Vol.12 No. 1, Page No. 26–33 (2023)

Received: February, 2023; Accepted: April, 2023

Performance of Different Varieties of Wheat (*Triticum aestivum* L.) to Levels of Nitrogen in Gird Region

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Abstract

A field experiment entitled "Effect of nitrogen levels on different varieties of wheat (Triticumaestivum L.) in Gird region of Madhya Pradesh" was conducted at Crop Research Centre, School of Agriculture, ITM University Gwalior-474001(M.P.) during Rabi season (2021-22).The soil of the experimental field was sandy loam in texture. The results revealed that there was a significant difference among the various levels of Nitrogen. The growth parameter like plant height, no. of leaves per plant, leaf area per plant, dry matter accumulation, leaf area index, were significantly influenced by various levels of Nitrogen. Significant improvements in growth parameters were recorded with the application of 100 kg N ha^{-1}withvariety HD-2967over other levels but was at par with 150kg N ha^{-1}withvarietyHD-2967.The maximum yield, higher net returns, and B-C ratio were observed under the application of 150 kg Nha^{-1} with the variety HD-2967.

Keywords:- *Wheat, varieties, nitrogen levels*

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Introduction

The area under wheat in Madhya Pradesh has successively grown each year doubling from 4.1 million hectares in 2007-08 to around 7.72 million hectares in 2018-19. In financial year 2020, over 19.61 million metric tons of wheat was produced in Madhya Pradesh. According to the office of the Director of the Department of Agriculture Madhya Pradesh, there was a huge jump in the wheat area in MP in the 2019-20 Rabi season when it increased by 2.5 million hectares and reached to over 10.02 million hectares. An increase of 32.4 percent in the wheat area was witnessed in MP in just one year. Among the different factors responsible for low productivity, cultivars, fertilizers, and water management are of prime importance in northern parts of the country where winters are almost dry, soils are deficient to Nitrogen.

Nitrogen is also considered one of the most important factors affecting crop morphology, crop growth rate and grain yield. The most important role of N in the plant is its presence in the structure of the protein, the most important building substance 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 leaves. Chlorophyll enables the plant to transfer energy from sunlight by photosynthesis. Therefore, the nitrogen supply to the plant will influence the amount of protein, protoplasm and chlorophyll formed. In turn, this influences cell size and leaf area, and photosynthetic activity. Wheat is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization. Insufficient N availability to wheat plants results in low yields and significantly reduced profits compared to a properly fertilized crop. The amount of nitrogen that a wheat crop needs to maximize yield and quality will depend on the seasonal conditions, soil type, and rotational history of the soil as well as the potential yield of the crop[1]. The rate of uptake and partition of N is largely determined by supply and demand during various stages of plant growth.

High-yielding wheat varieties have a potential for high yields[2,3,4], which is unquestionably related to their propensity to use large amounts of nitrogen. However, the efficiency of adding additional nitrogen fertilizer ranges from 50 to 70% because applied nitrogen is prone to a variety of field losses that result in low output. In order to maximize the benefits of nitrogen use, it must not only be supplied in the proper quantity but also at the appropriate time based on the crop's stage of growth. This issue is made worse by India's soil’s low nitrogen content. Therefore, for a crop with improved yield and quality, nitrogen fertilization must be applied as effectively as possible.

Materials and Methods

The present Field experiment was conducted at Research Farm, of School of Agriculture, ITM University, which is located at a latitude of 26014’ N and a longitude of 78014’ E with an elevation of 206 m above the mean sea level, during the Rabi season of 2021-22. The field having homogenous fertility and uniform textural make up was selected for the experimentation. The soil was sandy loam and was well drained. To determine the fertility status and other physio chemical properties of soil of experimental area a composite soil sample from 15-30 cm depth was taken just before layout and was subjected to mechanical analysis. Pre-sowing irrigation was done to maintain the moisture for proper germination. At proper tilth two cross ploughings followed by planking by a tractor was done. Then the field was finally laid out into plots leaving irrigation channels and bunds in between treatments.

To test the significance of result, standard statistical method based on the analysis of variance technique as suggested by Panse and Sukhatme (1967) were employed. The treatments differences were compared with the critical difference (CD) at 5% level of probability to ascertain their significance, all the results have been summarized in the suitable tables.

The economic efficiency of various treatments taken in this study was worked out on the basis of input-output relationship with respect to net return (Rs ha^{-1}) and benefit-cost (B:C) ratio. The prevailing market rates for inputs and minimum support price during the year 2021-22 of output were taken into account for this purpose.

Results and Discussion

Growth and Development

Plant Stand (number of shoots meter^{-1}row length)

The data given in table 1 reveals that the germination count practically unaffected due to levels of nitrogen. Whereas the number of shoots matre^{-1} rows pan increased significantly, with every rise in the level of nitrogen application up to 100 kg N ha^{-1}. When levels of nitrogen application was increased from 100 to 150 kg N ha^{-1}, the number of shoots metre^{-1} row length increased nominal and could not reach the level of significance at any stages of crop growth. At harvest, the number of shoots metre^{-1} row length recorded with 50, 100 and 150 Kg Nha^{-1} were116.65, 123.42 and 126.56 respectively. The controlled plots recorded with the minimum number of shoots i.e. 107.05.The table also shows that germination count did not influence appreciably. Whereas the maximum number of shoots metre^{2} row length was recorded with the variety HD-2967 which was significantly higher than that of Raj-4037 and DBW-187 at all the stages of crop growth. At harvest, the magnitude of increase in the number of shootsmetre^{-1} row length with the variety HD-2967 (124.58) was to the tune of 7.34 and 8.69 percent, respectively over the variety Raj-4037 and DBW-187.

Table 1 Growth and development characteristics as influenced by levels of nitrogen and different varieties (At harvest)

Treatments		Number of shoots m^{-1} row length	Plant height (cm)	Leaf area index	Dry matter (g) 25 cm row length	Days to 50 percent spike emergence
Levelsofnitrogen(kg ha^{-1})						
0	**N0**	107.05	72.39	2.22	127.26	66.06
50	**N1**	116.65	84.72	2.59	135.46	69.61
100	**N2**	123.42	93.86	2.91	142.84	73.13
150	**N3**	126.56	95.55	3.08	143.76	74.04
SEm±		1.77	1.52	0.09	2.37	1.06
CD(P=0.05)		5.20	4.46	0.25	6.95	3.11
Varieties						
HD-2967	**V1**	124.58	90.25	2.92	145.68	71.84
Raj-4037	**V2**	116.06	85.38	2.60	133.75	69.96
DBW-187	**V3**	114.62	84.26	2.58	132.56	69.43
SEm±		1.53	1.32	0.07	2.05	0.92
CD(P =0.05)		4.50	3.86	0.22	6.02	2.69

Plant height(cm)

The application of nitrogen produced significantly longer plants than the control at all the stages of crop growth except 30 days stage, where levels of nitrogen did not differ appreciably among themselves. Further plant height was increased significantly with every increase in the level of nitrogen application upto 100 kg N ha^{-1}, beyond that it was increased marginally at all the stages of crop growth. At harvest, the maximum plant height (95.55 cm) was noted with the application of 150 kg N ha^{-1}and the minimum (72.39 cm) from the control. The magnitude of increase in plant height with the application of 50,100, and 150 kg Nha^{-1} was to the tune of 17.0, 29.66 and 31.99 percent, respectively over the control. The plant height increased significantly with the variety HD-2967 over Raj-4037 and DBW-187 at all the stages of crop growth except at 30 days stage where the difference in plant height was not appreciable. At harvest, the maximum plant height (90.25 cm) was noted with the variety HD-2967. The magnitude of increase in plant height with the variety HD-2967 over Raj-4037and DBW-187 was to the tune of 5.70 and 7.13 percent, respectively.

Leaf area index

The leaf area index increased significantly with increasing levels of nitrogen up to 100 kg N ha^{-1}during the 60, and 90 Days after Sowing. When the level of nitrogen was increased from 100 to 150 kg N ha^{-1}, the leaf area index increased marginally. Similarly, at 90 DAS Leaf area index $plant^{-1}$ increased appreciably as 2.59, 2.91 and 3.08 respectively with the application of 50, 100 and 150 kg N ha^{-1} was to the tune of 28.38, 31.08 and 38.74 percent, respectively over the control (2.22). There was a non-significant effect of varieties on the leaf area index. However, the maximum leaf area index (2.92) was noted with the variety HD-2967 and the minimum (2.58) with DBW-187.

Dry matter accumulation in plants (25 cm row length) (g)

The dry matter accumulation in plants of 25 cm row span has been significantly enlarged with every upsurge in the level of nitrogen up to 100kg N ha^{-1}. When the level of Nitrogen was increased from 100 to 150 kg N ha^{-1}, the improvement indry matter accumulation was not appreciable at any stage of crop growth and it was statistically atpar with the 100 kg N ha^{-1} level of nitrogen. At harvest, the dry matter noted was 127.26, 135.46, 142.84, and 143.76 g respectively with the application of 0, 50, 100 and 150 kg N ha^{-1}respectively.

The magnitude of increase in the dry matter accumulation in plants of 25 cm row length with 50, 100, and 150 kg Nha^{-1} was to the tune of 6.44, 12.24,and12.97 percent, respectively when compared with no nitrogen application. Table 1 reveals that the effect of wheat varieties on dry matter accumulation in plants of 25 cm row length was statistically significant at all the stages of crop growth. At harvest, Variety HD-2967 (145.68 g) resulted in conspicuously higher dry matter accumulation in plants of 25 cm row length when compared with Raj-4037 (133.75 g) and DBW-187 (132.56 g) varieties, the magnitude of increase was to the tune of 8.92 and 9.90 percent, respectively. Both these varieties did not differ much among themselves and could not reach the level of significance.

Days to 50 percent spike emergence (days)

The number of days required by the crop to come to 50 percent spike emergence was affected significantly due to the application of different levels of nitrogen. The number of days required for 50 percent spike emergence increased significantly with the application of nitrogen over the control and the difference was appreciable with increasing levels of nitrogen upto 100 kg N $ha^{-1}$when the level of nitrogen was increased from 100 to 150 kg N ha^{-1}, the increase in the number of days for 50 percent spike emergence was marginal and could not reach the level of significance. On average 66.06 days were required for 50 percent spike emergence with no nitrogen. Whereas the plants fertilized with 50, 100, and 150kg N ha^{-1} took 69.61, 73.13, and 74.04 days for50 percent spike emergence of the crop. Further, the variety HD-2967 required significantly more days (71.84) to 50 percent spike emergence than Raj-4037 (69.96) and DBW-187(69.43) which did not differ appreciably.

Yield Attributes

Number of spikes m^{-1} row length

The data presented in table 2 reveal that the number of spikes metre^{-1} row span was enlarged significantly with every upsurge in the level of nitrogen up to 100 kg N ha^{-1}. When the level of nitrogen was increased from 100 to 150 kg N ha^{-1}, the number of spikes metre^{-1} row length was increased marginally and could not reach the level of significance. The number of spikes metre^{-1} row length with the application of 0, 50,100 and 150 kg N ha^{-1}were 101.06, 111.34, 117.85 and 119.73 respectively. The magnitude of increase in this parameter was to the tune of 10.17, 16.67 and 18.67 percent, respectively over the control. The table also indicates that variety HD-2967 resulted insignificantly higher number of spikes metre^{-1} row length by 7.03 and 9.26 percent than Raj-4037 and DBW-187 varieties and both these varieties did not differ appreciably.

Length of spike (cm)

A critical examination of the data computed in table 2 indicates that length of spike increased with increasing levels of nitrogen up to 150 kg N ha^{-1}. The magnitude of the increase in length of spike with 50,100 and 150 Nha^{-1} was to the tune of 10.46, 18.84, and 21.22 percent, respectively over the control. The variety HD-2967 had significantly higher length of spike by 9.17 and 9.90 percent, respectively over Raj-4037 and DBW-187 varieties which did not well mark with each other.

Number of fertile spikelets spike^{-1}

The number of fertile spikelets spike^{-1} improved significantly up to 100 kg N ha^{-1}, beyond that it increased marginally and could not reach the level of significance (Table 2). The maximum and the minimum number of fertile spikelets per spike were 16.60 and 13.26 respectively with the application of 150 kg N^{-1} and control. The magnitude of increase in the number of fertile spikelets spike^{-1} with the application of 50, 100 and 150 kg N ha^{-1} was to the tune of 11.92, 22.62, and 25.19 percent, respectively over control.The table further indicates that variety HD-2967 produced significantly higher number of fertile spikelets spike^{-1}by 5.32 and 6.95 percent, respectively over Raj-4037 and DBW-187 varieties which did not differ appreciably from each other.

Number of grains spike^{-1}

The number of grains spike^{-1} improved significantly, with every increase in the level of nitrogen application up to 100 kg N ha^{-1}.When the level of nitrogen was increased from 100 to 150 kg N ha^{-1}, the improvement in the number of grains spike^{-1} was marginal and could not reach the level of significance. The magnitude of increase in the number of grains spike^{-1} with 50, 100 and 150 kg N ha^{-1} was to the tune of 11.85, 19.04, and 22.12 percent, respectively over the control.The variety HD-2967 produced significantly higher number of grains spike^{-1} by 9.64 and 9.46 percent, respectively than Raj- 4037 (V_2) and DBW-187 (V3) varieties which themselves did not differ appreciably in this respect.

Weight of grains spike^{-1} (g)

The data presented in table 2 indicate that weight of grains spike^{-1} (g) was significantly increased with every increase in the level of nitrogen application up to 100 kg N ha^{-1}. When the level of nitrogen was increased from 100 to 150 kg N ha^{-1}, the weight of grains was increased marginally and could not reach the level of significance. The magnitude of increase in weight of grains $spike^{-1}$ with 50, 100 and150 kg N ha^{-1} application was to the tune of 12.74, 26.11 and 27.39 per cent, respectively over the control.The data also reveal that variety HD-2967 had significantly higherweight of grains $spike^{-1}$ (g) by 12.50 and 13.14 per cent, respectively when compared with Raj- 4037and DBW-187 varieties which were not significant with each other.

Table 2 Yield contributing characters of wheat as influenced by levels of nitrogen and different variety

Treatments	No ofspikesmetre^{-1}row length	Length of spike	No offer tile spikelets $spike^{-1}$	No ofgrainsspike^{-1}	Weight ofgrainsspike^{-1}	1000 Grains weight(g)
Levels of nitrogen (kg ha^{-1})						
0	101.06	9.66	13.26	32.14	1.57	43.04
50	111.34	10.67	14.84	35.95	1.77	41.92
100	117.85	11.48	16.26	38.26	1.98	41.02
150	119.73	11.71	16.60	39.25	2.00	38.14
SEm±	1.85	0.19	0.26	0.68	0.04	0.92
CD(P=0.05)	5.43	0.56	0.75	1.95	0.12	2.63
Varieties						
HD-2967	118.46	11.55	15.85	38.68	1.98	43.52
Raj-4037	110.68	10.58	15.05	35.28	1.76	39.80
DBW-187	108.42	10.51	14.82	35.24	1.75	39.77
SEm±	1.60	0.16	0.22	0.59	0.03	0.79
CD(P =0.05)	4.70	0.47	0.64	1.68	0.10	2.28

Discussion

When the nitrogen level was increased from 100 to 150 kg N ha^{-1}, the growth at tributes were increased marginally and could not reach the level of significance. The favourable effect of nitrogen on plant growth might be because nitrogen is the constituent of the lipids and nucleon proteins, and the abundance of nitrogen in the meristematic region might have helped in cell division and multiplication, it is also concerned for carboxylate transformation, respiration and nitrogen fixation and hence it boosted plant growth. As stated, earlier that dry matter accumulation in plants reflects the physiological efficiency of specific treatments regarding the net saving of photosynthates, which ultimately improves the biomass production of a unit area and portion of photosynthates in different plant organs, particularly in grain. The application of nitrogen increased one or more characteristics i.e., the number of shoots $metre^{-1}$ row length, plant height, leaf area and leaf area and leaf area index $plant^{-1}$ and dry matter accumulation in plants of 25 cm row length[4,6,7].The maximum number of shoots $metre^{-1}$row length and higher plant height with the variety HD-2967 might be due to the genetic characteristics of the variety. The highest leaf area index be attributed to the higher number of leaves plant^{-1}. Drymatter accumulation in plants of 25 cm row length showed an increasing trend with the age of the crop. Varieties influenced the dry matter significance at all the stages of crop growth. Growth is a function of a complex process of plant systems with varying environmental conditions. The dry matter accumulation in the plant, by and large, is understood as an index of growth. Dry matter accumulation level was very slow during the seed to tillering stage due to poor production of photo synthetic surface structure. With the advancement in growth, the leaves were capable of synthesizing more photosynthates and offering roots to proliferate and absorb more nutrients from the soil hence dry matter accumulation gained momentum at later stages[8,9,10]. During the later part of growth, faster spike development and translocation of photosynthates towards grain contributed to the more dry matter at post-anthesis. The rapid increase in spike weight is the principal reason for faster dry matter accumulation in the plant at harvest.

Conclusion

The number of shoots metre^{-1} row length, plant height, leaf area index plant^{-1}, dry matter accumulation in plants of 25cm row length and number of days required to 50 per cent spike emergence increased appreciably with the application of nitrogen up to100 kg N ha^{-1} over the control beyond that they were increased marginally. Variety HD–2967 produced a significantly higher number of shoots metre^{-1} row length, plant height, leaf area index and dry matter accumulation in plants of 25 cm row length than Raj – 4037 and DBW– 187 varieties.

Hence, it may be concluded that variety HD–2967 fertilized with 150 kg N ha^{-1} produced significantly higher values in growth parameters and yield attributing characters in this study.

Acknowledgment

The authors are grateful to I.T.M. University Gwalior (M.P.) to provide all the facilities to conduct this experiment.

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