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Nitrogen Management in Late Sown Wheat (*Triticum Aestivum L.*)

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Research Article

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ABSTRACT

A field experiment entitled "Nitrogen management in late sown wheat (*Triticum aestivum L.*)" was conducted during rabi 2018,19 at Research Farm, Guru Kashi University, Talwandi Sabo, Bathinda (Punjab). The 50% recommended dose of nitrogen with 3% urea foliar application at tillering and earing recorded resulted in the highest growth parameters *viz.,* plant height, dry matter, number of tillers and yield attributes *viz.,* number of effective tillers, ear length, number of grains/ear and 1000-grain weight in late sown wheat. Nitrogen application 1/3 at sowing +1/3 at first irrigation +1/3 at second irrigation (N_5) recorded significantly higher grain yield (47.2 q/ha) of wheat than other treatments. Urea foliar application (3%) at tillering and earing with 50% recommended dose of nitrogen at sowing significantly increased the grain yield in wheat under late sown conditions. Treatment T_7: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering and earing recorded 41.8, 52.6 and 30.6% higher grain yield than T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing, T_2: 75% recommended dose of nitrogen at sowing, T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha, respectively.

INTRODUCTION

Wheat (*Triticum aestivum L*) is the world's most widely cultivated cereal which occupies a significant position among other cultivated cereals. Wheat is the second most crucial cereal crop in India next to rice, contributing nearly 35% to the national food basket and plays an important role in food and nutritional security of the nation. It finds a major place in meals of common population of major wheat growing states of the country. It is primarily grown in temperate region at higher altitude of tropical region [1].

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India is the 2nd largest producer after china, contributes 1/10 of global wheat production. In India wheat is cultivated on an area of 35.86 million ha with a production level of 94.76 million tonnes (Anonymous 2019a) [2]. Although, it is grown in most of the states, the major production comes from the north western part of the country. Punjab occupies second place after Uttar Pradesh in contributing to the central pool. Punjab is premier wheat growing state of India with an area of 3.50 million ha and 16.80 million tonnes production with per hectare yield of 4724 kg (Anonymous 2019b) [3].
IFPRI summarized several studies that showed food grain demand in India reaching 293 million tonnes by 2020 and increasing to 355 million tonnes by 2026. Assuming 20 percent hike in per capita requirement of food grain, due to better standard of living and increase in the demand of processing industries, requires wheat production to be around 109 million tonnes by the year 2025. Under late sown condition wheat may be sown up to 15th December in Punjab After that there is drastic reduction in yield despite of best management practices [4]. Nitrogen is a basic nutrient used in modern agriculture, but only 25 to 50 percent is recovered by the crops [5]. Different nitrogen sources can be used to increase the NUE of wheat. Many researchers have attested that nutrients (like nitrogen) absorbed from the roots and leaves, can spread all over the plant tissues [6].

MATERIALS AND METHODS

The present study was carried out during the rabi season 2019-20 at agricultural research farm of Guru Kashi University, Talwandi Sabo, Bathinda located at 29 57'N latitude and 75 7'E longitude and altitude of 213 meters above the sea level. This tract is characterized by semi-arid climate, where both winters and summers are extreme. The mean weekly maximum and minimum temperatures during the crop season ranged from 17.2 to 33.5°C and 4.4 to 16.1°C, respectively. A maximum of 33.5°C and minimum of 4.4°C were recorded during 14th and 1st standard meteorological week, respectively. The mean weekly relative humidity ranged from 55 to 84% during the crop season. The total rainfall received during the crop season was 43.4 mm. The maximum mean weekly rainfall of 14.4 mm was observed during 7th standard meteorological week. The trial was laid in randomized complete block design with eight treatments *viz.*, (T_1) 100% recommended dose of nitrogen (125 kg N/ha) at sowing, (T_2) 75% recommended dose of nitrogen at sowing, (T_3) 75% recommended dose of nitrogen at sowing +FYM 6 t/ha, (T_4) 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering, (T_6) 50% recommended dose of nitrogen at sowing+3% Urea foliar application at earing, (T_7) 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing, (T_8) LCC (Leaf Colour Chart) based N application with three replications.
The data recorded were analysed statistically using randomized complete block design described by Cochran and Cox (1957) and statistical package CPCS-1 by Cheema and Singh [6]. Level of significance was kept 5 percent is all the comparisons [7].

RESULTS AND DISCUSSION

Growth parameters of wheat

Plant height: Analysed data revealed that the plant height of late sown wheat was significantly influenced by different nitrogen management practices (Table 1). However, at 30 DAS, the plant height was not significantly influenced by different nitrogen management practices [8]. At 60, 90 DAS and at maturity, maximum plant height of wheat was recorded under treatment T_8, LCC (leaf 21 colour chart) based N application and it was statistically at par with the plant heights of wheat recorded under the treatments T_7 i.e. 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing and T_5 (50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and was significantly superior to rest of the treatments. Similar results were also reported by Matilo et al. [9].

Table 1: Effect of nitrogen soil and foliar application on periodic plant height of wheat.

Treatment	Plant height (cm)			
	30 Days	60 Days	90 Days	At harvest
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	12.8	29.4	62.7	93.4
T_2: 75% recommended dose of nitrogen sowing at	12.6	27.1	58.1	92.9
T_3: 75% recommended dose of nitrogen sowing at FYM 6 t/ha	12.5	30.2	65.1	95.6

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T_4: 75% recommended dose of nitrogen (1/2 at sowing + 1/2 at first irrigation)	13.0	33.8	66.0	96.9
T_5: 50% recommended dose of nitrogen sowing at 3% Urea foliar applicationtillering	12.0	34.5	68.2	99.8
T_6: 50% recommended dose of nitrogen at sowing + 3% Urea foliar application at earing	12.1	33.2	67.0	98.0
T_7: 50% recommended dose of nitrogen sowing + 3% at Urea foliar application tillering and earing	12.2	34.7	68.9	100.1
T_8: LCC (Leaf Color Chart) based N application	12.5	35.2	70.2	101.5
CD (p=0.05)	NS	0.8	2.6	2.1

Number of tillers/m²

The data pertaining to effect of different treatments on the number of tillers/m² have been shown in Table 2. Data revealed that the number of tillers/m² of late sown wheat was significantly influenced by different nitrogen management practices. At 60, 90 and 120 DAS, highest number of tillers/m² of wheat was recorded under treatment T_7 i.e. 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing and it was statistically at par with treatments T_4: 75% recommended dose of nitrogen (1/2 at sowing+1/2 at first irrigation), T_5: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and T_8: LCC (leaf color chart) based N application and was significantly higher than other treatments.). Similar results were also reported by Matilo et al. [10].

Table 2: Effect of nitrogen soil and foliar application on periodic number of tillers/m² of wheat.

Treatment	Number of tillers/m²		
	60 Days	90 Days	120 Days
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	231	228	220
T_2: 75% recommended dose of nitrogen at sowing	220	217	215
T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha	250	246	243
T_4: 75% recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation)	262	258	255
T_5: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering	268	266	260
T_6: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at earing	256	253	248
T_7: 50% recommended dose of nitrogen at sowing +3%Urea foliar application at tillering and earing	270	265	262
T_8: LCC (Leaf Color Chart) based N application	267	264	257
CD (p=0.05)	10	08	09

Dry matter accumulation

The dry matter accumulation of late sown wheat was significantly influenced by different nitrogen management practices (Table 3). Treatment T_7: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing

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recorded the highest dry matter accumulation of late sown wheat and it was statistically at par with T_8: LCC (Leaf Colour Chart) based N application at 30 DAS; with T_4: 75% recommended dose of nitrogen (1/2 at sowing+1/2 at first irrigation) and T_8: LCC (leaf colour chart) based N application at 60 and 120 DAS and it was significantly higher than other treatments of nitrogen. T_2: 75% recommended dose of nitrogen at sowing recorded lowest dry matter accumulation. Similar results were also reported by Matilo et al. [11].

Table 3: Effect of nitrogen soil and foliar application on dry matter accumulation in late sown wheat.

Treatment	Dry matter accumulation (q/ha)		
	30 Days	60 Days	120 Days
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	3.52	32.7	72.8
T_2: 75% recommended dose of nitrogen at sowing	3.25	31.2	70.0
T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha	4.10	36.5	82.5
T_4: 75% recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation)	4.83	40.8	84.8
T_5: 50% recommended dose of nitrogen at sowing +3% urea foliar application at tillering	4.70	39.7	84.1
T_6: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at earing	4.50	37.9	80.3
T_7: 50% recommended dose of nitrogen at sowing +3%Urea foliar application at tillering and earing	5.07	42.5	86.4
T_8: LCC (Leaf Color Chart) based N application	5.00	41.7	85.7
CD (p=0.05)	0.15	2.9	3.1

Yield attributes of wheat

Ear length (cm): Ear length, to some extent, is related to the number of spikelets, which in turn affect the grain yield. Much of the ear differentiation and development depends on the availability of carbohydrates during the early stages of growth when there is a competition with strong sinks like tillers, leaf and stem. The ear length recorded with various treatments is given in Table 4. Ear length of late sown wheat was significantly influenced by different nitrogen management. Treatment T_7: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing recorded the maximum ear length of late sown wheat and it was statistically at par with T_6: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at earing and it was significantly higher than other treatments. Similar results were also reported by Matilo et al. [12].

Table 4: Effect of nitrogen soil and foliar application on ear length (cm) in late sown wheat.

Treatment	Ear length (cm)
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	8.93
T_2: 75% recommended dose of nitrogen at sowing	8.80

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T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha	8.95
T_4: 75% recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation)	9.00
T_5: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering	9.02
T_6: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at earing	9.21
T_7: 50% recommended dose of nitrogen at sowing +3%Urea foliar application at tillering and earing	9.26
T_8: LCC (Leaf Color Chart) based N application	9.12
CD (p=0.05)	0.10

Number of grains/ear

Potential yield is determined during the early stage of differentiation of inflorescence by the number of tillers that form inflorescence and the number of spikelets formed on each spike. The data on number of grains/ear have been presented in Table 5 [13]. Nitrogen management practices showed significant effect on number of grains/ear of late sown wheat. Treatment T_7: 50% recommended dose of nitrogen at sowing+3% Urea foliar at tillering and earing recorded the maximum number of grains/ear, being at par with T_4: 75% recommended dose of nitrogen (1/2 at sowing+1/2 at first irrigation) and T_6: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at earing treatments and was significantly higher than all other treatments. Similar results were also reported by Yasmeen et al and Yassen et al. [14].

Table 5: Effect of nitrogen soil and foliar application on number of grains/ear in late sown wheat.

Treatment	Number of grains/ear
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	38.7
T_2: 75% recommended dose of nitrogen at sowing	36.2
T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha	40.4
T_4: 75% recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation)	45.2
T_5: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering	40.8
T_6: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at earing	45.9
T_7: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering and earing	46.8
T_8: LCC (Leaf Color Chart) based N application	42.5
CD (p=0.05)	2.1

1000-grain weight (g)

The 1000-grain weight represents the development and plumpness of grains. The data on 1000-grain weight have been presented in Table 6. Increased 1000-grain weight recorded under treatment T_7: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing, being at par with the 1000-grain weights of T_4:75%

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recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation) and T_6: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at earing treatments and was significantly higher than all other treatments. Yasmeen et al and Yassen et al also reported that the test weight of crop increased significantly with combined application of soil and foliar feeding of nitrogen. Similar results were observed by Matilo et al. [15].

Table 6: Effect of nitrogen soil and foliar application on 1000-grain weight in late sown wheat.

Treatment	1000-grain weight (g)
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	36.5
T_2: 75% recommended dose of nitrogen at sowing	34.3
T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha	37.7
T_4: 75% recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation)	40.1
T_5: 50% recommended dose of nitrogen at sowing +3% urea foliar application at tillering	39.2
T_6: 50% recommended dose of nitrogen at sowing +3% urea foliar application at earing	41.9
T_7: 50% recommended dose of nitrogen at sowing +3% urea foliar application at tillering and earing	42.8
T_8: LCC (Leaf Color Chart) based N application	40.5
CD (p=0.05)	3.2

Grain yield

Grain yield of late sown wheat was significantly influenced by different nitrogen management practices. Treatment T_7 i.e. 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing recorded the highest grain yield of wheat and it was significantly higher than all other treatments (Table 7). Growth and yield parameters are positively correlated with grain yield. Yasmeen et al and Yassen et al. reported that the grain yield increased significantly with combined application of soil and foliar feeding of nitrogen. Combined application of reduced dose of nitrogenous fertilizer in soil and foliar feeding of urea solution as nutrient supplementation of wheat crop recorded which might be due to the stimulating effect of urea through improving the physiological performance of plants and multiple advantage of foliar application method such rapid and efficient response to plant needs, less product needed and independence of soil conditions [13-15]. Similar results were observed by Matilo [10]. Who reported that wheat grain yield were significantly increased by the integral application of urea through broadcasting and foliar spray over soil application alone.

Table 7: Effect of nitrogen soil and foliar application on grain yield in late sown wheat.

Treatment	Grain yield (q/ha)
T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing	35.8
T_2: 75% recommended dose of nitrogen at sowing	33.3
T_3: 75% recommended dose of nitrogen at sowing +FYM 6 t/ha	38.9

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P-ISSN: 2319-9857

T_4: 75% recommended dose of nitrogen (1/2 at sowing +1/2 at first irrigation)	47.5
T_5: 50% recommended dose of nitrogen at sowing +3% Urea foliar application at tillering	39.2
T_6: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at earing	46.9
T_7: 50% recommended dose of nitrogen at sowing+3%Urea foliar application at tillering and earing	50.8
T_8: LCC (Leaf Color Chart) based N application	45.2
CD (p=0.05)	2.2

CONCLUSION

In conclusion, the 50% recommended dose of nitrogen with 3% urea foliar application at tillering and earing recorded resulted in the highest growth parameters *viz.*, plant height, dry matter, number of tillers and yield attributes *viz*., number of effective tillers, ear length, number of grains/ear and 1000-grain weight in late sown wheat. Nitrogen application 1/3 at sowing+1/3 at first irrigation+1/3 at second irrigation (N_5) recorded significantly higher grain yield (47.2 q/ha) of wheat than other treatments. Urea foliar application (3%) at tillering and earing with 50% recommended dose of nitrogen at sowing significantly increased the grain yield in wheat under late sown conditions. Treatment T_7: 50% recommended dose of nitrogen at sowing+3% Urea foliar application at tillering and earing recorded 41.8, 52.6 and 30.6% higher grain yield than T_1: 100% recommended dose of nitrogen (125 kg N/ha) at sowing, T_2: 75% recommended dose of nitrogen at sowing, T_3: 75% recommended dose of nitrogen at sowing +FYM **0** 6 t/ha, respectively.

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