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Effect of nitrogen levels and its time of application on growth parameters of barley (*Hordeum vulgare* L.)

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Abstract

An investigation was conducted in *rabi* season of 2013-14 to find out the suitable dose of Nitrogen in barley crop and to study the time and dose of nitrogen application for higher productivity of barley. The experiment was laid out in split plot design with four levels of nitrogen (0, 20, 40, and 60 kg N ha^{-1}) and three time of application (½ at the time of sowing and ½ after first irrigation, 1/3 at sowing and 2/3 after first irrigation, 1/3 at sowing and 1/3 after first irrigation and 1/3 after second irrigation) with three replications. Nitrogen level (60 $kgha^{-1}$) treatment and Time of application (1/3 at sowing and 2/3 after first irrigation) treatment was found best over rest of the treatments in all aspects of growth parameters *i.e.*, IPP, Plant height, Number of shoots, Dry matter accumulation and Leaf area index (LAI). Treatment N_3 (60 kg N ha^{-1}) increases significantly and was found maximum with No. of shoots (393.45), Plant height (70.70 cm), Leaf area index (5.10) & Dry matter accumulation (621.25 g) under main plot treatments. Treatment T_2 (1/3 at sowing and 2/3 after first irrigation) was found best with No. of shoots (389.96), Plant height (61.31 cm), Leaf area index (4.46) and Dry matter accumulation (554.94 g) as compared to other treatments and being at par with Treatment T_3 (1/3 at sowing and 1/3 after first irrigation and 1/3 after second irrigation) in all aspects of growth parameters.

Keywords: Nitrogen levels, Time of Application, Growth parameters, Barley

Introduction

Barley (*Hordeum vulgare* L.) is one of the world's fourth most important cereals after wheat, rice and maize. In India, it is popularly known as "Jau." India is on 7^{th} ranks in the world in respect to total area and production. In India, barley crop was grown over an area of 695.0 thousand hectare with a production of 1743.2 thousand tones and productivity of 25.10 qha^{-1} during 2012-13 (Anonymous, 2013) [1]. Uttar Pradesh is one of the most important barley growing states of India. In Uttar Pradesh, the area under cultivation of barley is about 168.0 thousand ha^{-1} with a production of 441.0 thousand tones and productivity of 26.3 qha^{-1} (Anonymous, 2013) [1]. Half of the total area under this crop is irrigated and rest remains rainfed. This crop has wider adoptability and needs less water and it is more tolerant to salinity and other stress conditions. Therefore, it is of great significance in areas where successful wheat crop cannot be grown due to unsuitable soil and insufficient irrigation.

Barley is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization. The most important role of nitrogen in the plant is its presence in the structure of protein and nucleic acids, which are the most important building and formative substances from which the living material or protoplasm of every cell is made. In addition, nitrogen is also found in chlorophyll, the green coloring matter of plants. Excessive nitrogen causes excessive vegetative growth, resulting in greatly increased danger of lodging, delayed maturity and greater susceptibility to diseases and pests. Nitrogen application at proper dose has the most important effect in terms of increasing crop production. Farmers use nitrogen fertilizers indiscriminately without adequate information concerning actual soil requirements.

Nitrogen is a key factor in achieving an optimum yield in cereals and in their growing period requires lot amount of absorbed nitrogen. Proper dose of nitrogen increased leaf area, tillers formation, leaf area index and leaf area duration and this increase led to much greater production of dry matter and grain yield.

Seeding of barley is generally done in early November to late December. Late harvesting of preceding crops, excessive soil moisture after rainy season and increasing cropping intensity have pushed a sizable barley area under moderately late to late sown condition. Late sown plants experience low temperature at the vegetative stage, which decrease the physiological processes particularly, root growth and nutrient and water uptake. On the contrary, reproductive stage of late sown plants experience high temperature, which reduces grain growth and ultimately crop productivity. There are few options regarding fertilizer requirement of late planted barley. Some argue for higher level of nutrient to the crop to compensate yield loss owing to delayed seeding (Kotrba *et al*., 1984) [4], others advocate lower level of nutrient as the crop is unable to absorb higher level of nutrient owing to its reduced growth duration (Kahnt and Kubler 1981) [3].

The most important factors of maintenance of soil fertility status leading to the successful crop production. Thus, dose of nitrogenous fertilizers and their time of application has to be carefully scheduled. To get maximum benefit from the fertilizer use the fertilizer should not only be applied in optimum quantity but also at right time as timely nitrogen application in one agronomic technique which has helped considerably in increasing the nitrogen use efficiency (NUE). It is now very well established that for most crops nitrogen must be applied in two or three split doses coinciding with the crop growth stages when its requirement is high therefore, it is high time to assess the effect of optimum dose of nitrogen and its time of application to increase the fertilizer use efficiency in barley.

Thus, nitrogen fertilization strategies must be so tuned as to balance the often contradicting goal of maximum production with desirable protein content in grain. Method of split application of nitrogen, to meet the crop requirement throughout life cycle for higher production and less accumulation of nitrogen in grain, may be one of the strategies to achieve the high yield and quality of barley for malting industries. However, little work has been done on this aspect of effect of time and levels of nitrogen application on late sown barley. Keeping all above facts in view the present study was undertaken to find out the suitable dose of Nitrogen in barley crop and to study the time and dose of nitrogen application for higher productivity of barley.

Materials & Methods

The present investigation was under taken during *rabi* 2013-14 at the Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. The experimental site falls under subtropical climate in Indo-Gangetic plains having alluvial calcareous soil and lies between 26°47' North latitude and 82°12' East longitude at an altitude of 113 m from mean sea level. The region receives annual rainfall ranging from 1000-1200 mm and 90 per cent of which is received in Mid-June to end of September. The soil of the experimental field was silt loam, having pH 8.1, organic carbon 0.38, available N, P and K 185.0 kg ha^{-1}, 15.25 kg ha^{-1} and 265.0 kg ha^{-1} respectively. The seeds were sown at proper moisture on 29th December 2013 of variety Narendra Barley 1. Sowing was done in rows 20 cm apart and 4 cm deep in furrow with desi plough. A certified seed was used at the rate of 100 kg ha^{-1}. There were twelve treatment combinations as detailed below:

The experiment was laid out in split plot design with four levels of nitrogen (0, 20, 40, and 60 kg N ha^{-1}) and three time of application (1/2 at the time of sowing and 1/2 after first irrigation, 1/3 at sowing and 2/3 after first irrigation, 1/3 at sowing and 1/3 after first irrigation and 1/3 after second irrigation) with three replications. Main plot consists of four Nitrogen levels, *i.e.* N_0: N Level (0 $kgha^{-1}$), N_1: N Level (20 $kgha^{-1}$), N_2: N Level (40 $kgha^{-1}$), N_3: N Level (60 $kgha^{-1}$) and sub plot consists of three Time of application, *i.e.* T_1: Half at the time of sowing and half after first irrigation, T_2: One third at sowing and two third after first irrigation and T_3: One third at sowing and one third after first irrigation and one third after second irrigation.

Observations were recorded at different growth stages of wheat. Initial plant population of each treatment was taken at 20 DAS from three randomly selected locations with quadrate in each plot and averaged figure were converted in to number of plants m^{-2}. Five plants were selected randomly in each plot and tagged for measuring height at different intervals. Height was measured at 30, 60, 90 DAS and at harvest stage with the help of meter scale from ground surface to the tip of the top most leaf before heading and up to the base of ear head after heading. The number of shoot m^{-2} were counted at 30, 60, 90 DAS and at harvest by placing quadrate at three places in each plot and the plants which come within the quadrate were average out to express shoots per square meter. The leaf area was measured at 30, 60, 90 DAS stage to calculate the leaf area index. The plants of 0.25 m row length were taken and green leaves were separated to record their surface area by automatic leaf area meter. All the leaves were grouped into three *viz.* small, medium and large. Five leaves from each group were taken and their surface area was measured. Area of leaves was multiplied with respective leaf number of a group and sum of all three gave the total leaf area. For obtaining leaf area index, Leaf area was divided by ground area.

$$\text{Leaf area index} = \frac{\text{Leaf area}}{\text{Ground area}}$$

Plant samples for dry matter accumulation purpose were taken randomly from two spots by using a quadrate of 25 x 25 cm in each plot at 30 days interval till maturity. The plants were sun dried separately and then oven dried at 70 ^{0}C ± 20C till a constant weight was obtained. The weight of dried sample were recorded and expressed in g m^{-2}.

Results and Discussion

The data on Plant height, no. of plants, dry matter accumulation and leaf area index (LAI) increased significantly with N_3: N level (60 $kgha^{-1}$) under main plot and T_2: One third at sowing and two third after first irrigation under sub plot during course of investigation. The data pertaining to initial plant population have summarized in Table 1. Data indicate that different nitrogen levels and time of application did not show significant variation among themselves in initial plant population m^{-2} recorded at 20 days after sowing. The initial plant population counts at 20 days after sowing was not influenced significantly by levels and time of nitrogen application. This was because the germination totally depends on moisture and varietal germinability. Similar findings were reported by Singh *et al*. (1968) [12] and Kumar (1985) [5]. Initial plant population taken at 20 days after sowing was not influenced significantly by rate and time of nitrogen application. The data on number of shoots m^{-2} at successive stages of crop growth as influenced by various treatments have been summarized in Table 1. In general, the tillers formation was very rapid from 30 to 60 DAS whereas the maximum number of tillers was recorded of 90 DAS and thereafter, there was gradual reduction in number of tillers. The number of tillers was influenced significantly by the rate of nitrogen at all the growth stages of crop. The maximum number of tillers m^{-2} was obtained at 90 DAS with 60 kg N ha^{-1} being at par with 40 kg N ha^{-1}. The number of tillers m^{-2} was affected significantly due to time of nitrogen application at all the growth stages of crop. At 30, 60, 90 DAS and harvest stage, the number of tillers m^{-2} was recorded significantly higher in T_2 treatment (1/3 at sowing and 2/3 after first irrigation) as compared to rest of the treatments. The lowest number of tillers was obtained under the treatment where nitrogen was applied as ½ at sowing and ½ after first irrigation (T_1). The number of shoots m^{-2} was influenced significantly by rates of nitrogen. Maximum numbers of shoots were recorded under 60 kg N ha^{-1} at 90 days after sowing. This may be due to least plant competition for nutrient caused by sufficient supply of nitrogen which increased the better absorption of nutrients from the soil. Reduction in number of tillers after 90 days of sowing may be due to mortality of shoots. Similar results were reported by Streigl (1978) [17] and Hooda and Singh (1979) [2]. The time of nitrogen application had the profound effect on number of shoots. At all stages of crop growth the number of shoots m^{-2} was recorded significantly higher in T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) over rest of the treatments. This might perhaps be ascribed to be adequate availability of nitrogen during entire grand growth period of the crop which increased the utilization and absorption of nitrogen by growing plant from the soil as the result of least competition for nitrogen. The lowest number of shoots was recorded under the treatment where nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. Similar results was reported by Singh and Singh (2005) [11] and Singh and Singh (2013) [13]. Number of shoots was recorded significantly more with 60 kg N ha^{-1}. The time of nitrogen application had significant influence on number of shoots m^{-2} at all the stages. It was recorded significantly higher (401.48) under T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation). The lowest number of shoots were recorded when nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. Data pertaining to plant height of barley recorded at 30, 60, 90 DAS and at harvest have been presented in Table 2. Data revealed that the rate of growth was rather slow during the initial stage upto 30 DAS thereafter, a rapid increase in growth was observed till 90 DAS, referring to its grand growth period. Plant height increased successively till the harvest stage but the increase was rather slow after 90 DAS. It is quite evident from the data given in Table 2 that different levels of nitrogen had significant effect on plant height at all the growth stages of crop, except at 30 DAS. Increasing nitrogen levels increased the plant height. The maximum plant height was recorded under 60 kg N ha^{-1} which was significantly superior over rest of the treatments. The time of nitrogen application had significant effect on plant height at all successive stage of crop growth except at 30 DAS where the differences in plant height was found non-significant. At 60, 90 DAS and at harvest stages the plant height of barley were recorded significantly higher under T_2 (½ at sowing and 2/3 after first irrigation) treatment as compared to other treatments. Treatment T_1 (½ at sowing and ½ after first irrigation) produced significantly lower plant height at all the stages of crop growth. There was rapid increased in height of plant from 30 to 90 days after sowing thereafter, increased in height was rather slow. Maximum plant height was recorded under 60 kg N ha^{-1} at all the crop growth stages, which was mainly due to more availability of nitrogen. Higher nitrogen levels resulted in higher nitrogen uptake, which could ultimately result in to increased protein synthesis, cell division and cell elongation and finally expressed morphologically on increased in height of the plant. Similar findings were reported by Raghuvanshi *et al*. (1987) [7], Saini and Thakur (1999) [10]. Plant height was affected significantly due to different time of nitrogen application at all stages of growth, except 30 DAS. The height was recorded significantly higher in T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) as compared to rest of the time of nitrogen application. The taller plant associated with T_2 treatment were due to proper availability of nitrogen throughout the crop growth coinciding with the germination, tillering and ear initiation stages. The maintenance of proper and continuous nitrogen supply to the crop helped in greater root establishment due to increased meristematic activities which contributed to rapid cell division, cell elongation and thus led to taller plants under the treatment. The lowest height at all the stages of crop growth was recorded under T_1 treatment (½ at the time of sowing and ½ after first irrigation) due to poor cell division as the result of poor meristematic activities caused by lower availability of nitrogen at critical stages. The results are in close proximity to those of Ramose *et al*. (1985) [9] and Singh and Singh (2005) [11]. In general plant height increased with advancement of crop growth stages and was maximum at harvest stage. Highest plant height at all the stages was recorded with 60 kg N ha^{-1}. The time of nitrogen application had significant effect on plant height at all the successive stage of crop growth except at 30 DAS. The maximum plant height (70.70 cm) was recorded under T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) as compared to rest of the treatments. The lowest plant height (47.90 cm) was recorded when nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. The data recorded on leaf area index as affected by different nitrogen levels and their time of application at 30, 60 and 90 DAS have been presented in Table 3. The data indicate that leaf area index during initial stage was rather slow and thereafter, increased rapidly 30 to 60 DAS and then declined thereafter indicating grand growth period line between 60 to 90 DAS of the crop. It is quite evident from the data that increasing nitrogen supply successively increased the leaf area index and it was significantly affected due to different levels of nitrogen at 60 and 90 DAS The time of nitrogen application had significant effect on leaf area index at all the successive stages of crop growth. It was recorded significantly higher under T_2 (1/3 at sowing and 2/3 after first irrigation) treatment as compared to rest of the treatments at all the stages, except at 30 DAS. However, the lowest value of leaf area index was recorded under T_1 treatment where nitrogen was applied as ½ at sowing and ½ after first irrigation. Leaf area index was affected significantly due to different nitrogen levels and its time of application at all the stages of crop growth except at 30th day stage. Initially leaf area index (LAI) increased very slowly up to 30th day stage of crop growth and after that ushered in a rapid expansion up to 60^{th} day stage. Later declining trend in LAI was observed. Slow increased in LAI at initial stage was due to less time available for growth and development of the plant. Rapid increased up to 60 DAS was possibly because of increased rate of light absorption, high photosynthetic activities and increased absorption of nutrient from the soil. The reduction in LAI at 90 DAS were caused possibly due to increased senescence. The leaf area index increased with increasing the nitrogen levels and was recorded maximum under 60 kg N ha^{-1} at all the crop growth stages, except 30^{th} day stage. This may be due to increased rate of light absorption, high photosynthetic activities and increased absorption of nutrients from the soil. Leaf area index was affected significantly at all the stages of crop growth due to different time of nitrogen application. It was recorded significantly higher in T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) as compared to rest of the treatments. The lowest

LAI was recorded under T_1 treatment where nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. It was possibly due to the poor plant height, less number of leaves, low rate of light absorption, low photosynthetic activities and low absorption of nutrients from the soil. In general, the leaf area index (LAI) increased with advancement of crop growth. The maximum leaf area index was recorded under 60 kg N ha^{-1} at all the growth stages, except at 30 DAS. Time of nitrogen application had significant effect on leaf area index at all the successive stage of crop growth, except at 30 DAS. It was recorded significantly higher under T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) as compared to rest of the treatments. The data pertaining to dry matter accumulation at successive stages of crop growth have been summarized in Table 4. The data on dry matter accumulation pattern as affected by different nitrogen levels and their time of application revealed that in general, dry matter accumulation increased with the advancement in crop age. The rate of increase in the dry matter production was very slow in the initial stage (up to 30 days) and was found faster from 30 days to maturity of the crops. The dry matter yield increased with increasing rates of nitrogen at all the stages, except at 30 DAS. At other stages the dry matter accumulation was found significantly higher with the successive increase in application of nitrogen. The dry matter yield at 30 DAS was not influenced significantly by time of nitrogen application. However, at 60, 90 DAS and at harvest stage, it was recorded significantly higher under T_2 treatment as compared to rest of the treatments. The lowest value of dry matter accumulation was recorded under T_1 treatment where nitrogen was applied ½ at sowing and ½ after first irrigation. Initially the rate of dry matter production in all the treatments was slow but it increased steadily till harvest. Different nitrogen levels had significant effect on the dry matter accumulation at all the successive stages of the plant growth, except 30 DAS. Maximum dry matter accumulation was recorded under 60 kg N ha^{-1} at all stages. This might be due to higher collective contribution of various growth characters like plant height, number of shoot, leaf area index and yield of vegetative part. Similar findings were reported by Singh and Seth (1979) [16], Singh and Mishra (1980) [14] and Singh (1981) [15]. Dry matter accumulation of barley was affected significantly due to different time of nitrogen application at all the stages of crop growth, except at 30 DAS. It increased successively till the harvest. The rate of increase in dry matter production was slow during initial stage due to slow crop growth but it increased rapidly at later stages up to harvest due to bright sunshine and rise in temperature. Significantly higher dry matter accumulation was recorded in T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) over rest of the treatments. This was due to more assimilation and utilization of available nitrogen by the growing plants during the entire grand growth period. As the result of this more dry matter accumulation in root, stem, leaves and grains which favored to increase the dry weight under this treatment. The lowest dry matter was recorded under the treatment T_1 where nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. This could be mainly due to the fact that growing plants did not achieve sufficient nitrogen at later stages leading to poorer growth of the crop which consequently resulted into lowest dry weight. Similar results were reported by Zubriski *et al.* (1970) [18], Pameranz *et al.* (1971) [6] and Raghuvanshi *et al.* (1987) [8]. The dry matter accumulation increased with advancement of crop growth and it reached maximum at harvest. The maximum dry matter accumulation was recorded under 60 kg N ha^{-1} at all the growth stages, except at 30 DAS. It was recorded significantly higher under T_2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) as compared to rest of the treatments.

On the basis of result of the experiment, it may be concluded that a dose of 60 kg N ha^{-1} seems to be suitable for better growth, yield and quality of late sown barley and application of 60 kg nitrogen in two split application *i.e.* 1/3 at the time of sowing and 2/3 after first irrigation proved to be the best time for the cultivation of higher productivity of late sown barley.

Table 1: Effect of nitrogen levels and its time of application on initial plant population and number of shoots at various growth stages of barley.

Treatment	Initial plant population (per m^2)	Number of shoots (m^{-2})			
		30 DAS	60 DAS	90 DAS	At harvest
Nitrogen levels (kg ha^{-1})					
N_0	182.33	193.87	309.20	322.04	315.60
N_1	197.67	232.60	369.01	385.23	377.63
N_2	199.67	237.13	372.16	389.56	381.76
N_3	201.67	248.47	382.27	401.48	393.45
SEm±	5.90	7.07	11.35	11.95	11.36
CD (P=0.05)	NS	24.47	39.29	41.36	39.33
Time of application					
T_1	193.25	221.15	336.94	351.88	344.84
T_2	196.25	239.40	379.30	397.92	389.96
T_3	198.75	223.53	358.24	373.94	366.84
SEm±	4.31	5.08	7.87	7.92	7.50
CD (P=0.05)	NS	15.23	23.62	23.76	22.50

Where,

Main Plots: Nitrogen Levels	**Sub-plots:** Time of Application
N_0: N level (0 kg ha^{-1})	T_1: Half at the time of sowing and half after first irrigation
N_1: N level (20 kg ha^{-1})	T_2: One third at sowing and two third after first irrigation
N_2: N level (40 kg ha^{-1})	T_3: One third at sowing and one third after first irrigation and one third after second irrigation
N_3: N level (60 kg ha^{-1})	

Table 2: Effect of nitrogen levels and its time of application on plant height at various growth stages of barley

Treatment	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
Nitrogen levels (kg ha^{-1})				
N_0	24.50	35.60	43.55	47.90
N_1	25.55	42.58	51.35	55.90
N_2	26.32	48.68	58.65	63.50
N_3	26.82	53.88	65.50	70.70
SEm±	0.78	1.46	1.95	2.05
CD (P=0.05)	NS	5.06	6.74	7.1
Time of application				
T_1	25.29	42.17	51.70	56.94
T_2	26.56	47.19	57.23	61.31
T_3	25.54	46.20	55.36	60.26
SEm±	0.55	1.15	1.33	1.46
CD (P=0.05)	NS	3.46	4.0	4.36

Where,

Main Plots: Nitrogen Levels	Sub-plots: Time of Application
N_0: N level (0 kg ha^{-1})	T_1: Half at the time of sowing and half after first irrigation
N_1: N level (20 kg ha^{-1})	T_2: One third at sowing and two third after first irrigation
N_2: N level (40 kg ha^{-1})	T_3: One third at sowing and one third after first irrigation and one third after second irrigation
N_3: N level (60 kg ha^{-1})	

Table 3: Effect of nitrogen levels and its time of application on leaf area index at various growth stages of barley.

Treatment	Leaf area index		
	30 DAS	60 DAS	90 DAS
Nitrogen levels (kg ha^{-1})			
N_0	1.02	3.48	2.92
N_1	1.11	4.75	3.97
N_2	1.12	5.48	4.59
N_3	1.15	6.07	5.10
SEm±	0.031	0.17	0.13
CD (P=0.05)	NS	0.60	0.46
Time of application			
T_1	1.09	4.46	3.74
T_2	1.10	5.33	4.46
T_3	1.12	5.05	4.24
SEm±	0.025	0.10	0.09
CD (P=0.05)	NS	0.32	0.29

Where,

Main Plots: Nitrogen Levels	Sub-plots: Time of Application
N_0: N level (0 kg ha^{-1})	T_1: Half at the time of sowing and half after first irrigation
N_1: N level (20 kg ha^{-1})	T_2: One third at sowing and two third after first irrigation
N_2: N level (40 kg ha^{-1})	T_3: One third at sowing and one third after first irrigation and one third after second irrigation
N_3: N level (60 kg ha^{-1})	

Table 4: Effect of nitrogen levels and its time of application on dry matter accumulation at various growth stages of barley

Treatment	Dry matter accumulation (g m^{-2})			
	30 DAS	60 DAS	90 DAS	At harvest
Nitrogen levels (kg ha^{-1})				
N_0	65.84	181.36	302.28	355.62
N_1	71.36	246.69	411.13	483.70
N_2	72.49	285.24	475.40	559.30
N_3	73.89	316.84	528.08	621.25
SEm±	2.16	8.38	13.97	17.87
CD (P=0.05)	NS	29.02	48.36	61.83
Time of application				
T_1	69.77	232.03	386.70	515.78
T_2	72.06	277.53	462.56	554.94
T_3	70.85	263.04	438.41	544.19
SEm±	1.54	6.02	10.04	10.98
CD (P=0.05)	NS	18.06	30.11	32.93

Where,

Main Plots: Nitrogen Levels	Sub-plots: Time of Application
N_0: N level (0 kg ha^{-1})	T_1: Half at the time of sowing and half after first irrigation
N_1: N level (20 kg ha^{-1})	T_2: One third at sowing and two third after first irrigation
N_2: N level (40 kg ha^{-1})	T_3: One third at sowing and one third after first irrigation and one third after second irrigation
N_3: N level (60 kg ha^{-1})	

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