Influence of Nitrogen on growth indices of different wheat varieties in late sown condition

Abstract

Growth indices changes from sowing till harvesting of the crop were monitored under the influence of four varieties (PBW- 373, HD- 2285, K-7903, HUW-234) and four Nitrogen levels (0 kg ha^{-1} (Control), 120 kg ha^{-1} ,150 kg ha^{-1} and 180 kg ha^{-1}) during *rabi* season of 2019-20 and 2020-21. Analysis of the two years average data indicated that PBW-373 along with 150 kg N ha^{-1} resulted in the highest significant values of Crop Growth Rate (CGR) and Net Assimilation Rate (NAR) up to 60 and 90 DAS respectively after which it declines whereas Relative Growth Rate (RGR) show a declining trend from sowing till harvesting. Net Assimilation Rate (NAR) was found to be unaffected by the varieties but were significantly affected by different level of nitrogen being highest with 150 kg N ha^{-1}. However, it was found to be declines from sowing to harvesting. Leaf area duration (LAD) was also found to be increases from sowing till harvest being highest with 150 kg N ha^{-1}. No interaction effect was found among different treatments. The overall findings concluded that variety PBW-373 along with 150 kg N ha^{-1} could be more beneficial in the study area.

INTRODUCTION

Wheat (*Triticum aestivum* L.) belongs to the Poaceae family. It is a staple food of the planet. India is one among the main wheat producing and consuming countries in the world. In India, it is cultivated on an area of 31.62 million hectare having productions of 109.52 million tones with average productivity of 3460 kg ha^{-1} **(Anonymous, 2022).** Uttar Pradesh rank first with reference to production 35.50 million tones contributing about 32.42% of country production followed by Punjab 17.62 and Madhya Pradesh 17.14 tones ha^{-1} **(Anonymous, 2022).**

Wheat is very sensitive and 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 colouring matter of plants. Excessive nitrogen causes succulent growth, resulting in lodging, delayed maturity and greater susceptibility to diseases and pests. Nitrogen application at proper dose has had by far the most important effect in terms of increasing crop production.

METHOD AND MATERIAL

The present research work entitled "Response of nitrogen to different varieties of late sown wheat (*Triticum aestivum* L.) in eastern U.P." was carried out during two successive *Rabi* seasons of 2019-20 and 2020-21 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.). Ayodhya is situated at about 26^{o}47' North latitude and 82^{o}12'East longitudes with an altitude of location is 113 meters above the Mean Sea Level. The location of the experimental field was same for both the years of investigation. The soil of the experimental site was homogeneous in fertility status with uniform textural make up. The alluvial soils of Indo-Gangetic plains in general are deep, flat, well drained with low available nitrogen and medium in available phosphorus and potassium. The soil of experimental field was moderate alkaline in reaction (pH) 8.32 and 8.26, low in organic carbon (0.31% and 0.32%), low in available nitrogen (189 kg ha^{-1} and 185 kg ha^{-1}), phosphorus (16.2 kg ha^{-1} and 16.3 kg ha^{-1}) and medium in potassium (282 kg ha^{-1} and 284 kg ha^{-1}) during 2019-20 and 2020-21, respectively. The experiment was laid out in split plot design during both the years with three replications. 4 Varieties were allocated to main plot i.e., PBW- 373, HD- 2285, K-7903, HUW-234 and 4 Nitrogen level in sub plots i.e., - 0 kg ha^{-1} (Control), 120 kg ha^{-1} 150 kg ha^{-1} 180 kg ha^{-1}. Growth indices was calculated based on the formula given by different scientists.

Crop growth rate (g m^{-2} day^{-1})

The rate of dry matter production per unit land area per unit time or crop growth rate (CGR) was worked out by using the formula proposed by Watson (1947) and expressed as g m^{-2} day^{-1}.

$$CGR = \frac{W2 - W1}{t2 - t1} \times \frac{1}{P}$$

Where,

W_1 and W_2 are dry matter of crop (g) at time t_1 and t_2 respectively.

P= Ground area covered by crop (m^2)

Relative growth rate (g g^{-1} day^{-1})

The rate of increase in dry weight per unit dry weight of crop expressed in g g^{-1} day^{-1} was calculated using the formula suggested by Blackman (1919).

$$RGR = \frac{Log\ W2 - Log\ W1}{t2 - t1}$$

Where,

W_1 and W_2 are dry weight (g) of crop at time t_1 and t_2 respectively.

Net assimilation rate (g cm^{-2} day^{-1})

It indirectly indicates the rate of net photosynthesis. It is expressed as g of dry matter produced per m^2 of leaf area in a day. For calculating NAR, the total leaf area of crop has to be used but not the leaf area index. It was calculated at 30, 60 and 90 DAS intervals as per the formula given by Beadle (1987) and expressed in g cm^{-2} day^{-1}.

$$NAR = \frac{(W2 - W1)\ (Log\ LA2 - Log\ LA1)}{(t2 - t1)(LA2 - LA1)}$$

Where,

W_1 and W_2 are the dry matter accumulation (g) at time t_1 and t_2 respectively.

LA1 and LA2 are leaf area index at time t_1 and t_2 respectively.

Leaf Area Duration (day)

To correlate the dry matter yield with LAI, integrated the LAI with time and called as Leaf Area Duration. LAD takes account, both the duration and extent of photosynthetic tissue of the crop canopy. The LAD expresses in days.

$$LAD = (LA1 + LA2) \times (T2 - T1)/2$$

Where,

LA1 = Leaf Area at time T_1

LA2 = Leaf Area at time T_2

The details of the procedures adopted for raising the crop and criteria used for treatment evaluation and methods adopted during the course of investigation are presented in this chapter.

Result and Discussion

A perusal of data reveals that crop growth rate remained unaffected by treatments. However, maximum crop growth rate was recorded under PBW 373 at all stages which is at par with HD-2285 and HUW-234 during both years. Whereas, minimum crop growth rate was recorded in variety K 7903. Whereas in case of nitrogen level, 150 kg N ha^{-1} was recorded significantly higher CGR which is at par with 180 kg N ha^{-1}. The data reveal that crop growth rate was higher during second year of experiment as compare to first year. From the mean data of CGR it can observed that maximum CGR was recorded up 60 DAS after which it declines till harvest. Patra and Ray, (2018) reported that high nitrogen levels increased leaf area, leaf number and vegetative growth of plants thus increasing the photosynthetic capacity; consequently, the higher dry matter produced increasing crop growth rate (CGR).

Relative growth rate was found to be higher during initial growth stages and gradually decline further. It was found to be maximum with PBW 373 which is at par with HD 2285 and HUW 234. Variety K 7903 recorded minimum relative growth rate at all stages. However varietal treatment failed to show any significant effect between 60-90 DAS during second year. Different nitrogen level found significant effect on RGR at all growth stages being highest with 150 kg N ha^{-1} which is at par with application of 180 kg N ha^{-1}. RGR was relatively maximum in second year than first year. However, minimum RGR was recorded under control treatment. These results are confirmatory to those revealed by Ali *et al.* (2011).

A perusal of data reveals that net assimilation rate remained unaffected among varietal treatment. However, maximum NAR was recorded under K 7903 at all stages followed by HUW-234 and HD-2285 during both years. Whereas, minimum NAR was recorded in variety PBW 373. Whereas in case of nitrogen level, control treatment recorded significantly higher NAR followed by 120 kg N ha^{-1}. The data reveal that NAR was lower during second year of experiment as compare to first year. From the mean data of NAR, it can observe that maximum NAR was recorded upto 60 DAS after which it declines till harvest. NAR decreased significantly with decreases in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1}. This result was in close conformity with Alemu (2018).

Leaf area duration found to be lower during initial growth stages and gradually increased further. It was found to be maximum with PBW 373 which is at par with HD 2285. Variety K 7903 recorded minimum LAD at all growth stages. However varietal treatment failed to show any significant effect during initial days i.e., 0-30 DAS. Different nitrogen level found significant effect on LAD at all growth stages being highest with 150 kg N ha^{-1} which is at par with application of 180 kg N ha^{-1} and 120 kg N ha^{-1}. LAD was relatively more during second year of investigation than first year. However, minimum LAD was recorded under control treatment. These findings are supported by Islam and Jahan (2018) in wheat, LAD describes the total amount of leaf area present over a particular period of growth and is directly correlated with dry matter production. It has been observed that any practice that increases the longevity of green leaves should increase the dry weight of plants.

Conclusion

After summarizing the overall results of this study, it can be concluded that variety PBW 373 in combination with application of nitrogen 150 kg ha^{-1} accelerated the growth indices hence growth of the crop.

References;

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Table 1: Effect of Nitrogen levels and varieties on crop growth rate (g/m^2/ day) × 10^{-3}

Treatments	0-30 DAS		30-60 DAS		60-90 DAS	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
Varieties						
HD 2285	**2.25**	**2.34**	**14.69**	**15.09**	**8.47**	**8.56**
PBW 373	**2.27**	**2.36**	**15.13**	**15.57**	**8.71**	**8.78**
K 7903	**2.19**	**2.27**	**12.53**	**12.89**	**7.36**	**7.43**
HUW 234	**2.21**	**2.32**	**13.99**	**14.37**	**8.10**	**8.17**
SEm±	**0.04**	**0.04**	**0.43**	**0.46**	**0.22**	**0.22**
CD at 5%	**NS**	**NS**	**1.49**	**1.58**	**0.76**	**0.75**
Levels of nitrogen						
0 (Control)	**2.15**	**2.22**	**12.40**	**12.76**	**7.28**	**7.35**
120 kg ha^{-1}	**2.25**	**2.34**	**13.99**	**14.39**	**8.12**	**8.19**
150 kg ha^{-1}	**2.45**	**2.49**	**17.33**	**17.85**	**8.67**	**8.75**
180 kg ha^{-1}	**2.38**	**2.44**	**17.24**	**17.79**	**8.57**	**8.65**
SEm±	**0.04**	**0.04**	**0.35**	**0.36**	**0.17**	**0.17**
CD at 5%	**NS**	**NS**	**1.03**	**1.06**	**0.49**	**0.50**

Table 2: Effect of Nitrogen levels and varieties on relative growth rate (g g^{-1} day^{-1}) × 10^{-3}

Treatments	30-60 DAS		60-90 DAS	
	2019-20	2020-21	2019-20	2020-21
Varieties				
HD 2285	39.94	40.29	23.03	23.48
PBW 373	41.16	42.33	23.67	23.90
K 7903	34.08	35.07	20.02	21.37
HUW 234	38.06	39.08	22.03	22.66
SEm±	1.17	1.17	0.59	0.80
CD at 5%	4.12	4.13	2.09	NS
Levels of nitrogen				
0 (Control)	33.72	33.94	19.79	21.12
120 kg ha^{-1}	38.04	39.12	22.08	22.61
150 kg ha^{-1}	40.94	42.11	23.58	23.73
180 kg ha^{-1}	40.53	41.60	23.31	23.94
SEm±	0.95	0.96	0.45	0.48
CD at 5%	2.80	2.83	1.34	1.41

Table 3: Effect of Nitrogen levels and varieties on Net assimilation rate (g/m^2/ day) × 10^{-3}

Treatments	30 -60 DAS		60 -90 DAS	
	2019-20	2020-21	2019-20	2020-21
Varieties				
HD 2285	54.07	52.49	22.92	23.16
PBW 373	53.58	53.15	23.61	22.66
K 7903	55.82	55.32	25.60	24.18
HUW 234	54.71	54.24	24.78	23.51
SEm±	1.91	1.30	1.54	1.68
CD at 5%	NS	NS	NS	NS
Levels of nitrogen				
0 (Control)	59.70	50.14	29.04	33.59
120 kg ha^{-1}	53.17	55.98	23.94	20.65
150 kg ha^{-1}	52.36	54.42	22.15	19.43
180 kg ha^{-1}	52.96	54.66	21.78	19.84
SEm±	1.49	1.48	1.32	1.31
CD at 5%	4.37	NS	3.88	3.86

Table 4: Effect of tillage options, residue and weed management practices leaf area duration (Days)

Treatments	0-30 DAS		30-60 DAS		60-90 DAS	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
Varieties						
HD 2285	**25.31**	**26.10**	**88.20**	**90.71**	**135.08**	**138.30**
PBW 373	**25.61**	**26.36**	**89.66**	**92.99**	**137.93**	**142.64**
K 7903	**24.60**	**25.35**	**81.23**	**83.96**	**121.76**	**125.59**
HUW 234	**24.86**	**25.61**	**84.23**	**86.63**	**127.09**	**130.80**
SEm±	**0.54**	**0.71**	**1.41**	**1.59**	**2.06**	**2.12**
CD at 5%	**NS**	**NS**	**4.87**	**5.51**	**7.13**	**7.34**
Levels of nitrogen						
0 (Control)	**23.78**	**24.53**	**72.15**	**74.33**	**101.89**	**104.81**
120 kg ha^{-1}	**25.35**	**26.10**	**88.24**	**90.60**	**132.49**	**136.13**
150 kg ha^{-1}	**25.73**	**26.48**	**91.65**	**94.91**	**144.49**	**148.76**
180 kg ha^{-1}	**25.54**	**26.33**	**91.28**	**94.45**	**142.99**	**147.63**
SEm±	**0.47**	**0.59**	**1.20**	**1.92**	**1.74**	**2.69**
CD at 5%	**1.37**	**NS**	**3.49**	**5.59**	**5.07**	**7.85**