International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 07-08-2021, Accepted: 20-08-2021, Published: 12-09-2021
Volume 6, Issue 5, 2021, Page No. 148-150

Influence of different sources of nitrogen and time of application on growth and yield of wheat (*Triticum aestivum)*

Sanjeev[1], Shilpa Kaushal[2], Abhishek[1], Abhishek Singh[1], Kritika[1]
[1] M.sc Scholar's (Agronomy), UIAS, Chandigarh University, Mohali, Punjab, India
[2] Assistant Professor, UIAS, Chandigarh University, Gharuan, Mohali, Punjab, India

Abstract
A field experiment was conducted during *Rabi* 2019 at Crop Research Center of Chandigarh University, Gharuan (Mohali) to study the Influence of different sources of nitrogen and time of application on growth and yield of wheat (*Triticum aestivum*). There was total six treatments comprising of wheat with treatment details M1: Vermicompost + FYM, M2: FYM + Vermicompost + Urea, S1: control, S2: 50% N as basal through VC, 25% at CRI and 25% at booting stage through urea, S350% N as basal through FYM, 25% at tillering and 25% at booting stage through Urea, S4: 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea. The experiment was laid down in split plot design with three replications with source of nutrient as main plots and time of application as sub plot treatments. Growth, yield attributes, grain and straw yields of wheat were more in case of time of nitrogen was in 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea(S4). Among sources of nitrogen, M2: FYM + Vermicompost+ Urea gave the best results. Highest available nitrogen, available phosphorus, and available potassium was in treatment 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea(S4) was recorded whereas, sources combination M2 (FYM + vermicompost+ Urea) recorded highest N kg/ha, P, K. Highest net returns ₹ 24650 and net returns per rupee invested of ₹ 1.38 was recorded in treatment S4 followed by treatment M2.

Keywords: nitrogen, FYM, vermicompost, urea

Introduction

Wheat is a major cereal crop grown as well as consumed all over the world. In India wheat is grown almost all over the country and specially in central and northern India. During 2019-2020 total area under wheat was 29 million hectares and production was 107.18 million tonnes (ministry of agriculture). Nitrogen is one of the prime nutrients required by plants to efficiently complete their life cycle and various metabolic processes during their life period. Inorganic nutrients have contributed substantial surge in crop yields in the 20th century. Stewart *et al.* (2005) [2] reported that 50 to 60% of the rise in crop yields globally owed to application of chemical fertilizers, they also specified that during the 21st century, the essential plant nutrients would be one of the reasons restraining crop yields, especially in developing countries, the main factors accountable for low yield are less or more plant density and inadequate crop nutrition. Wheat yields particularly those of new developed genetic constitution are among the most dependent nitrogen fertilization plant species (Hirel *et al*., 2001) [3].Application of FYM gave a noteworthy rise in all numerical yield characteristics as compared with the control treatment (Ghamry *et al.* 2008) [4]. Nitrogen fertilization improved wheat biomass (Ghamry *et al*., 2013) [4], production (Khan *et al.*, 2009 and Tariq Jan *et al.*, 2011) [6, 7] and protein percentage (Saint Pierre *et al*., 2008) [8].The wheat needs of nitrogen is a complex characteristic depending on genetic constitution, years, locations, stage of development, soil type, tillage methods, crop rotation and amount and type of nitrogen fertilizer (López-Bellido *et al*., 2001) [9]. The sources of chemical fertilizer have a noteworthy role in nutrients accessibility and crop production. The ammonium nitrogen enhanced leaf and stem growth than nitrate nitrogen in wheat but did not affect the grain production (Spratt and Gasser, 1970) [10]. Application of FYM significantly reduced soil bulk density and increased mean weight diameter (MWD) and SOC contents in different aggregate size fractions (Bhattacharyya *et al.* 2003) [13]. The application of enhanced DAP 100 kg ha^{-1} with Enhanced Urea-2 100 kg ha^{-1} is recommended to optimize the growth and yield performance of wheat (Ayalew *et al.* 2018) [11]. Optimum grain yield (6060.04 kg ha^{-1}) was recorded when 240 kg N ha^{-1} was applied ¼ at sowing, ½ at tillering and ¼ at booting, and it showed no significant additional response to *N* fertilizer above this rate (Belete *et al.* 2018) [12]. Nitrogen fertilizer in tillering, booting and flowering sources with ammonium nitrate and urea enhanced the grain yield (7.75%), protein percentage (11.54%) using source liquid (Ferrari *et al.* 2016) [15]. Significant increase was recorded in number of effective tillers m-2, spikelets spike-1, grains spike-1, thousand-grain weight and grain yield with foliar application of urea (Rahman *et al.* 2014) [14].

Materials and Methods

This experiment was conducted during the 2019-2020 rabi season at university farm, University Institute of Agricultural Sciences, Chandigarh University, Gharuan (Punjab) to study the Influence of different sources of nitrogen and time of application on growth and yield of wheat (*Triticum aestivum).* The experiment was laid out in a split plot design with three replications having a plot size of 5m x 2m. Row spacing of 20cm was maintained. Wheat variety PBW-343 was sown at the rate 100 kg ha^{-1} on 14-12-2019. Farm yard manure and Vermicompost were incorporated in soil during seed bed preparation except those under control.

During study 2 different combinations of nitrogen sources i.e., Farm yard manure + vermicompost (M1) and Farm yard manure + vermicompost + urea (M2) in main plot and four different time of application i.e. Control (S1), 50% N as basal through VC, 25% at CRI and 25% at booting stage through urea (S2), 50% N as basal through FYM, 25% at tillering and 25% at booting stage through Urea (S3), 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea (S4) were evaluated. Data was analysed for growth and yield attributing characters like plant height, dry matter accumulation (m^{-2}), leaf area index, number of effective tillers (m^{-2}), fertile spikelets/ear, test weight, grain yield were recorded.

The data recorded on various aspects in the present study was subjected to the statistical analysis using analysis of variance as per procedure suggested by Gomez and Gomez (1984).

Result and Discussion

Influence of different sources of nitrogen and time of application on growth parameters of wheat

Plant Height

At all the stages of crop growth significantly taller plants were observed in treatment 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea. Among sources, FYM + Vermicompost + Urea recorded significantly maximum height (91cm), whereas, source FYM + Vermicompost recorded lowest plant height (87 cm) at harvesting stage, respectively. Similar results have been observed by Ferrari *et al.* (2016) [15]. This might be due to the reason that nitrogen was available throughout the life cycle of crop.

Dry Matter Accumulation

The wheat crop with split application of nitrogen 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea produced significantly more dry matter at all the stages of growth and harvest, respectively followed by other treatments. Most dry matter (647 gm m^{-2}) was produced by FYM + Vermicompost + Urea sources of nitrogen. Similar observation was reported by Rahman *et al.* (2014) [14]. This could be due to the reason that application urea improved the growth of crop.

Leaf Area Index

The nitrogen application 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea resulted in higher LAI values. FYM + Vermicompost + Urea resulted in significant enhancement of LAI at 30, 60, 90 DAS followed by FYM + Vermicompost. Similar results were obtained by Kumar *et al.* (2017) [17]. This might be due to the fact that application of urea imparted greener colour to the leaves.

Table 1: Influence of different sources of nitrogen and time of application on growth parameters of wheat

Treatments	Plant Height Harvesting	Dry Matter Accumulation Harvesting	Leaf Area Index 90 (DAS)
Sources of Nitrogen			
M1	86.83	608.65	3.54
M2	91.00	646.91	3.77
CD (P=0.05)	3.42	15.00	0.03
Time of Application			
S1	79.83	552.22	2.49
S2	90.17	607.08	3.69
S3	90.63	647.37	3.94
S4	95.00	704.45	4.50
CD (P=0.05)	1.89	9.03	0.09

Number of Effective Tillers

Split application of nitrogen 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea caused a significant improvement (246^{-2}) in number of effective tillers and was lowest in control (214), other treatments were at par with each other. Among sources of nitrogen FYM + Vermicompost + Urea resulted in significant improvement in number of effective tillers m^{-2} (236) in comparison with FYM + Vermicompost (224). Similar results were obtained by Mandal *et al*. (2015). This could be due to reason that nitrogen was available to plants during their entire life cycle.

Fertile Spikelets/spike

significant increase in fertile spikelets (22) with 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea then and lowest in control (14) other two treatments were at par with each other. FYM + Vermicompost + Urea resulted in significantly more fertile spikelets (20) and lowest fertile spikelets per ear was achieved by FYM + Vermicompost (17). Similar finding was reported by Ishete *et al*. (2019) [18]. This might be due to the reason that nitrogen was available to plants during their entire life cycle.

Test Weight

split application of nitrogen 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea resulted in significant increase in the test weight which was (42 gm) and was lowest in control (34 gm). The nitrogen source FYM + Vermicompost + Urea resulted in highest test weight which was (40 gm) followed by FYM + Vermicompost with (36 gm) weight. Similar results were obtained by Ram *et al*. (2006) [19]. This could be due to the reason that multiple split application of nitrogen during the growth stages of crop improved grain size and quality.

Grain Yield (q/ha)

A careful purview of data revealed that grain yield was significantly higher (46.13 q/ha) under split application of nitrogen 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea then the other treatments. It was lowest in control (31 q/ha) and grain yield was (41.02 q/ha) in S2 and in S3 it was (42.72 q/ha). Among the sources of nitrogen, FYM + Vermicompost + Urea resulted significantly higher yield (41.29 q/ha) then FYM + Vermicompost (39.15 q/ha). Similar results were obtained by Akhter *et al.* (2017) [20]. This might be due to the reason that, urea contains more nitrogen concentration and improved the grain yield.

Table: 2

Treatments	Number of Tillers	Fertile spikelets/spike	Test Weight	Grain Yield Q/ha
Sources of Nitrogen				
M1	224.42	17.25	35.25	39.15
M2	235.83	20.42	43.17	41.29
CD (P=0.05)	2.51	0.72	2.87	1.17
Time of Application				
S1	214.00	14.33	25.00	31
S2	226.67	19.00	40.67	41.02
S3	233.50	20.00	43.50	42.73
S4	246.33	22.00	47.67	46.13
CD (P=0.05)	3.07	1.26	1.91	0.79

Conclusion

From the above findings it can be concluded that treatment 50% N as basal through VC+FYM (1:1), 25% at tillering and 20% at booting stage and 5% N as foliar spray at pre flowering stage through urea and among sources of nitrogen FYM + Vermicompost + Urea combination produced highest grain yield.

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