followed by 50% RDF + vermicompost @5 t ha<sup>-1</sup> + crop residue.

### Economics

In order to evaluate the economic feasibility of different nutrient management treatments, cost of cultivation, gross returns, net returns and net returns per rupee invested were worked out and presented in Table 4 maximum cost of cultivation (Rs 58490 ha<sup>-1</sup>) was incurred with organic nutrient management with crop residue *i.e.* VC @10 t ha<sup>-1</sup> + Azotobacter @5 g kg<sup>-1</sup> + crop residue. Among all the treatments the lower cost of cultivation was recorded under control (Rs 37150 ha<sup>-1</sup>). The higher cost of cultivation maximum gross returns was incurred with the application of VC @5 t ha<sup>-1</sup> + 50% RDF + crop residue (Rs 131555 ha<sup>-1</sup>) followed by other treatments. However, it remained statistically at par with the application of 100% RDF + crop residue. The significantly higher net returns were recorded with VC @5 t ha<sup>-1</sup> + 50% RDF + crop residue (Rs.79558 ha<sup>-1</sup>) and was statistically at par with 100% RDF + crop residue (Rs.79467 ha<sup>-1</sup>) these are in accordance with (Devi *et al*, 2011) [4]. Among all the treatments the lower net returns were obtained under control (Rs 36420 ha<sup>-1</sup>). The integrated nutrient management with crop residue *i.e.* VC @5 t ha<sup>-1</sup> + 50% RDF + crop residue recorded maximum net returns per rupee invested (1.53) but it was statistically at par with inorganic nutrient management with crop residue *i.e.* 100% RDF + crop residue (1.51) and integrated nutrient management without crop residue *i.e.* VC @5 t ha<sup>-1</sup> + 50% RDF (1.48).

### Conclusion

From this study it was concluded that the treatment with VC @ 5 t ha<sup>-1</sup> + 50% RDF + Crop residue recorded higher productivity and showed better growth compared to other treatments. The highest microbial growth was recorded in treatment with VC @ 10 t ha<sup>-1</sup>+Azotobacter @ 5g kg<sup>-1</sup> + crop residue .The integrated use of both organic manures and inorganic fertilizers provided better nutrient availability to the wheat crop throughout the growing period. The significantly higher net returns were recorded with VC @5 t ha<sup>-1</sup> + 50% RDF + crop residue.

**Table 1:** Effect of treatments on yield contributing characters of wheat

Treatments	Spike length(cm)	No. of grainsspike <sup>-1</sup>	1000 grain weight(g)
100% RDF + Crop residue	11.00	56.30	45.56
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5g kg <sup>-1</sup> + crop residue	10.07	55.23	43.29

VC @ 5 t ha <sup>-1</sup> + 50% RDF + Crop residue	11.62	57.86	46.07
100% RDF	9.35	52.90	42.04
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5g kg <sup>-1</sup>	8.40	51.77	40.59
VC @ 5 t ha <sup>-1</sup> + 50% RDF	9.67	54.51	42.73
Control	8.04	50.49	38.91
SEm (±)	0.57	0.81	0.78
CD (P=0.05)	1.76	2.48	2.39

**Table 2:** Effect of treatments on yield of wheat

Treatments	Grain yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )	Biological yield (kg ha <sup>-1</sup> )	Harvest Index
100% RDF + crop residue	4754	6939	11693	0.41
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5g kg <sup>-1</sup> + crop residue	4453	6757	11210	0.40
VC @ 5 t ha <sup>-1</sup> + 50% RDF + crop residue	4732	6926	11658	0.41
100% RDF	4348	6659	11007	0.40
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5 g kg <sup>-1</sup>	4077	6510	10587	0.39
VC @ 5 t ha <sup>-1</sup> + 50% RDF	4441	6665	11106	0.40
Control	2555	4202	6757	0.38
SEm (±)	52	64	68	0.004
CD (P=0.05)	161	197	208	NS

**Table 3:** Effect of different treatments on soil microbes in wheat crop

Treatments	Bacterial count	Fungal count
	(cfu g <sup>-1</sup> ) (x 10 <sup>6</sup> )	(cfu g <sup>-1</sup> ) (x 10 <sup>6</sup> )
100% RDF + crop residue	26.8	24.3
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5g kg <sup>-1</sup> + crop residue	33.5	31.6
VC @ 5 t ha <sup>-1</sup> + 50% RDF + crop residue	29.7	27.4
100% RDF	16.3	24.0
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5 g kg <sup>-1</sup>	18.4	28.8
VC @ 5 t ha <sup>-1</sup> + 50% RDF	19.3	27.6
Control	9.4	15.4
CD (P=0.05)	NS	NS

**Table 4:** Effect of treatments on economics of wheat

Treatments	Cost of Cultivation (Rs ha <sup>-1</sup> )	Gross returns (Rs ha <sup>-1</sup> )	Net returns (Rs ha <sup>-1</sup> )	Net returns per rupee invested
100% RDF + crop residue	52594	132061	79467	1.51
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5g kg <sup>-1</sup> + crop residue	58490	125115	66625	1.14
VC @ 5 t ha <sup>-1</sup> + 50% RDF + crop residue	51997	131555	79558	1.53
100% RDF	50444	122504	72060	1.43
VC @ 10 t ha <sup>-1</sup> + Azotobacter @ 5 g kg <sup>-1</sup>	57390	116331	58941	1.03
VC @ 5 t ha <sup>-1</sup> + 50% RDF	50197	124365	74168	1.48
Control	37150	73570	36420	0.98
SEm (±)		974	974	0.02
CD (P=0.05)		3002	3002	0.06

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