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Response of nitrogen management on growth and yield of wheat (*Triticum astivum*) crop

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Abstract

The particulars of experimental material used and techniques adopted during the course of investigation entitled "Find out the suitable method of nitrogen application in wheat (*Triticum aestivum*) crop". Field experiment was carried out during rabi season of 2021-22 at Agricultural Research Farm of Faculty of Agriculture sciences and allied Industries Rama University, Mandhana Kanpur (U.P). The experiment was laid out in Randomized block design with three replications keeping seven nitrogen management practices Control, 50% N as basal + 50% N after 1st irrigation, 50% N as basal + 25% N after 1st irrigation + 25% N after 2st irrigation, 25% N as basal + 25% N after 1st irrigation + 25% N after 2st irrigation+ 25% N after 3st irrigation, 75% N through vermicompost + 25% N as basal, 50% N through vermicompost + 50% N as basal, 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation. Results revealed that among weed management practices weed free followed by Sulfosulfuron (30g) + metsulfuron (4g) a.i ha^{-1} proved as superior than other treatments with respect to higher crop growth and yield attributes where as plant height, number of tillers m^{-2}, grain per spike, grain weight per spike(g), grain and straw yield (q/ha). Maximum gross return and cost of cultivation was found with 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation. While maximum net return was found with 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation. Maximum B:C ratio was obtained in combination of 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation. The planting was done on 4th December 2021. Among the various nitrogen management treatment 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation recorded highest B:C ratio and yield.

Keywords: Nitrogen, management, wheat, *Triticum astivum*

Introduction

Wheat is a grass widely cultivated for its sees, a cereal grain which is a worldwide staple food. The many species of wheat together make up the genus *Triticum*; the most widely grown is common wheat (*T. aestivum*). The archaeological recorde suggests that wheat was first cultivated in the regions of the Fertile Crescent around 9600 BCE. Botanically, the wheat kernel is a type of fruit called a caryopsis.

Wheat is grown on more land area than any other food crop (220.4 million hectares, 2014). World trade in wheat is greater than for all other crops combined. In 2017, world production of wheat was 772 million tonnee, with a forecast of 2019 production at 766 million tonnes, making it the second most-produced cereal after maize. Since 1960, world production of wheat and other grain crops has tripled and is expected to grow further through the middle of the 21st century. Global demand for wheat is increasing due to the unique voscoelastic and adhesive properties of gluten proteins, which facilitate the production of processed foods, whose consumption is increasing as a result of the worldwide industrialization process and the westernization of the diet.

To get maximum benefit from the fertilizer use, the fertilizer should not only be applied in optimum quantity but also at the right time. As timely nitrogen applications in is agronomic technique which has helped considerably increase the nitrogen use efficiency? It is now very well established that most crops, nitrogen must be applied in two or three split doses coinciding with the crop growth stages when requirement is high.

Therefore, it is high time to assess the fertilizer use efficiency in wheat. Application of nitrogen in two equal split (basal & first node stage) record highest production and good quality and showed significantly difference in grain N uptake (Patel *et al.*, 2004) [3]. Soil organic matter plays a key role in influencing the nutrient dynamics in soils. It acts as a sink by hoarding the nutrients temporarily through an array of biochemical processes ranging from adsorption reactions to organic-nutrient forms. Organically held plant nutrients play a vital role in sustaining the plant nutrient availability. It also maintains optimum temperature and moisture in soil. FYM is a good source of nutrient sand contributed towards building up of organic matter in soil (Das *et al*. 2008) [1].

Result and Discussion

Initial plant emergence

Data pertaining to initial plant emergence in percent recorded at 15 DAS, have been presented in Table.1. Perusal of data presented in table.1 clearly indicated that the plant emergence percent did not influenced significantly due to Nitrogen management treatments. The germination percentage counts at 15 days after sowing was significantly by time of nitrogen application. This was because; the germination totally depends on moisture and varietals germinability. Similar findings were reported by Naphade *et al.* (1993) [2], Sheoran *et al.*, (2015) [5] and Verma *et al.*, (2014) [8].

Table 1: Effect of sowing methods and nitrogen management on plant height (cm) of wheat

Treatment	IPP at 15 DAS	60 DAS	At harvest
Nitrogen management			
Control	124.15	69.25	71.37
50% N as basal + 50% N after 1st irrigation	123.60	76.34	78.79
50% N as basal + 25% N after 1st irrigation + 25% N after 2st irrigation	122.90	78.65	81.18
25% N as basal + 25% N after 1st irrigation + 25% N after 2st irrigation+ 25% N after 3st irrigation	122.30	80.72	73.32
75% N through vermicompost + 25% N as basal	122.10	83.80	86.50
50% N through vermicompost + 50% N as basal	123.15	87.29	90.10
50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation	122.50	90.83	93.75
S.Em+	1.07	1.72	4.37
CD at 5%	N.S	5.32	13.48

Plant height

Data pertaining to plant height recorded as 60 DAS and at harvest are presented in (Table.1). Nitrogen management affected the plant height significantly at all stages of crop growth.

Critical analysis of data revealed that nitrogen management has significant effect on plant height at 60 DAP. The higher plant height was recorded 90.83 cm and 93.75 cm at 60 DAP and at harvest respectively was recorded with 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation which was significantly superior over the rest of the treatments. The results are in close conformity to those of Wagan *et al.* (2002) [9], Ram *et al.* (2006) [4].

Number of tillers per meter^2

Data pertaining number of to tillers per meter^2 are significantly affected by different treatments at different growth stages are presented in Table.2.

Table 2: Effect of Nitrogen management on number of tillers per meter^2 on wheat

Treatment	60 DAS	At harvest
Nitrogen management		
Control	331.79	341.76
50% N as basal + 50% N after 1st irrigation	365.73	376.71
50% N as basal + 25% N after 1st irrigation + 25% N after 2st irrigation	376.85	388.14
25% N as basal + 25% N after 1st irrigation + 25% N after 2st irrigation+ 25% N after 3st irrigation	386.72	398.33
75% N through vermicompost + 25% N as basal	401.54	413.58
50% N through vermicompost + 50% N as basal	418.20	430.76
50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation	435.18	488.24
S.Em+	3.07	3.51
CD at 5%	9.47	10.83

Data obtained on number of tillers per meter^2 was increased sharply from 60 DAS in comparison to at harvest. The significantly higher number of tillers per meter^2 was recorded under 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation method of application of nitrogen at 60 DAS and at harvest and that was found at par with 50% N through vermicompost + 50% N as basal through urea. Thereafter, it was fully ignored during the entire grand growth period resulting into lowest number of tillers production. Similar results reported by Singh *et al.*, (2014) and Naphade *et al.*, (1993) [2].

Number of grain per spike

The data pertaining on number of grain per spike was influenced by different nitrogen management treatments have been present in (Table.3).

The result revealed that the number of grain per spike of wheat increased significantly due to different nitrogen management treatments present in (Table.3). Among different nitrogen management, significantly higher number of grain per spike was noticed with application of (T7) 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation, which was at par with (T6) 50% N through vermicompost + 50% N as basal. The significantly lowest number of grain per spike was observed with treatment control.

Grain weight per spike

Grain weight per spike recorded at harvest significantly influenced by different different of nitrogen management practices hav been presented in Table.3.

The data pertaining on grain weight per spike influenced by different nitrogen management. Significantly higher number of Grain weight per spike was noticed with nitrogen management (T7) 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation, which was followed by (T6) 50% N through vermicompost + 50% N as basal. Whereas, significantly lowest grain weight per spike was noticed with treatment (T_7) control. Similar results were obtained by Singh *et al.*, (2019) [7], Verma *et al.*, (2014) [8], Shah *et al.*, (2009) [6].

Table 3: Effect of nitrogen management on different yield attributes of wheat.

Treatment	Grain/spike	Grain weight/spike(g)
Control	42.45	2.16
50% N as basal + 50% N after 1st irrigation	46.67	2.38
50% N as basal + 25% N after 1st irrigation + 25% N after 2nd irrigation	48.30	2.46
25% N as basal + 25% N after 1st irrigation + 25% N after 2nd irrigation+ 25% N after 3rd irrigation	49.67	2.55
75% N through vermicompost + 25% N as basal	51.60	2.64
50% N through vermicompost + 50% N as basal	53.50	2.74
50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation	55.65	2.85
S.Em+	1.30	0.08
CD at 5%	4.03	0.25

Yields attributes (q/ha)

Yield of wheat crop varied significantly due to different nitrogen management treatments are present in (Table.4).

Wheat grain yield and straw yield both under different nutrient levels showed significant variation in yield, (T7) 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation produced significantly higher grain and straw (54.65q ha^{-1}, 74.94q ha^{-1}) yield compression to other treatments, which was at par with (T6) 50% N through vermicompost + 50% N as basal. Whereas, the (T6) 50% N through vermicompost + 50% N as basal was the second best treatment followed by (T_5) 75% N through vermicompost + 25% N as basal. The significantly least grain and straw yield was observed with application of 0 kg N per ha (control).

Table 4: Effect of nitrogen management on test weight, grain and straw yield, of wheat.

Treatment	Grain yield	Straw yield	Harvesting index
Nitrogen management			
Control	41.65	60.46	40.78
50% N as basal + 50% N after 1st irrigation	45.90	65.43	41.22
50% N as basal + 25% N after 1st irrigation + 25% N after 2nd irrigation	47.30	67.01	41.37
25% N as basal + 25% N after 1st irrigation + 25% N after 2nd irrigation+ 25% N after 3rd irrigation	48.55	68.11	41.61
75% N through vermicompost + 25% N as basal	50.40	70.20	41.79
50% N through vermicompost + 50% N as basal	52.45	72.73	41.89
50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation	54.65	74.94	42.17
S.Em+	1.30	1.81	0.17
CD at 5%	NS	2.57	0.24

Economic

The highest total cost of cultivation (Rs. 50201 ha^{-1}) was recorded under treatment (T_5) 75% N through vermicompost + 25% N as basal due to high amount of vermicompost and lowest cost of cultivation of (Rs. 47974/ha) was recorded with treatment control (T_1).

The data on the gross return have been presented in Table 4.5 indicate that the maximum gross income Rs. 143842 ha^{-1} in 2021-22 were obtained with the treatment T_7 followed by Rs. 137508 ha-1 under the treatment T_6 respectively. The minimum gross return Rs. 111133 ha^{-1} were obtained under treatment (T1).

A perusal data given in table 4.5 indicated that the highest net return of Rs. 94583 ha^{-1} was found with treatment T7 followed by Rs. 88259 ha^{-1} with the treatment T6 respectively. The lowest net return of Rs. 63159 ha^{-1} was found with treatment control (T1).

The data pertaining on B:C ratio (Rs. rupee^{-1} invested) have been presented in Table-5. It is observed from the table that maximum B-C Ratio: (1.92) was obtained with application of (T7) 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation followed by (T6) 50% N through vermicompost + 50% N as basal (1.79) per hectare for wheat crop.

Table 5: Effect of nitrogen management on different economics of wheat are practices.

Treatment	Cost of cultivation	Gross retune	Net return	B:C ratio
Nitrogen management				
Control	47974	1,11,133	63159	1.31
50% N as basal + 50% N after 1st irrigation	47974	1,21,932	73958	1.54
50% N as basal + 25% N after 1st irrigation + 25% N after 2nd irrigation	47974	1,25,464	77490	1.61
25% N as basal + 25% N after 1st irrigation + 25% N after 2nd irrigation+ 25% N after 3rd irrigation	47974	1,28,477	80503	1.67
75% N through vermicompost + 25% N as basal	50201	1,33,146	82945	1.68
50% N through vermicompost + 50% N as basal	49259	1,37,508	88259	1.79
50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation	49261	1,43,842	94583	1.92

Conclusions

- The results of experiments conducted at Agronomy research farm Rama University Mandhana Kanpur (U.P.) during 2021-22 conducted that to ensure maximum grain yield and remuneration from wheat.
- On the basis of above summarized results, the following conclusion can be drawn: Nitrogen application of 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation increased the nitrogen use efficiency and found suitable for higher growth, yield and quality of wheat.
- 50% N through vermicompost + 25% N as basal + 25% N after 1st irrigation recorded significantly higher yield over the rest of the treatments. Net returns and benefits cost ratio was also found significantly higher.

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