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# Effect of nitrogen scheduling and crop residue management on yield contributing characters and yield of wheat

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**Abstract**
A field experiment was conducted during *Rabi* 2020-21 at Experimental farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan (Mohali) to study the effect of effect of nitrogen scheduling and crop residue management on yield contributing characters and yield of wheat. The experiment consisted of seven treatments comprising of nitrogen levels and crop residue *i.e*. RDF (120% N + 100% P) + crop residue, 25% N + 100% P + crop residue, 50% N + 100% P + crop residue, 75% N + 100% P + crop residue, 125% N + 100% P + crop residue and 150% N + 100% P + crop residue and 0% N + 100% P + crop residue were tested in Randomized block design, replicated 3 times. Results revealed that yield attributes, grain yield and straw yield of wheat were increased with increasing nitrogen rate. Application of 150% N + 100% P + crop residue being statistically at par with 125% N +100% P + crop residue recorded maximum yield attributes, grain yield and straw yield of wheat over 0% N + crop residue. Nitrogen application of 150 kg $ha^{-1}$ + crop residue recorded higher net returns (Rs 76993) and net returns per rupee invested (1.55) but remained statistically at par with 125% N + 100% P and RDF + crop residue.

**Keywords:** crop residue, economics, nitrogen, yield

## Introduction
Wheat (*Triticum aestivum* L.) has been described as "king of cereals" and one of the most important staple food crop. Wheat has its own outstanding importance as a human food; is rich in carbohydrates and protein. Wheat is cultivated in at least 43 countries of the world. Nitrogen is one of the major nutrient which reduce the yield of wheat if not applied in proper amount as it is needed for fast growth of plants and to get high production per hectare. Nitrogen play important role in all the metabolic processes of plants. Nitrogen is the main component and major constituent of plants especially in living tissues formation. Every single indispensable process in the plant is related with protein, of which nitrogen is a fundamental constituent. To get the maximum yield of wheat, application of nitrogen in adequate amount is considered as a key to success. Availability of nitrogen to wheat during various phases of its growth and development is an important factor influencing the yield and quality of grain (Yousaf *et al*, 2014) [8]. Nitrogen insufficiency influences biomass synthesis and use of sun energy for productivity of the plant, with an extraordinary effect on grain yield and yield contributing parameters (Heinemann *et al*, 2006) [1].
Crop residue management is a well-known and widely accepted practice for controlling various soil physical, chemical and biological functions. Crop residue incorporate large number of nutrients in the soil for crop production and affect soil water movement, runoff and infiltration (Sarkar *et al*, 2020) [6]. Plant availability of NPK nutrients from crop residues mostly depends on different soil physical, chemical and biological processes. Integrated management with fertilization and the amount of crop residue remaining for incorporation in the crop field determine the degree of cycling and plant availability of nutrients from crop residues. Management of crop residues for a better C sequestration and the amount and site of crop residue application coupled with optimum use of N fertilizer are necessary for promoting soil organic matter (Rathod *et al*, 2019) [5].
Nitrogen is also very susceptible to different type of losses under careless application and improper management practices like leaching, denitrification and volatilization especially in case of chemical/synthetic fertilizers like urea, DAP and ammonium sulphate. After green revolution due to excess application of synthetic fertilizers the Indian soils have been degrading year by year and the organic content is also decreasing in soil. Hence, the present study was carried out with the objective to study the effect of nitrogen scheduling and crop residue management on yield contributing characters and yield of wheat.

## Materials and Methods
The field experiment was conducted during the *Rabi* (wheat) season of 2020-21 at Experimental Farm of University Institute of Agricultural Sciences, CU, Gharuan, Mohali situated at 30.7° N latitude and 76.5° E longitude at an altitude of 309 meters above mean sea level. The soil of the experimental site was clay loam in texture and nearly neutral in reaction. The soil was rated as low in organic carbon and available nitrogen, medium in available phosphorus and available potassium. The experiment was laid out in randomized block design with three replications. The experiment consisted of seven treatments comprising of nitrogen levels and crop residue *i.e*. RDF (120% N + 100% P) + crop residue, 25% N + 100% P + crop residue, 50% N + 100% P + crop residue, 75% N + 100% P + crop residue, 125% N + 100% P + crop residue and 150% N + 100% P + crop residue and 0% N + 100% P + crop residue. The layout

of the experiment was done manually and the plots were drawn and then flattened with the help of labour. Wheat variety "Unnat PBW-343" was sown using seed rate of 100 kg $ha^{-1}$ in first week on well prepared seed bed in December, 2020. The different fertilizer rate of nitrogen $ha^{-1}$ was used as basal and top dressing. Nitrogen was added in the form of urea and full dose of phosphorus fertilizers were used at the time of sowing. Yield attributes were recorded just before the harvesting of crop. The grain yield of each plot was recorded in kg $ha^{-1}$.

## Results and discussion

### Yields attributes of wheat

A perusal of data on different yield attributes of wheat presented in Table 1 revealed that number of effective tillers per meter square, spike length and number of grains per spike was significantly higher due to higher dose of nitrogen. However, the other yield attributes *viz*. 1000 grain weight did not vary significantly due to variation in nitrogen levels and crop residue management. The maximum number of effective tillers was recorded with 150% N + 100% P + crop residue (276.21). However, the overall minimum number of effective tillers was recorded in 0% N + 100% P + crop residue (244.75). It might be due to the fact that nitrogen is an essential element for growth and development and thus promotes vegetative growth which results in production of higher number of effective tillers. Similar results were reported by Imran *et al*, (2017) [2]. Among different level of nutrient management and crop residue, the maximum length of spike was recorded with the 150% N + 100% P + crop residue which was statistically at par with 125% N + 100% P + crop residue and RDF + crop residue. Maximum number of grains $spike^{-1}$ of wheat was recorded from the treatment where 150% N + 100% P fertilizer applied as basal and top dressing being statistically at par with number of grains per spike recorded from 125% N + 100% P. It might be due to higher nitrogen rate because nitrogen promotes the initiation of spikelets that resulted in more number of grains per spike. These findings were in accordance with Ullah *et al,* (2018) [7]. Similarly, Khan (2016) [3] reported that number of grains per spike correlated with biomass and leaf area of crop, as more assimilation and photosynthetic translocation is possible in varieties with higher biomass, thus giving higher number of grains count per spike.

### Yield of wheat crop

The data pertaining to grain yield of wheat under nitrogen level and crop residue management have been presented in Table 2. The grain yield was significantly influenced by nitrogen and residue treatments. Maximum grain yield was recorded in 150% N + 100% P + crop residue and was significantly superior over rest of treatments during experimentation. However, it was also statistically at par with 125% N + 100% P + crop residue. The minimum grain yield was recorded in 0% N + 100% P + crop residue. The nutrient management and crop residue management practices produced statistically similar grain yield which were significantly higher over the 0% N + 100% P + crop residue. It might be due to the enhanced biological processes by microbes in plant and soil enzymatic activity which increased the yield contributing characters of wheat and hence, resulted in higher yield. Similar findings were also reported by Mosanaei *et al,* (2017) [4]. The straw yield was significantly influenced by nitrogen and residue treatments. It is evident from the data that 150% N + 100% P + crop residue recorded highest straw yield which was statistically at par with 125% N + 100% P + crop residue and was found significant superior to other treatments. It might be due to adequate quantity and balanced proportion 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 straw yield Similar results were also reported by Ullah *et al*. (2018) [7]. Different nitrogen level and crop residue management methods brought significant variation in biological yield. Highest biological yield was observed in 150% N + 100% P + crop residue which was statistically at par with 125% N + 100% P + crop residue. The minimum yield was recorded in 0% N + 100% P + crop residue. Different treatments did not significantly influence the harvest index of the wheat crop.

### Economics

In order to evaluate the economic feasibility of different treatments, cost of cultivation, gross returns, net returns and net returns per rupee invested were worked out and the results have been presented in Table 3. It was observed that maximum cost of cultivation was recorded in 150% N + 100% P + crop residue (Rs 49769 $ha^{-1}$) and minimum cost of cultivation was (Rs 40300 $ha^{-1}$) in 0% N + 100% P + crop residue. 150% N + 100% P gave significantly higher gross returns of Rs 126762 $ha^{-1}$ which was statistically at par with the gross return obtained under 125% N + 100% P (Rs 124414 $ha^{-1}$) and RDF + crop residue (Rs 123254 $ha^{-1}$). The minimum gross returns were recorded in 0% N + 100% P + crop residue (Rs 82778 $ha^{-1}$). RDF + crop residue recorded significantly higher net returns of Rs 123254 $ha^{-1}$ as compared to 0% N + 100% P + crop residue (Rs 42478 $ha^{-1}$) which was the lowest. 150% N + 100% P + crop residue had maximum net returns per rupee invested (1.55) over 0% N + 100% P + crop residue (1.05). However, it was also statistically at par with 125% N + 100% P + crop residue (1.52) and RDF + crop residue (1.50).

## Conclusion

Nitrogen level of 150 kg $ha^{-1}$ + crop residue recorded maximum grain yield and straw yield than all other nitrogen levels. However, it was also statistically at par with 125% N + 100% P + crop residue. Application of 150% N + 100% P + crop residue recorded higher net returns per rupee invested over other treatments. But it remained statistically at par with 125% N + 100% P and RDF + crop residue.

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

| Treatments | No. of effective tillers $m^{-2}$ | Spike length (cm) | No. of grains $spike^{-1}$ | 1000 grain weight (g) |
|---|---|---|---|---|
| **RDF + crop residue** | 268.12 | 11.64 | 55.45 | 43.08 |
| 25% N + 100% P + crop residue | 251.84 | 8.48 | 52.07 | 40.84 |
| 50% N + 100% P + crop residue | 257.00 | 9.02 | 53.57 | 41.04 |
| 75% N + 100% P + crop residue | 261.47 | 10.28 | 54.72 | 42.15 |

| | | | | |
|---|---|---|---|---|
| 125% N + 100% P + crop residue | 272.04 | 12.32 | 57.10 | 44.12 |
| 150% N + 100% P + crop residue | 276.21 | 13.42 | 59.05 | 45.23 |
| 0% N + 100% P + crop residue | 244.75 | 8.13 | 51.67 | 39.67 |
| SEm (±) | 1.19 | 0.75 | 0.82 | 1.15 |
| CD (P=0.05) | 3.65 | 2.31 | 2.52 | NS |

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

| Treatments | Grain yield (kg ha$^{-1}$) | Straw yield (kg ha$^{-1}$) | Biological yield (kg ha$^{-1}$) | Harvest index |
|---|---|---|---|---|
| RDF + crop residue | 4194 | 6831 | 11025 | 0.38 |
| 25% N + 100% P + crop residue | 3977 | 6512 | 10489 | 0.38 |
| 50% N + 100% P + crop residue | 4086 | 6609 | 10695 | 0.38 |
| 75% N + 100% P + crop residue | 4127 | 6728 | 10855 | 0.38 |
| 125% N + 100% P + crop residue | 4374 | 6914 | 11288 | 0.39 |
| 150% N + 100% P + crop residue | 4438 | 7110 | 11548 | 0.38 |
| 0% N + 100% P + crop residue | 2705 | 5336 | 8041 | 0.34 |
| SEm (±) | 72 | 77 | 109 | 0.005 |
| CD (P=0.05) | 221 | 237 | 337 | NS |

**Table 3:** Effect of treatments on economics of wheat

| Treatments | Cost of Cultivation (Rs ha$^{-1}$) | Gross returns (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | Net returns per rupee invested |
|---|---|---|---|---|
| RDF + crop residue | 48988 | 123254 | 123254 | 1.50 |
| 25% N + 100% P + crop residue | 47818 | 114357 | 66539 | 1.39 |
| 50% N + 100% P + crop residue | 48205 | 117041 | 68836 | 1.43 |
| 75% N + 100% P + crop residue | 48596 | 118517 | 69921 | 1.44 |
| 125% N + 100% P + crop residue | 49378 | 124414 | 75036 | 1.52 |
| 150% N + 100% P + crop residue | 49769 | 126762 | 76993 | 1.55 |
| 0% N + 100% P + crop residue | 40300 | 82778 | 42478 | 1.05 |
| SEm (±) | | 1512 | 1512 | 0.03 |
| CD (P=0.05) | | 4658 | 4658 | 0.10 |

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