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Effect of Different Varieties and Levels of Nitrogen on Growth Functions of Wheat (*Triticum aestivum* L.)

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A B S T R A C T

An experiment was conducted during winter season of 2009-10 on sandy clay loam soils of Students' farm, College of Agriculture, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad to find out the Effect of different varieties and levels of nitrogen on Growth functions wheat (*Triticum aestivum* L.) The treatments consisted of three varieties (HP 4080, RAJ 4037 and HI 8682) and four nitrogen levels (0, 60, 120 and 180 kg N ha^{-1}). The experiment was laid out in randomized block design with varieties as first factor and nitrogen levels as second factor with three replications. The findings of experiment are summarized below. Crop growth rate was maximum between 60-90 DAS and maximum for variety RAJ 4037 and at 180 kg N ha^{-1} among all the levels of nitrogen. Relative growth rate and net assimilation rates were found maximum between 10-30 days after sowing. Leaf area duration was maximum with RAJ 4037 among the varieties and 180 kg N ha^{-1} produced higher Leaf area duration. Among the varieties RAJ 4037 produced highest grain yield with 180 kg N ha^{-1}.

Introduction

Wheat is the most important and widely cultivated food crop in the world. In India, Wheat is the second important cereal crop, first being Rice. In India wheat occupies an area of 28.15 million hectares with a total production of 758.06 million tonnes with an average productivity of 2,708 kg ha^{-1}. (Source: Ministry of Agriculture, Govt. of India).

In Andhra Pradesh, wheat occupies an area of 10,000 hectares with a total production of 9,000 tonnes with an average productivity of 900 kg ha^{-1} which is very less when compared to the national average productivity. To improve the production of wheat, as in any other crop, introduction of varieties with a high yield potential is essential.

Variety contributes more than 50 percent of the increased production. The next important component for increased production is the nutrient availability. Native fertility level of the tropical soils with special reference to nitrogen is invariably insufficient for touching the peak production mark of a variety and

hence, the need for supplementing this nutrient is obvious with most varieties.

Productivity of wheat is governed by improved varieties coupled with matching production technology. Suitability of varieties to a particular agro- climate is the most important factor in realizing their yield potential which is further influenced by their response to application of nutrients, particularly nitrogen.

Selection of suitable genotype is of prime importance as the genetic potential of varieties limits response to nitrogen. Moreover, varieties differ both in yield and nutrient uptake.

Hence, it is necessary to find out the correct dose of nitrogen and suitable varieties for maximizing wheat yields in Southern Telangana agro-climatic zone. Therefore, the present study was carried out.

Materials and Methods

The experiment was conducted during winter seasonon sandy loam soils at students' farm, College of Agriculture, Rajendranagar, Hyderabad which is geographically situated at $17^0.19^1$ N latitude, 78^028^1 E longitudes and at an altitude of 542.3 m above mean sea level, covered under Southern Telangana agro-climatic zone of Andhra Pradesh.

The weekly mean average temperature of 29.7°c minimum temperature 15.7°c. Mean relative humidity ranged from 45 to 82 per cent. The total rain fall received during the crop growth period was 44.8 mm spread in three rainy days.

The weekly mean sunshine hours varied from 4.4 to 9.1 with an average of 7.66 hours per day and mean evaporation ranged from 4.8 to 7.9 mm with an average of 6.2 mm per day. The mean wind speed ranged from 1.6 to 5.4 km hr $^{-1}$ with an average of 3.2 km hr.$^{-1}$ during the crop growth period

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

Crop growth rate was calculated at the intervals of 10-30 days, 30-60 days, 60-90 days and 90DAS-harvest.

$$CGR = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,

W_1 =Dry weight at time t_1
W_2 =Dry weight at time t_2

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

$$RGR = \frac{Log_eW_2 - Log_eW_1}{t_2 - t_1}$$

Where,

W_1 =Dry matter at time t_1.
W_2 =Dry weight at time t_2.

Net assimilation rate (NAR): (g dm^{-2} day^{-1})

Net assimilation rate was calculated at twenty days interval from 10-30 days, and at 30days interval from 30- 60 days after sowing (DAS) and at 90 days after sowing (DAS) to harvesting date.

$$NAR = \frac{(W_2 - W_1)(Log_e L_2 - Log_e L_1)}{(t_2 - t_1)(L_2 - L_1)}$$

Where,

W_1 =Dry weight at time t_1.
W_2 =Dry weight at time t_2.

L_1 =Leaf area at time t_1.
L_2 =Leaf area at time t_2.

Leaf Area Duration (LAD): (m^2 day^{-1})

$LAD = (LAI_1 + LAI_2) \times (T_2 - T_1)/2$

Where,

LAI_1 = Leaf area Index at t_1
LAI_2 = Leaf area index at t_2

Results and Discussion

Crop growth rate

Crop growth rate of wheat increased up to 60-90DAS and then decreased.

Crop growth rate of wheat was significantly influenced by varieties and nitrogen levels and the interaction effect was found to be significant from 60-90DAS and 90DAS-harvest.

Among the varieties RAJ 4037 recorded significantly higher CGR at all the growth stages and was on par with HI 8682 at 30-60DAS, which in turn was comparable with variety HP 4080 at other stages.

The higher CGR of variety RAJ 4037 can be attributed to rapid accumulation of dry matter compared to other two varieties.

Crop growth rate of wheat was significantly influenced by nitrogen levels at all the growth stages. With increase in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1} CGR also increased significantly. From 90DAS-harvest application of 120 kg N ha^{-1} and 180 kg N ha^{-1} recorded on par CGR. The higher dose of nitrogen has led to better accumulation of dry matter, thus the effect is reflected in the form of crop growth rate between different sub-stages.

Interaction studies revealed that at 180 kg N ha^{-1} all the three varieties recorded on par and maximum CGR from 60-90 DAS. From 90DAS-harvest application of 120 and 180 kg N ha^{-1} recorded comparable CGR in RAJ 4037 and HI 8682 and was significantly higher than other variety and other levels of nitrogen.

Relative growth rate

Relative growth rate of wheat decreased with increase in duration of the crop.

Up to 60 DAS the varieties did not vary significantly in RGR whereas from 60-90 DAS HP 4080 recorded significantly higher RGR over RAJ 4037 and HI 8682 which were on par with each other.

Relative Growth Rate of wheat was significantly influenced by nitrogen levels at all the growth stages. From 10-30 DAS with increase in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1} RGR also increased significantly. From 30-60 DAS, RGR decreased significantly with increase in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1} whereas from 60-90 DAS 0 kg ha^{-1} recorded significantly lower RGR compared to other three doses which were on par with each other. From 90DAS-harvset N application up to 120 kg N ha^{-1} recorded significantly higher RGR over other three doses which were comparable with each other.

The interaction of varieties and nitrogen levels on RGR was found to be significant at all growth stages except from 30-60DAS. From 10-30DAS highest RGR was recorded at 180 kg N ha^{-1} by the variety HP 4080 which was found significantly superior to all the other interactions. From 60-90 DAS increase in nitrogen levels from 120 kg to 180 kg ha^{-1} did not increase RGR significantly with HP 4080 whereas RAJ 4037 and HI

8682 gave significantly higher and comparable RGR with 60 and 120 kg N ha^{-1}.

Net assimilation rate

Net assimilation rate of wheat decreased with increase in duration of the crop. The net assimilation rate was found highest at 10-30 DAS. Net assimilation rate of wheat was not significantly influenced by varieties at early growth stages whereas from 60-90 DAS highest net assimilation rate was recorded by varieties HP 4080 and RAJ 4037 which were found significantly superior to HI 8682.

Table.1 Crop Growth Rate (g m^{-2} day^{-1}) of wheat as influenced by varieties and nitrogen levels

Treatment	10- 30 DAS	30- 60 DAS	60-90 DAS	90 DAS-harvest
Varieties				
HP 4080	5.54	4.46	6.27	4.27
RAJ 4037	5.88	4.95	6.46	4.81
HI 8682	5.64	4.81	6.10	4.51
S.Em ±	0.06	0.05	0.06	0.09
C.D (P=0.05)	0.12	0.16	0.18	0.26
Nitrogen levels				
0 kg N ha^{-1}	3.15	3.73	2.61	2.50
60 kg N ha^{-1}	4.76	4.51	6.08	3.77
120 kg N ha^{-1}	6.52	5.23	7.33	6.03
180 kg N ha^{-1}	8.32	5.49	9.09	5.83
S.Em ±	0.05	0.06	0.07	0.10
C.D (P=0.05)	0.15	0.19	0.20	0.30
Interaction (V X N)	N.S	N.S	0.36	0.52

Table.2 Interaction effect of different varieties and nitrogen levels on Crop Growth Rate (g m^{-2} day^{-1}) at 60-90 DAS

Treatments	**Varieties**			
	HP 4080	RAJ 4037	HI 8682	**Mean**
Nitrogen levels kg ha^{-1}				
0 kg N ha^{-1}	2.71	2.66	2.45	2.61
60 kg N ha^{-1}	5.71	6.50	6.04	6.08
120 kg N ha^{-1}	7.47	7.51	7.00	7.33
180 kg N ha^{-1}	9.20	9.15	8.91	9.09
Mean	6.27	6.46	6.10	
S.Em ± **0.12**				
C.D (P=0.05) **0.36**				

Table.3 Interaction effect of different varieties and nitrogen levels on Crop Growth Rate (g m^{-2} day^{-1}) at 90DAS-Harvest

Treatments	**Varieties**			
	HP 4080	RAJ 4037	HI 8682	**Mean**
Nitrogen levels kg ha^{-1}				
0 kg N ha^{-1}	1.88	2.93	2.67	2.50
60 kg N ha^{-1}	4.33	3.67	3.30	3.77
120 kg N ha^{-1}	5.53	6.33	6.25	6.03
180 kg N ha^{-1}	5.33	6.31	5.84	5.83
Mean	4.27	4.81	4.51	
S.Em ± **0.18**				
C.D (P=0.05) **0.52**				

Table.4 Relative growth rate (g $g^{-1}day^{-1}$) of wheat as influenced by varieties and nitrogen levels

Treatment	10-30 DAS	30-60 DAS	60-90 DAS	90DAS-Hrvest
Varieties				
HP 4080	0.111	0.026	0.018	0.008
RAJ 4037	0.112	0.026	0.017	0.009
HI 8682	0.111	0.026	0.017	0.009
S.Em ±	0.001	0.001	0.0002	0.0002
C.D (P=0.05)	N.S	N.S	0.0006	N.S
Nitrogen levels				
0 kg N ha^{-1}	0.097	0.031	0.012	0.008
60 kg N ha^{-1}	0.108	0.027	0.019	0.008
120 kg N ha^{-1}	0.118	0.025	0.018	0.010
180 kg N ha^{-1}	0.123	0.021	0.019	0.008
S.Em ±	0.0005	0.0003	0.0003	0.0002
C.D (P=0.05)	0.0014	0.001	0.0008	0.0007
Interaction (V X N)	0.003	N.S	0.001	0.001

Table.5 Interaction effect of different varieties and nitrogen levels on RGR (g $g^{-1}day^{-1}$) at 10-30 DAS

Treatments	**Varieties**			
	HP 4080	RAJ 4037	HI 8682	**Mean**
Nitrogen levels kg ha^{-1}				
0 kg N ha^{-1}	0.094	0.101	0.097	0.097
60 kg N ha^{-1}	0.109	0.107	0.107	0.108
120 kg N ha^{-1}	0.117	0.120	0.119	0.118
180 kg N ha^{-1}	0.126	0.122	0.121	0.123
Mean	0.111	0.112	0.111	---
S.Em ±	**0.001**			
C.D (P=0.05)	**0.003**			

Table.6 Interaction effect of different varieties and nitrogen levels on RGR (g $g^{-1}day^{-1}$) at 60-90 DAS

Treatments	**Varieties**			
	HP 4080	RAJ 4037	HI 8682	**Mean**
Nitrogen levels kg ha^{-1}				
0 kg N ha^{-1}	0.013	0.011	0.011	0.012
60 kg N ha^{-1}	0.018	0.019	0.019	0.019
120 kg N ha^{-1}	0.020	0.018	0.017	0.018
180 kg N ha^{-1}	0.020	0.019	0.019	0.019
Mean	0.018	0.017	0.017	
S.Em ±	**0.005**			
C.D (P=0.05)	**0.001**			

Table.7 Interaction effect of different varieties and nitrogen levels on RGR (g $g^{-1}day^{-1}$) at 90 DAS-harvest

Treatments	**Varieties**			
	HP 4080	RAJ 4037	HI 8682	**Mean**
Nitrogen levels kg ha^{-1}				
0 kg N ha^{-1}	0.007	0.009	0.009	0.008
60 kg N ha^{-1}	0.009	0.008	0.007	0.008
120 kg N ha^{-1}	0.009	0.010	0.010	0.010
180 kg N ha^{-1}	0.008	0.009	0.008	0.008
Mean	0.008	0.009	0.009	---
S.Em ±	**0.005**			
C.D (P=0.05)	**0.001**			

Table.8 Leaf area duration (m^2 day^{-1}) of wheat as influenced by varieties and nitrogen level

Treatment	10-30 DAS	30-60 DAS	60-90 DAS
Varieties			
HP 4080	15.00	57.30	59.85
RAJ 4037	16.21	61.76	64.97
HI 8682	15.68	59.60	62.60
S.Em ±	0.09	0.24	0.37
C.D (P=0.05)	0.26	0.70	1.08
Nitrogen levels			
0 kg N ha^{-1}	8.40	33.75	37.07
60 kg N ha^{-1}	13.97	55.41	59.83
120 kg N ha^{-1}	18.04	69.88	73.03
180 kg N ha^{-1}	22.12	79.16	80.01
S.Em ±	0.10	0.27	0.42
C.D (P=0.05)	0.30	0.81	1.25
Interaction (V X N)	N.S	N.S	N.S

Table.9 Net Assimilation Rate (g dm^{-2} day^{-1}) of wheat as influenced by Varieties and nitrogen levels

Treatment	10-30 DAS	30-60 DAS	60-90 DAS
Varieties			
HP 4080	0.087	0.026	0.031
RAJ 4037	0.084	0.027	0.030
HI 8682	0.085	0.027	0.029
S.Em ±	0.001	0.001	0.0004
C.D (P=0.05)	N.S	N.S	0.0010
Nitrogen levels			
0 kg N ha^{-1}	0.084	0.035	0.022
60 kg N ha^{-1}	0.082	0.026	0.031
120 kg N ha^{-1}	0.085	0.024	0.031
180 kg N ha^{-1}	0.090	0.022	0.035
S.Em ±	0.001	0.0005	0.0004
C.D (P=0.05)	0.003	0.0015	0.0012
Interaction (V X N)	N.S	N.S	0.002

Table.10 Interaction effect of different varieties and nitrogen levels on Net Assimilation Rate (g dm^{-2} day^{-1}) at 60-90 DAS

Treatments	**Varieties**			
	HP 4080	RAJ 4037	HI 8682	**Mean**
Nitrogen levels kg ha^{-1}				
0 kg N ha^{-1}	0.025	0.021	0.021	0.022
60 kg N ha^{-1}	0.030	0.032	0.031	0.031
120 kg N ha^{-1}	0.033	0.031	0.030	0.031
180 kg N ha^{-1}	0.037	0.034	0.034	0.035
Mean	0.031	0.030	0.029	
S.Em ±	**0.001**			
C.D (P=0.05)	**0.002**			

Table.11 Grain yield (kg ha^{-1}), Straw yield (kg ha^{-1}) and Harvest Index (%) of wheat as influenced by varieties and nitrogen levels

Treatment	Grain yield (kg ha^{-1})
Varieties	
HP 4080	2660.41
RAJ 4037	2930.00
HI 8682	2784.16
S.Em ±	10.86
C.D (P=0.05)	31.85
Nitrogen level	
0 kg N ha^{-1}	1506.66
60 kg N ha^{-1}	2513.00
120 kg N ha^{-1}	3324.44
180 kg N ha^{-1}	3821.11
S.Em ±	12.55
C.D (P=0.05)	36.81
Interaction (V X N)	63.77

Net assimilation rate of wheat was significantly influenced by nitrogen levels at all the growth stages. With increase in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1} NAR also increased significantly except from 30-60 DAS, where, NAR decreased significantly with increase in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1}.

The interaction effect of varieties and nitrogen levels was found to be significant from 60-90DAS. From 60-90DAS the NAR was found maximum with HP 4080 at 180 kg N ha^{-1} which was significantly superior over all the other interaction effects.

Leaf area duration

Leaf area duration of wheat was significantly influenced by varieties and nitrogen levels. The interaction of varieties and nitrogen levels on leaf area duration was found non-significant.

Among the varieties RAJ 4037 recorded significantly higher leaf area duration followed by HI 8682 and HP 4080 at all growth stages. With increase in nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1} LAD also increased significantly upto180 kg N ha^{-1}. These results were in conformity with the findings of A. Srinivas (2002). For varieties and nitrogen levels LAD

increased rapidly up to 60 DAS and there after increase was marginal. This might be due to the decrease in leaf area index at 90 DAS.

Grain yield

The grain yield of wheat was significantly influenced by varieties and nitrogen levels. The variety RAJ 4037 recorded the highest grain yield (2930kg ha^{-1}) which was significantly superior to the other two varieties tested. The results were in conformity with Parihar and Tiwari (2003), Behara and Pradhan (2007) and Sharma and Ashok Kumar (2009).

Increasing the nitrogen level from 0 kg ha^{-1} to 180 kg ha^{-1} significantly increased the grain yield from 1506.66 kg ha^{-1} to 3821.11 kg ha^{-1}. The increase in grain yield with enhanced N levels can be ascribed to better plant growth and dry matter production due to higher photosynthetic area. The results were in corroboration with findings of Sharma and Manohar (2002) that increase in yield was up to 120 kg N ha^{-1}

The interaction effect studies of grain yield has shown that highest grain yield (4033.00 kg ha^{-1}) was obtained at 180 kg N ha^{-1} with the variety RAJ 4037 which was significantly higher than HI 8682 and HP 4080**.** Among the three varieties RAJ 4037 proved to be the best variety in terms of Crop growth rate and Leaf area duration which in turn led to higher grain yield when compared to the other two varieties HP 4080 and HI 8682. Net assimilation rate was not significantly influenced at early stages, whereas from 60-90 DAS highest net assimilation rate was recorded by varieties HP 4080 and RAJ 4037 which were found significantly superior to HI 8682. Among the nitrogen levels 180 kg ha^{-1}has produced higher Crop growth rate, Leaf area duration. Net assimilation rate also followed the same trend except at 30-60 days after sowing. The increase in Crop growth rate, Dry matter accumulation, Net assimilation rate and Leaf area duration led to higher grain yield at 180 kg N ha^{-1}.Among the three varieties RAJ 4037 has proved to be the best variety and 180 kg Nha^{-1}produced the maximum in terms of grain yield.

As the grain yield has shown the increasing trend from 0 kg N ha^{-1} to 180 kg N ha^{-1}, further study may be carried out with higher levels of nitrogen.

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