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The Interaction Effect of Nitrogen Levels on Growth Characteristic of Wheat Crop (*Triticum aestivum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The present research work was carried at the Agronomy Farm, Department of Agronomy, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad (U.P.), during Rabi season of 2014-2015. This farm is located at a distance of 42 Km. from Faizabad district headquarters at Faizabad – Raibareilly road. The ANOVA of the research trail used a design: randomized block design (factorial) to evaluate growth traits, comprising of initial plant population, plant height (cm), number of shoots (m^{-2}). The data indeed suggested that initial plant population was not significantly influenced by either variety levels or nitrogen levels. Contrastingly, the data showed that variety levels and nitrogen levels significantly affected plant height at 30, 60, 90 days after sowing (DAS) and at harvest. The number of shoots at 30 DAS was not affected significantly by variety levels and nitrogen levels in the data. In addition, Variety levels showed a significant effect on the shoot number at 60 and 90 DAS and also at harvest stage, while nitrogen levels did not show significant effects in growth attributes of wheat under study.

Keywords: Varieties; nitrogen levels; F-RBD; wheat crop.

1. INTRODUCTION

Wheat, *Triticum aestivum* L., family Poaceae, is one of the world's most important staple foods. Wheat is an exotic but ancient crop that has been grown in India since pre-historic times. Any crop has a social and cultural heritage, particularly so if it is a staple. Cultural heritage is transmitted from generation to generation. It has been constantly recreated by communities and groups in reaction to their environment, their relationship with nature, and their history. India occupies a prime position among the world's major wheat-producing and consuming countries. It is the second most important crop in Indian agriculture after rice. It is a dominant crop in north-western Indian states; the vast Indo-Gangetic plains are the most suitable providers of climate for it. This Indian region is described as "wheat bowl of India". India is the 4th major producing country and also by area, it ranks 4th in the world (FAO, 1982). The cumulative impact of crop introduction in the long past has affected our habits to an extent that majority of our food sources we utilize today owe their origin too far off countries or regions outside India. About 55% of the world population uses wheat for intake of about 20% of food calories.

Wheat is cultivated worldwide on an area of 220.88 million hectares with a production of 725.47 million tonnes and productivity of 3.28 tonnes per hectares. In India, it is grown in an area of 30.47 million hectares with a production of 95.85 million tonnes and productivity of 3.15 tonnes per hectare. Six states, viz., U.P., Punjab, Haryana, M.P., Rajasthan and Bihar, contribute about 91% towards the total wheat production. Among them, Uttar Pradesh ranks first in respect of both area and production. It is followed by Punjab and Haryana. It covers an area of 9.2 mha with a production of 24.50 mt and productivity of 2.7 tonnes per hectare. However, its productivity is comparatively low as compared to the states of Punjab and Haryana. In the case of continuation of rice-wheat cropping system, ultimately with imbalanced fertilization, delay in wheat sowing acts as the main cause for low productivity.

Due to several self-evident reasons, wheat area sown in late has increased considerably in U.P. from past few years. In the state of U.P., rice-wheat is the most common cropping system followed by most of the farmers. By Patel et al. [1], delayed transplanting of rice due to delayed monsoon, wider use of long duration varieties and heavy rainfall at the later stages of crop growth are the main causes responsible for wheat sown in late. Besides the proceeding crop like sugarcane, potato and toria also leave the fields very late. Under late sown condition wheat produces poor yield because of the lesser exploitation of the potentialities of the crop [2,3]. Primary reductions in productivity occur due to delayed emergence of the seedling and assuredly the growth and development period of the crop by annual report (2014-15). Delayed

emergence of the crop followed by high temperature and hot desiccating winds during grain filling stages result in forcing of maturity in the case of late-sown wheat due to dehydration, finally resulting in a heavy reduction in the whole biomass and yield [4-6]. The purpose of our research was to increase crop productivity without degrading soil fertility. varieties and nitrogen levels were used to restore soil fertility and nutrient availability, while also reducing environmental impact by Maqsood et al. [7].

2. MATERIALS AND METHODS

Field experiment was conducted at Agronomy Research Farm, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad (U.P.), during Rabi season of 2014-2015. This farm is located at an elevation of 42 Km. from Faizabad districts headquarter at Faizabad – Raibareilly road. It falls in the sub-tropical zone of Indogangatic plains. Experimental site lies between 26047' North latitude, 82012' East longitude at an attitude of about 113.0 meter from mean sea level and is subjected to extremes of weather conditions.

2.1 Experimental Details

Material of experiment was arranged in the randomized block design with four varieties PBW-373, HD-2327, and NW-1014 and six nitrogen levels (0, 40, 80, 120, 160, and 200 kg N ha^{-1}) with three replications.

2.2 Details of Layout

Design: Randomized Block Design (Factorial), Replication : 3, Varieties : 3, Nitrogen levels: 6, Treatment combinations:18, Total no. of plots : 54 Gross plot size : 4 x5 = 20 m^2, Net plot size : 3.2 x 4 = 12.8 m^2, Row to row distance : 20 cm, Main irrigation channel : 1.5 m, Sub irrigation channel : 1 m, Replication border (path) : 1 m, Bunds: 0.5 m, Field border : 1 m. The traits monitored in the treatment were initial plant population (m^{-2}), Plant height (cm), Number of shoots (m^{-2}). On these traits, data recorded were statistically analyzed using the analysis of variance (ANOVA) technique as outlined by Gomez and Gomez (1992). The critical difference at 5 % level of probability was used to estimate the importance of variations between treatment means wherever F-test was significant [8].

3. RESULTS AND DISCUSSION

The initial plant population under different treatments based on varieties and nitrogen levels practices for the years 2014-2015 along with Table 1 and Fig. 1.

Varieties and Nitrogen levels: For Varieties of the highest initial plant population, Variety (V_1) NW-1014 in the data was recorded at 140.00 this is followed by Variety (V_2) HD-2327 reporting as 139.00 the lowest population was recorded in Variety (V_3) PBW-373 reporting as 135.00. Nitrogen though, in the highest initiation plant population was seen in N_4 at 160kg/ha this was followed by 140.13, in N_5 that was at 200kg/ha with a recorded value of 138.69. The smallest population was found in N_0, which the control had a value of 138.14 closed result recorded by Prashanth et al. [9].

3.1 Plant Height (cm) at 30 DAS

Varieties and Nitrogen levels: Table 1 and Fig. 2. Showed that Varieties that had the highest plant height at 30 days in (V_3) NW-1014 data was that with16.69 cm. (V_2) HD-2327 had a plant height of 15.80 cm. The least plant height was recorded in (V_3) PBW-373 with 15.54 cm this is as virtually the same as findings by Patel et al. [1] and Swelam et al. [10]. The highest plant height at 30 days in data was recorded for N_5 (200kg/ha) with 18.25cm, while plant height of 17.17 cm was recorded for N_4 (160kg/ha). The lowest plant height was recorded in the control group N_0 with 14.40 cm by Fadhil et al. [11]. Similar influence of fertilizer amendment was also noticed by Sultana et al. [12] in eggplant, Howlader et al. [13] in chili and Rahman et al. [14] in okra varieties.

3.2 Plant Height at 60 DAS

Varieties and Nitrogen levels: showed that Variety level highest plant height at 60 days in data was for (V_1) NW-1014 with 64.66 cm. (V_2) PBW-373 had a plant height of 59.78 cm. The lowest plant height was recorded for (V_3) HD-2327 with 58.56 cm. whereas in Nitrogen levels the highest plant height at 60 days data was for N_5 (200kg/ha) with 66.51 cm. N_4 (160 kg ha as a basal dose) had a recorded plant height at 65.88 cm. The lowest plant height was observed in the control N_0 at 53.68 cm, the same result was reported by Singh et al. (2023) and Kumar et al. [15,16].

Table 1. Effect of different treatments on initial plant population (m^{-2}), Plant height (cm) and Number of shoots (m^{-2})

Treatments	Initial plant population (m^{-2}) 20 DAS	Plant height (cm)				Number of shoots (m^{-2})			
		30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
Varieties									
PBW-373	135.00	15.54	58.56	79.68	80.18	175.50	329.26	350.06	346.56
HD-2327	139.00	15.80	59.78	81.34	81.84	180.70	356.59	379.05	376.05
NW-1014	140.00	16.69	64.66	87.98	88.48	182.00	362.95	387.30	383.42
SEm±	1.80	0.21	0.86	1.13	1.07	2.45	4.93	5.11	5.06
CD (P=0.05)	NS	0.62	2.49	3.26	3.08	NS	14.18	14.69	14.54
Nitrogen levels(kg ha^{-1})									
0	138.14	14.40	53.68	73.04	73.54	179.58	307.65	327.71	324.43
40	136.62	15.07	57.34	78.02	78.52	177.61	328.62	351.16	347.46
80	136.10	15.77	61.00	83.00	83.50	176.93	349.60	372.40	368.68
120	138.32	16.70	63.44	86.32	86.82	179.82	363.58	388.30	385.42
160	140.13	17.17	65.88	89.64	90.14	182.17	377.57	402.19	398.17
200	138.69	18.25	66.51	90.52	91.20	182.19	378.50	403.60	399.80
SEm±	2.54	0.30	1.22	1.60	1.51	3.47	6.97	7.23	7.15
CD (P=0.05)	NS	0.88	3.53	4.62	4.35	NS	20.05	20.78	20.57

Whereas variety-(V_1,V_2,V_3) and Nitrogen levels- N_0 N_1,N_2,N_3,N_4,N_5

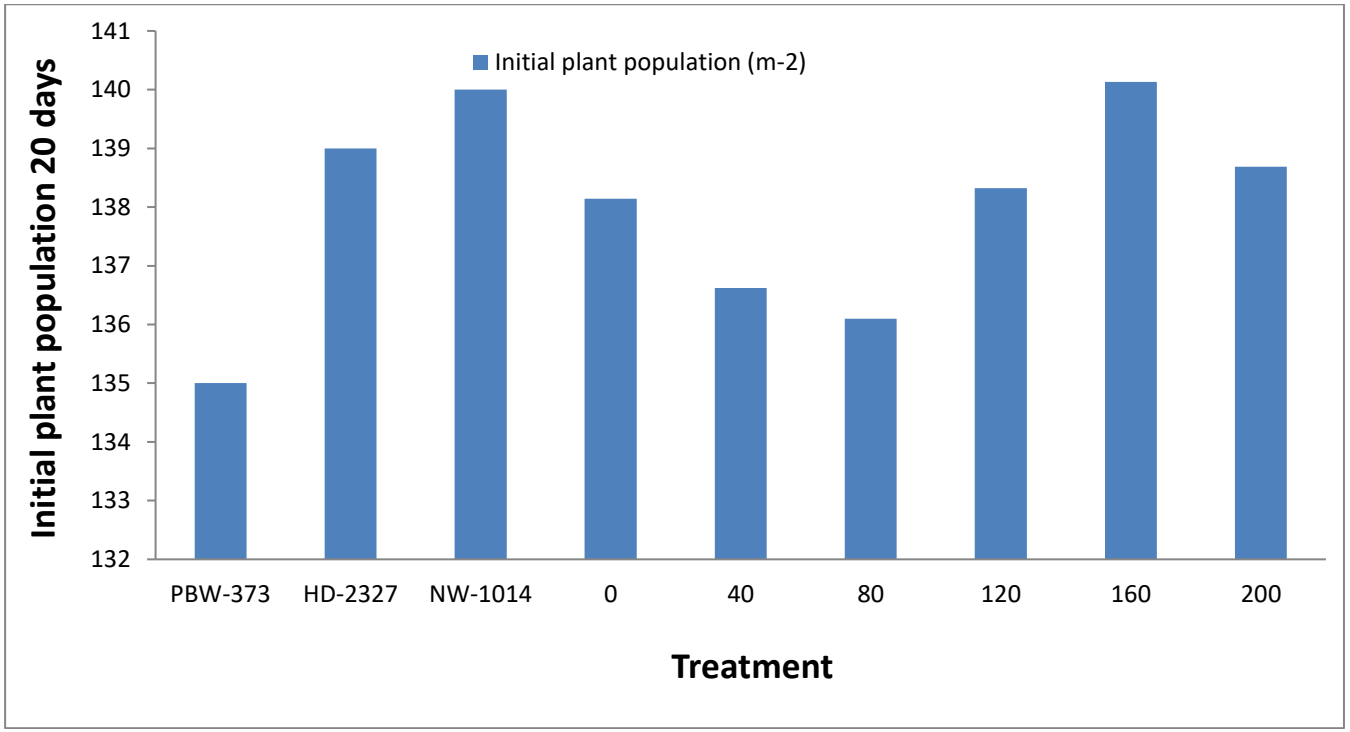

Fig. 1. Effect of different treatment on initial plant population

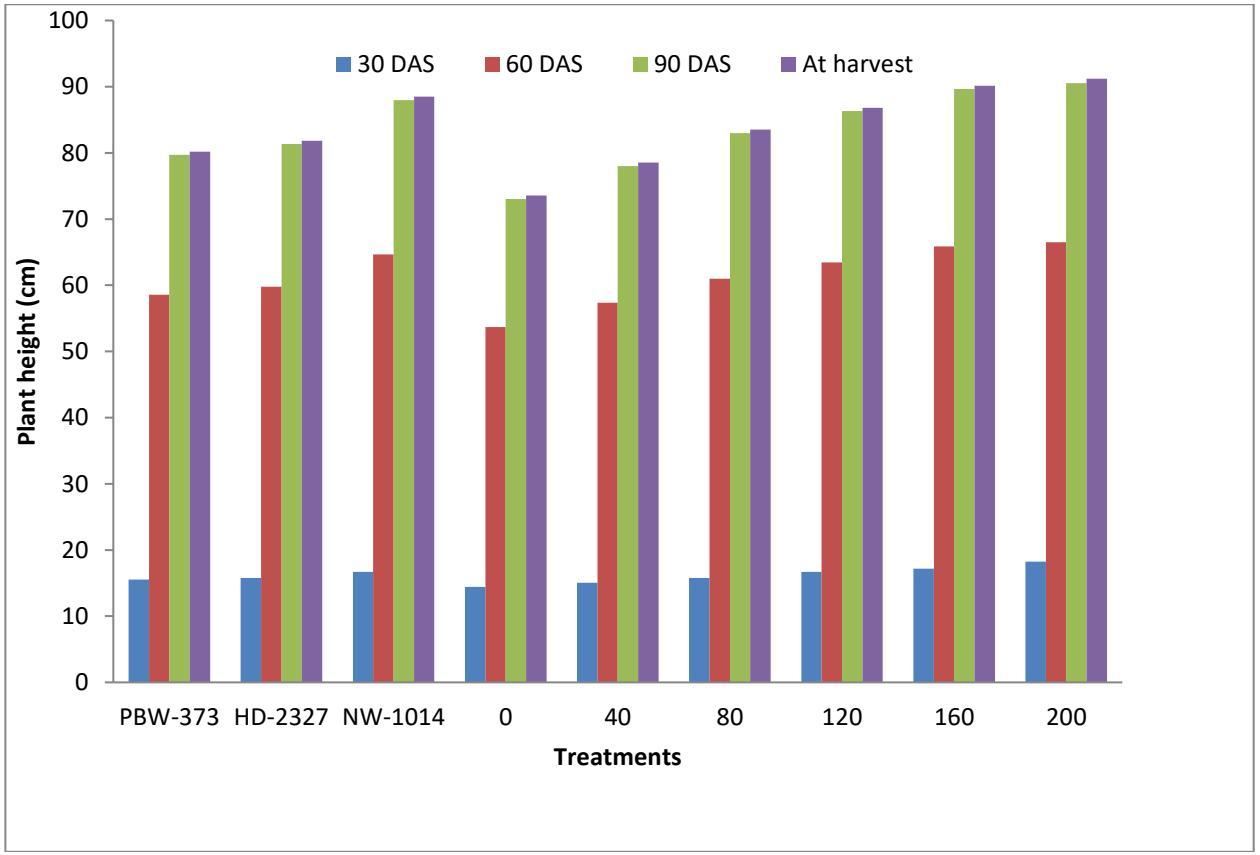

Fig. 2. Effect of different treatments on plant height (cm)at various growth stage of the crop

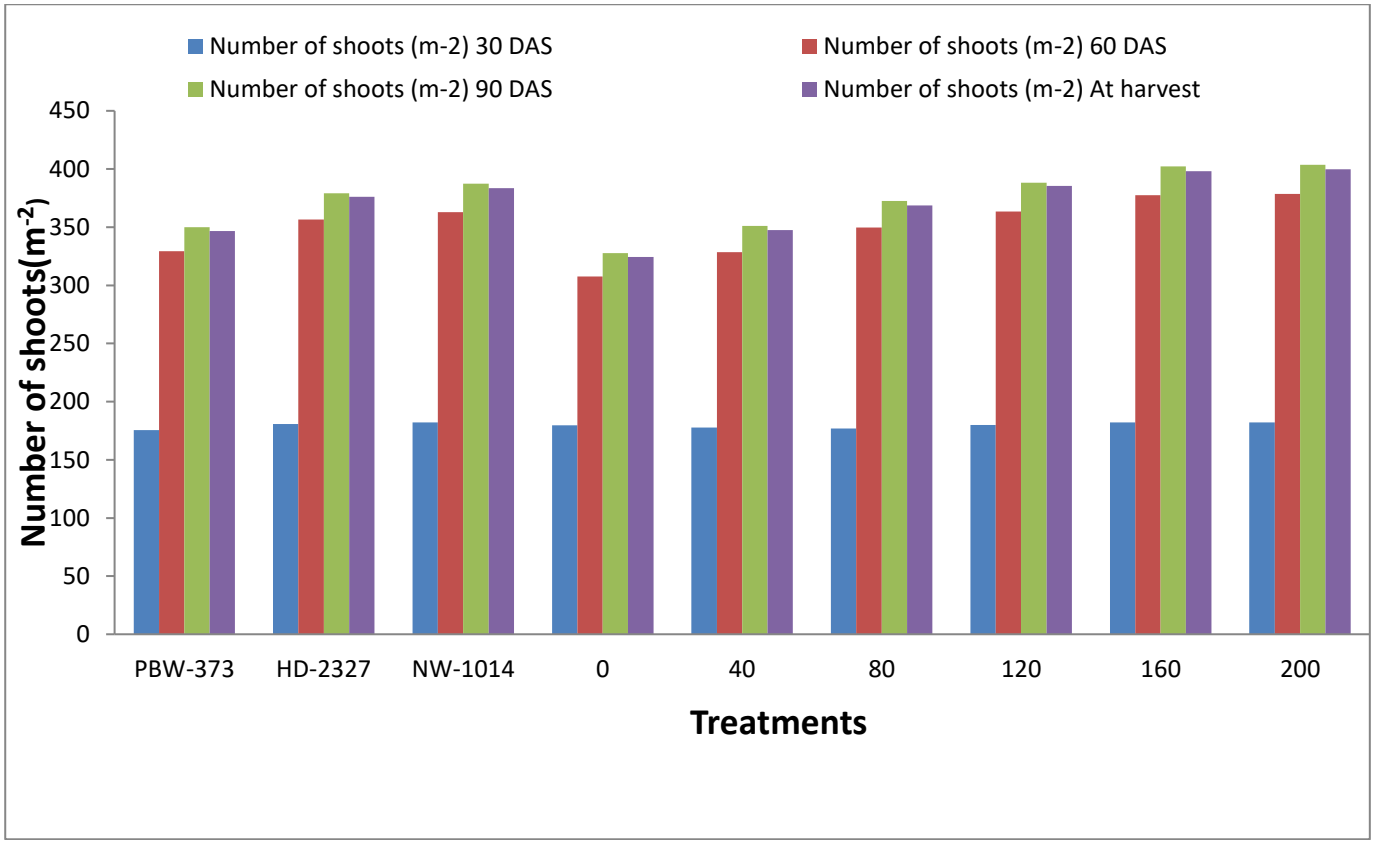

Fig. 3. Effect of different treatments on number of shoots at various growth stages of the crop

3.3 Plant Height (cm) at 90 DAS

Varieties and Nitrogen levels: Obtained the tallest plant at 90 days in (V_3) NW-1014 data with 87.98 cm. The plant height in (V_2) HD-2327 was 81.34 cm. The shortest plant was observed in (V_3) PBW-373 with 79.68 cm, which was in line with Tripathi et al. [17] and Salantur et al. [18]. In Nitrogen levels, the highest plant height at 90 days in data was for N_5 (200kg/ha) with 90.52cm. N_4 (160kg/ha) recorded a plant height of 89.64 cm. The minimum plant height was recorded from the control group N_0 with a plant height of 73.04 cm.

3.4 Plant Height (cm) at Harvest Stage

Varieties and Nitrogen levels: recorded Variety highest plant height at harvest stage in data was for V_1 NW- 1014 with 88.48 cm. (V_2) PBW - 373 was recorded with a plant height of 81.84 cm. The lowest plant height was recorded for (V_3) HD - 2327 with 80.18 cm. whereas in Nitrogen levels the highest plant height at harvest stage data was for N_5 (200kg/ha) with 91.20 cm. N_4 (160kg/ha as a basal dose) was observed with a plant height of 90.14 cm. The lowest plant height was obtained with control N_0 group, which was 73.54 cm similar result that was reported by Shekoofa et al. [19] and Maqsood et al. [7]. Plant height is an important crop growth attribute which denotes the ultimate yield of that crop. However, crop varieties respond variably to the nutrient availability to exhibit growth in height. Similar crop growth instances were also highlighted by Rahman et al. [14] where nitrogen amendments drastically changed the plant height in okra.

3.5 Number of Shoots (m^{-2}) at 30 DAS

Varieties and Nitrogen levels: Table 1 and Fig. 3. At the Variety, the highest Number of shoots (m^{-2}) at 30 DAS stage in Varieties level Table 1 indicated that the highest Number of shoots (m^{-2}) in 30 DAS data was recorded for V_1 (NW-1014) with 182.00 m^{-2}. V_2 (PBW-373) had a Number of shoots 180.70 m^{-2}. The Number of shoots was in V_3 (HD-2327) with 175.50(m^{-2}). Where recorded that the highest number of shoots (m^{-2}) data was encountered for N_5 (200kg/ha) with 182.19 m^{-2}, whereas N_4 (160 kg/ha as a basal dose) recorded the number of shoots with 182.17 m^{-2}. The lowest number of shoots was found to be in the control group, N_0, having 179.58 m^{-2} closed finding reported by Kumar et al. [20] and Satish et al. [21].

3.6 Number of Shoots (m^{-2}) at 60 DAS

Varieties and Nitrogen levels: Reported that Variety the highest Number of shoots at 60 DAS stage in data was for (V_1) NW-1014 with 362.95 m^{-2}. (V_2) PBW-373 had a Number of shoots 356.59m^{-2}. The lowest Number of shoots was recorded for (V_3) HD-2327 with 329.26 m^{-2}. Where as in Nitrogen levels the highest Number of shoots at 60 DAS stage data was for N_5 (200kg/ha) with 378.50 m^{-2}. N_4 (160kg/ha as a basal dose) recorded a Number of shoots of 377.57 m^{-2}. The lowest Number of shoots was observed in the control group N_0 with 307.65 m^{-2} similar result reported by Kumar et al. [15,16] and Dagash et al. [22].

3.7 Number of Shoots (m^{-2}) at 90 DAS

Varieties and Nitrogen levels: showed that Variety the highest Number of shoots at 90 DAS stage in data was for (V_1) NW-1014 with 387.30 m^{-2}. (V_2) PBW-373 had a Number of shoots 379.05 m^{-2}. The lowest Number of shoots was recorded for (V_3) HD-2327 with 350.06 m^{-2}. Where as in Nitrogen levels the highest Number of shoots at 90 DAS stage data was for N_5 (200kg/ha) with 403.60 m^{-2}. N_4 (160kg/ha as a basal dose) recorded a Number of shoots of 402.19 m^{-2}. The lowest Number of shoots was observed in the control group N_0 with 327.71 m^{-2} similar result reported by Hussain et al. [23] and Sikarwar et al. [24].

3.8 Number of Shoots (m^{-2}) at Harvest Stage

Varieties and Nitrogen levels: estimated that Variety the highest Number of shoots at harvest stage in data was for (V_1) NW-1014 with 383.42 m^{-2}. As well as (V_2) PBW-373 had a Number of shoots of 376.05 m^{-2}. The lowest Number of shoots was recorded for (V_3) HD-2327 with 346.56 m^{-2}. Where as in Nitrogen levels the highest Number of shoots at harvest stage data was for N_5 (200kg/ha) with 399.80 m^{-2}. N_4 (160kg/ha as a basal dose) recorded a Number of shoots of 398.17 m^{-2}. The lowest Number of shoots was observed in the control group $N_0$with 324.43 m^{-2} similar result reported by Farooq et al. [25] and Prashanth et al. [9].

4. CONCLUSION

The experiment concluded that for the initial plant population, plant height (cm) and number of

shoots/m^2 the best results were obtained under the variety (V_3) NW-1014. Among the nitrogen levels (kg/ha) (N_5) practices (200 kg/ha), recorded the highest values. The lowest values were observed under the variety (V_2) HD-2327 and nitrogen level (N_0) the control levels.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of this manuscript. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

1. ChatGPT used

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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