

Original Research Article

Effect of nitrogen management on growth attributes and yield attributes of wheat

ABSTRACT

A field experiment was conducted during *rabi* 2022 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P) to determine the "Effect of Nitrogen management on growth and yield of wheat". There were nine treatments each replicated thrice and the experiment was laid out in Randomized Block Design. The results showed that treatment 6 (75% N through urea + 25 % N through poultry manure) recorded significantly higher plant height (119.20 cm), maximum number of tillers/ m² (214), higher plant dryweight (64.34 g), highest Crop growth rate during the interval of 50-75 DAS (35.73 g/m²/day), maximum number of effective tillers/m² (144.5), maximum number of grains/spike (53.33) and highest test weight (97.71g) compared to other treatments.

Keywords: *Wheat, Urea, Vermicompost, Poultry manure, Growth and Yield attributes*

INTRODUCTION

India's second-largest grain crop, wheat, is essential to the nation's food and nutritional security. Nearly 55% of the world population depends on wheat for about 20% of calories intake. It is one of the major food grains of the country and a staple food of the people of North India, where people have preference for chapatti. Wheat is a self-pollinated, long day, winter crop and belongs to the plant family Poaceae. It is grown for grains as well as for fodder purposes to fulfil human and livestock requirements. The lower production is due to inappropriate level and timing of fertilizers, alkalinity, nitrogen and organic matter deficit soil of the area. The diverse environmental conditions and food habits of people in India support the cultivation of three types of wheat (bread, durum and dicoccum).

The total area of wheat cultivation around the world is 221.91 million hectares, the total production was 781.01 million metric tons, and the productivity per hectare was 3.52 metric tons (USDA, 2022). The total sown area under wheat crop in India is around 31.61 million hectares. The total wheat production in India is around 109.52 million tons and productivity of 3464 kg/ hectare. Total area under wheat in Uttar Pradesh is 9.85 million hectares which is 31.16 % of total area under wheat cultivation in India. Total wheat production in Uttar Pradesh is 35.50 million tons and productivity is 3604 kg/ hectare (GOI, 2022).

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). The inconsistency in soil and climatic conditions related with forms that influence nitrogen elements in the root zone and their association with the plant may prompt variation in nitrogen accessibility and its necessity to plant (Similiet *al.*, 2008). Furthermore, the arrival of new cultivars with various requirements for their nutrition upsets summed up proposals of nitrogen fertilizers for wheat crop. The enthusiasm for boosting wheat yields has urged progressive farmers to perform the farm management operations intensively. It should be kept in mind that the optimized level of nitrogen applications should be low for the cultivar less responsive to its application and the rate of nitrogen should be high for the variety that is more responsive to its application and records more yield otherwise yield potential of the varieties would be decreased. However, sometimes more application of nitrogen results in toxicity and hampers the plant growth by making it more susceptible to lodging, causing environmental pollution through nitrate leaching (Riley *et al.*, 2001) and volatilization in form of ammonia (Maet *al.*, 2010).

Urea is one of the most widely used nitrogen-containing fertilizers. Nitrogen is the major element of chlorophyll, protein and amino acids and play an important role in wheat productivity (Khalil,

2008). Dwarfed wheat growth and lodging were recorded due to under- and over-application of nitrogen respectively than the optimum level (Hawkesford, 2014).

UNDER PEER REVIEW

Nitrogen enhances spike population and has a greater contribution in yield components (**Maqsood et al., 2014**), increased leaf area index and grain yield (**Bashir et al., 2017**). Research on synthetic nitrogen fertilizers depleted soil nitrogen (Mulvaney et al., 2009) showed that inorganic N fertilizers mainly in ammonium form reduced the mass of organic carbon due to more consumption through microorganisms and decreased total nitrogen within the soil because of more nitrogen uptake by the grains. (**Chaudhary et al., 2009**) have reported that high cost, degradation of soil and environmental pollution are the major problems of commercial fertilizer applied alone.

Vermicompost is a product of bio-oxidation and stabilization of organic material involving the joint action of earthworm and microorganisms. Although, microbes are responsible for the biological degradation of the organic matter, earthworms are the important drivers of the process, conditioning the substrate and altering biological activity (**Aira et al., 2002**). Vermicompost may be potential sources of nutrients for field crops if applied in suitable ratios with synthetic fertilizers. The earlier workers have reported a positive effect of vermicompost application on growth and productivity

of cereals and legumes (**Suthar, 2006**). In addition to considerable amount of nutrients with huge amount of beneficial microbial population, vermicompost also contains cytokinins, auxins, gibberellins like biological active growth promoting substances. It may be used alone or in combination with other organic and inorganic fertilizers in order to get a good qualitative and quantitative yield.

Poultry manure (PM) is a rich source of macro (N, P, K) and micro (S, Fe) nutrients and also has a better effect on soil health. It serves as an organic matter for the soil, improves soil biological life and enhanced soil water holding capacity. Mineralization of PM is higher than other natural manures (cattle, pig) thus it readily releases its nutrients when added to the soil for plant uptake. Application of poultry manure increases carbon content, water holding capacity, aggregation of soil, and decreases bulk density. Poultry manure contains 3-5% nitrogen; 1.5-3.5% phosphorus, 1.5-3% potassium, considerable amount of micronutrients and its pH is 6-

7 (**Chastain et al., 2001**). In cereals, application of poultry manure in integration with urea improves yield components more than other organic manures (**Khaliq et al., 2004**). Integration of poultry manure and urea helps to restore degraded soils and is also more economical than sole application of urea (**Monedero et al., 2004**). It has been observed that improving nitrogen use efficiency increases yield, activates low affinity transport system of nitrogen uptake in which passive uptake of nitrogen takes place that results in high yield (**Cui et al., 2008**).

MATERIAL AND METHODS

A field experiment was conducted during *rabi* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on the topic "Effect of nitrogen management on growth and yield of wheat", to study the response of nitrogen through urea along with combination of vermicompost and poultry manure. The soil of experimental plot was sandy loam in texture, soil pH was 8.0, low in organic carbon (0.62%), available N (225 kg/ha), available P (38.2 kg/ha) and available K (240.7 kg/ha). There were 9 treatments, each being replicated thrice and laid out in Randomized Block Design. The treatment combinations were 100% N through urea, 75% N through urea + 25 % N through vermicompost, 50% N through urea + 50% N through vermicompost, 25% N through urea + 75% N through vermicompost, 100 % N through vermicompost, 75% N through urea + 25 % N through poultry manure, 50% N through urea + 50% N through poultry manure, 25% N through urea + 75 % N through poultry manure, 100 % N through poultry manure. The data recorded on different aspects of crop such as, growth attributes and yield attributes were subjected to statistical analysis by analysis of variance method (Gomez and Gomez, 1984).

RESULT AND DISCUSSION

Growth

attributes of plant height (cm)

Plant height (cm)

Significant and higher plant height (119.20 cm) was recorded in treatment 6 (75% N through urea + 25% N through poultry manure). However, treatment 7 (50% N through urea + 50% N through poultry manure) was found to be statistically at par with treatment 6 (75% N through urea + 25 % N through poultry manure). Significant and higher plant height was recorded with 75% N through urea might be due to nitrogen application increases, the plant cell size expands, the protein content of the cells rises, increasing leaf area and photosynthesis rate and ultimately causing the plant to grow taller. Similar results were reported by Wysocki *et al.* (2007). Further, increase in plant height with application of 25% N through poultry manure may be due to increased nitrogen availability for cell elongation, development, photosynthesis, and metabolism and buildup of nitrogen together with other assimilates in flag leaf, which causes their rapid growth. Similar results were reported by Haberle *et al.* (2008).

Number of tillers/m²

Significant and higher number of tillers/m² (214.0) was recorded in treatment 6 (75% N through urea + 25 % N through poultry manure). However, treatment 2 (75% N through urea + 25 % N through vermicompost) and treatment 7 (50% N through urea + 50 % N through poultry manure) were found to be statistically at par with treatment 6 (75% N through urea + 25 % N through poultry manure). Significant and higher number of tillers/ m² was recorded with 75% N through urea might be due to boosted nitrogen reduced tiller mortality and increase tiller production from the main stem levels. Similar results were also reported by **Rahman et al. (2014)**. Further, increase in number of tillers/ m² with application of 25% N through poultry manure may be due to increased availability of nutrients and the ease of absorption by receiving plants, which accelerated their plant growth and development and ultimately produced more tillers/m². Similar results were also reported by **Enujeke (2013)**.

Plant dry weight (g)

Significant and higher plant dry weight/ plant (64.34 g) was recorded in treatment 6 (75% N through urea + 25% N through poultry manure). However, treatment 7 (50% N through urea + 50% N through poultry manure) was found to be statistically at par with treatment 6 (75% N through urea + 25 % N through poultry manure). Significant and higher plant dry weight was recorded with 75% N through urea might be due to nitrogen increases leaf area, photosynthesis occurs more quickly, assimilates are produced at a higher rate and plant dry matter is produced at a higher pace, leading to a rise in plant dry weight. Similar results were reported by **Rahman et al. (2014)**. Further increase in plant dry weight with application of 25% N through poultry manure may be due to wheat's photosynthetic pigments and chlorophyll content increased as a result of the N, increasing the plant's net photosynthetic rate, the higher net photosynthetic rate resulted in higher dry matter of the plant. Similar results were reported by **Iqra et al. (2021)**.

Crop growth rate (g/m²/day)

At 50-75 DAS, highest crop growth rate (35.73 g/m²/day) was recorded in treatment 7 (50% N through urea + 50% N through poultry manure), though there was no significant difference among the treatments. Significant and higher crop growth rate was recorded with 75% N through urea might be due to optimal nutrients utilization to ensure the nutrient uptake by plant and translocation of

assimilates to various plants parts which led to increased plant biomass, resulting in higher CGR. Similar results were reported by **Wanget al.(2010)**.

Yield attributes

Number of effective tillers/m²

Significantly higher number of effective tillers/m² (14.45) was recorded in treatment 6 (75% N through urea + 25% N through poultry manure). However, treatment 7 (50% N through urea + 50% N through poultry manure) was found to be statistically at par with treatment 6 (75% N through urea + 25% N through poultry manure). Significant and higher number of effective tillers/m² was recorded with 75% N through urea might be due to increased level of nitrogen resulted in more number of leaves, resulting in high rate of photosynthesis, assimilation, metabolic activities and cell division, which led to significant increase in number of effective tillers/m². Similar results were reported by **Chauhan et al.(2014)**. Further, increase in number of tillers/ m² with application of 25% N through poultry manure may be due to availability of both macro nutrients and micro nutrients present in the poultry manure which increased the number of effective tillers/m². Similar results were reported by **Muhammad et al.(2018)**.

Number of seeds/spike

Significantly higher number of seeds/spike (55.33) was recorded in treatment 6 (75% N through urea + 25% N through poultry manure). However, treatment 7 (50% N through urea + 50% N through poultry manure) was found to be statistically at par with treatment 6 (75% N through urea + 25% N through poultry manure). Significant and higher number of seeds/ spike was recorded with 75% N through urea might be due to increased photosynthesis rate because of higher dose of nitrogen which resulted in more amount of dry matter, more assimilates which were produced and transported to fill the seeds. Similar results were reported by **Imbad et al.(2018)**. Further increase in number of seeds/spike along with application of 25% N through poultry manure may be due to increased nitrogen rate that led to an increase in dry matter and more partitioning towards grains, which in turn led to an increase in the number of grains/spikes. Similar results were reported by **Muhammad et al.(2018)**.

Testweight(g)

Significantly higher test weight (97.71 g) was recorded in treatment 6 (75% N through urea + 25 % N through poultry manure). However, treatment 7 (50% N through urea + 50 % N through poultry manure) was found to be statistically at par with treatment 6 (75% N through urea + 25 % N through poultry manure). Significant and higher test weight was recorded with 75% N through urea might be due to the enormous buildup of proteins and other stored nutrients in the seed, the weight of one thousand grains increased. Similar results were reported by *Azametal.(2010)*. Further increase in test weight along with application of 25% N through poultry manure may be due to the accumulation of A-type starch granules is increased by enough nitrogen, A-type starch granules have more amylose, which makes grain rounder and bolder for more starch to accumulate in, increasing grain weight. Similar results were recorded by *Weietal.(2010)*.

CONCLUSION

Based on the findings it can be concluded that in wheat with the combination of 75% N through urea along with 25% N through poultry manure (treatment 6) was observed highest growth and yield attributes.

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Table 1: Effect of nitrogen management on growth attributes of wheat

S. No.	Treatments	Plant height (cm)	Number of tillers/m ²	Plant dry weight (g)	Crop growth rate (g/m ² /day)
1.	100% N through urea	108.20	189.3	54.67	32.07
2.	75% N through urea + 25% N through vermicompost	113.20	213.0	61.21	37.03
3.	50% N through urea + 50% N through vermicompost	114.80	204.0	59.06	34.17
4.	25% N through urea + 75% N through vermicompost	109.20	190.7	57.53	32.91
5.	100% N through vermicompost	110.50	180.0	52.00	31.29
6.	75% N through urea + 25% N through poultry manure	119.20	214.0	64.34	35.73
7.	50% N through urea + 50% N through poultry manure	116.20	213.7	64.00	35.16
8.	25% N through urea + 75% N through poultry manure	114.00	200.0	58.31	34.20
9.	100% N through poultry manure	106.20	180.0	53.46	33.33
	F-Test	S	S	S	NS
	SEm(±)	1.02	0.34	0.72	1.19
	CD (p=0.05)	3.08	1.03	2.17	-

Table 2: Effect of nitrogen management on yield attributes of wheat

S. No.	Treatments	Number of effective tillers/m ²	Number of seeds/spike	Test weight (g)
1.	100% N through urea	119.8	45.00	87.90
2.	75% N through urea + 25% N through vermicompost	140.5	52.33	94.38
3.	50% N through urea + 50% N through vermicompost	134.5	50.00	93.00
4.	25% N through urea + 75% N through vermicompost	121.2	46.67	89.25
5.	100% N through vermicompost	110.5	42.00	84.00
6.	75% N through urea + 25% N through poultry manure	144.5	55.33	97.71
7.	50% N through urea + 50% N through poultry manure	144.2	54.67	96.93
8.	25% N through urea + 75% N through poultry manure	130.5	49.40	90.51
9.	100% N through poultry manure	110.0	43.33	85.53
	F-Test	S	S	S
	SEm(±)	0.23	0.68	0.27
	CD (p=0.05)	0.69	2.05	0.82

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