

GROWTH INDICES, HARVEST AND ATTRACTION INDEX OF WHEAT CROP AS INFLUENCED BY DIFFERENT VARIETIES AND NITROGEN SOURCES

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Abstract: A field experiment was conducted at Agronomy Research Area, CCS HAU Hisar to study the influence of nitrogen source and varieties on growth indices and harvest index of wheat crop during *rabi* season of 2017-18 in split plot design with three replication. In the main plots there were five wheat varieties (WH 1105, WH 1142, HD 3086, HD 2967 and DBW 88) and in sub plots three nitrogen sources viz. 100 RDN through inorganic source (urea), 100 per cent RDN through organic source (vermicompost) and 50 per cent RDN through inorganic + 50 per cent RDN through organic source. Higher leaf area index and leaf area duration was recorded under variety HD 3086 and 100 % RDN through inorganic source (urea). Among varieties non significant differences were observed in respect of crop growth rate except at 31-60 days after sowing. Neither the varieties nor the nitrogen sources had any significant effect on relative growth rate, attraction index and harvest index.

Keywords: Wheat, Varieties, Growth indices, Nitrogen sources, Harvest index

INTRODUCTION

Wheat is dominant *rabi* cereal crop of north western plain zone and central zone of India due to rich source of carbohydrates and being staple food both for human as well as livestock. India is the second largest producer of wheat in the world next to China. It is grown under rice-wheat, cotton-wheat, pearl millet-wheat and cluster bean/mung bean-wheat crop sequences in different regions of the Haryana state. The selection of high yielding wheat genotypes for wide range of adaption to soil and climate condition is essential to increase yield of wheat. It is the fact that high yielding wheat varieties require higher dose of nitrogen as it is one of the primary nutrients, an integral part of the plant tissues and has both direct and indirect effects on the crop performance by enhancing leaf production and expansion rate that influences interception of photo synthetically active radiation and subsequently dry matter production. (Ali *et al.* 2012). It was observed that both an optimized nitrogen management for a less responsive cultivar and a restrictive management for a more demanding cultivar may result in lower yield which ultimately influence harvest and attraction index of the crop (Riley *et al.* 2001 and Ma *et al.* 2010). Without doubt, application of synthetic fertilizer increased crop yield but importance of organic manures for crop production as substitute of chemical fertilizers cannot be overlooked. Therefore, application of nitrogen in adequate quantity through organic and inorganic sources is essential to meet the nitrogen demand.

MATERIALS AND METHODS

To study the influence of varieties and nitrogen sources on growth indices and harvest index in wheat, a field experiment was conducted during *rabi* season of 2017-18 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar (India) located in Indo-Gangetic Plains of North-West India with a latitude of 29°10' North and longitude of 75°46' East at 215.2 meters above mean sea level in split plot design with three replication. In the main plots there were five wheat varieties (WH 1105, WH 1142, HD 3086, HD 2967 and DBW 88) and in sub plots three nitrogen sources viz. 100 RDN through inorganic source (urea), 100 per cent RDN through organic source (vermicompost) and 50 per cent RDN through inorganic + 50 per cent RDN through organic source. The soil of the field was sandy loam, having 0.25 % organic carbon and pH 7.73. It was low in available N (133 kg/ha), medium in available P (18 kg/ha) and medium in available K (245 kg/ha). The mean weekly maximum and minimum temperature ranged between 16 to 35.5 °C and 3 °C to 21.1 °C, respectively. The mean weekly values for morning and evening relative humidity ranged between 73 to 100 and 24.7 to 75.3 per cent, respectively. While sunshine hours ranged between 2.9 to 7.8 hours during the crop season. The growth parameters were recorded at 30 days interval till crop maturity. Growth indices and harvest index were calculated by the following formula:

Leaf area index (LAI): For leaf area measurement the samples were taken from 25 cm row length randomly in each plot at 30, 60, 90 and 120 DAS.

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Leaf area was measured by using leaf area meter. The leaf area index was calculated by the following formula given by Sestak *et al.* (1971):

$$LAI = \frac{\text{Leaf area (cm}^2\text{)}}{\text{Land area (cm}^2\text{)}}$$

Leaf area duration: Leaf area duration is calculated by the integral of leaf area index over a growth period and expressed in days and showed the ability of plant to produce leaf area on unit area of land over a time period.

$$LAD = \frac{LAI_1 + LAI_2}{2} \times T_2 - T_1$$

Where, LAI₁ and LAI₂ are the leaf area index at the beginning and end of the interval t₂ and t₁ are corresponding days.

Crop growth rate: For crop growth rate dry weight gained by a unit urea of crop in given time were used. Crop growth rate was calculated at 0-30, 31 - 60, 61 -90, 91 -120 days period and 121 -130 (at maturity). Crop growth rate calculated by using formula

$$CGR = \frac{W_2 - W_1}{S(T_2 - T_1)}$$

Where, W₁ and W₂ are plant dry weight (g) at time t₁ and t₂, respectively S is land area (m²)

Relative crop growth rate: Relative crop growth rate measured the increase of plant material per unit weight per unit time. It is expressed in g/g/day. RGR was calculated at 0-30, 31 - 60, 61- 90, 91 -120 days period and 121 -130 (at maturity). RGR was calculated by using following formula.

$$RGR = \frac{\ln W_2 - \ln W_1}{T_2 - T_1}$$

Where, W₁ and W₂ are plant dry weight (g) at time t₁ and t₂, respectively

Harvest index: It was calculated by economic or grain yield divided by the total biological yield or Total biomass into 100 and expressed as percentage, (Donald 1976)

$$\text{Harvest index} = \frac{\text{Grain or economic yield}}{\text{Biological yield}} \times 100$$

Attraction index: It was calculated by economic or grain yield divided by the straw yield into 100 and expressed as percentage.

$$\text{Attraction index} = \frac{\text{Grain or economic yield}}{\text{Straw yield}} \times 100$$

Table 1. Effect of varieties and nitrogen sources on leaf area index of wheat

Treatment	Leaf area index (LAI)			
	30 DAS	60 DAS	90 DAS	120 DAS
Varieties				
WH 1105	0.47	4.15	5.94	3.32
WH 1142	0.46	3.83	4.64	3.58
HD 2967	0.42	3.66	5.47	3.42
HD 3086	0.50	3.95	6.16	3.53
DBW 88	0.46	4.35	4.96	3.46
CD (P=0.05)	0.04	NS	0.3	NS
Nitrogen source				
100 % RDN through inorganic source (urea)	0.53	4.53	6.20	3.65
100 % RDN through organic source (vermicompost)	0.42	3.59	4.36	3.21
50 % RDN through inorganic + 50 % RDN through organic source	0.43	3.85	5.75	3.53
CD (P=0.05)	0.02	0.3	0.3	0.2

Table 2. Effect of varieties and nitrogen sources on leaf area duration of wheat

Treatment	Leaf area duration			
	0-30	31-60	61-90	91-120
Varieties				
WH 1105	7.0	76.3	206.5	181.6
WH 1142	6.9	71.3	184.4	177.0
HD 2967	6.3	67.6	198.7	191.7
HD 3086	7.0	73.3	210.8	198.1
DBW 88	7.5	80.3	204.8	178.1
CD (P=0.05)	0.6	NS	NS	8.4
Nitrogen source				
100 % RDN through inorganic source (urea)	8.0	80.9	228.7	202.3
100 % RDN through organic source (vermicompost)	6.4	66.6	172.9	161.5
50 % RDN through inorganic + 50 % RDN through organic source	6.5	73.8	201.6	190.1
CD (P=0.05)	0.3	5.0	10.6	11.2

Table 3. Effect of varieties and nitrogen sources on crop growth rate of wheat

Treatment	Crop growth rate (g/m ² /day)				
	0 -30	31 – 60	61 – 90	91-120	121 – 130
Varieties					
WH 1105	0.166	2.29	4.73	2.59	1.96
WH 1142	0.161	1.62	4.60	2.12	1.16
HD 2967	0.166	1.93	4.79	1.51	1.57
HD 3086	0.172	1.89	4.72	3.16	2.78
DBW 88	0.159	1.58	4.94	2.57	2.06
CD (P=0.05)	NS	0.4	NS	NS	NS
Nitrogen source					
100 % RDN through inorganic source (urea)	0.177	2.05	4.68	3.04	1.85
100 % RDN through organic source (vermicompost)	0.153	1.61	4.82	1.80	1.84
50 % RDN through inorganic + 50 % RDN through organic source	0.165	1.94	4.78	2.34	2.03
CD (P=0.05)	0.01	0.19	NS	0.85	NS

Table 4. Effect of varieties and nitrogen sources on relative growth rate of wheat

Treatment	Relative growth rate (g / g/day)			
	0 – 30	31 – 60	61 – 90	91 – 120
Varieties				
WH 1105	0.09	0.03	0.01	0.04
WH 1142	0.08	0.04	0.01	0.04
HD 2967	0.08	0.04	0.01	0.03
HD 3086	0.09	0.04	0.01	0.04
DBW 88	0.09	0.04	0.01	0.04
CD (P=0.05)	NS	NS	NS	NS
Nitrogen source				
100 % RDN through inorganic source (urea)	0.08	0.03	0.01	0.04
100 % RDN through organic source (vermicompost)	0.08	0.04	0.01	0.03
50 % RDN through inorganic + 50 % RDN through organic source	0.08	0.04	0.01	0.03
CD (P=0.05)	NS	NS	NS	NS

Table 5. Effect of varieties and nitrogen sources on harvest index of wheat and attraction index of wheat

Treatment	Harvest index (%)	Attraction index (%)
Varieties		
WH 1105	41.8	72.6
WH 1142	39.0	63.9
HD 2967	44.9	81.5
HD 3086	45.9	87.2
DBW 88	43.6	78.5
CD (P=0.05)	NS	NS
Nitrogen source		
100 % RDN (through inorganic (source)	43.7	79.0
100 % RDN through organic source (vermicompost)	40.7	71.7
50 % through inorganic + 50 % through organic source	44.2	80.3
CD (P=0.05)	NS	NS

RESULTS AND DISCUSSION

In general, leaf area index increased up to 90 DAS and thereafter decreased irrespective of varieties and nitrogen sources. Significantly higher leaf area index was recorded under variety HD 3086 at 30 and 90

DAS which did not differ significantly from the varieties with WH 1105, WH 1142 and DBW 88 at 30 DAS and WH 1105 at 90 DAS, however differences among varieties in respect of LAI was found no significant at 60 and 120 DAS. Among nitrogen sources, significantly higher leaf area index

was recorded with the application of 100 per cent RDN through inorganic source as compared to 100 % RDN through organic source and 50 % RDN through inorganic + 50 % RDN through organic source at different days after sowing (Table 1). Leaf area duration was significantly influenced by nitrogen sources and varieties except at 60 and 90 DAS in respect of varieties. Among the varieties, HD-3086 recorded significantly higher leaf area duration at maturity over WH-1105, WH-1142 and DBW-88 but it did not differ significantly with HD-2967. Among the different nitrogen sources, leaf area duration significantly increased with application of 100 per cent RDN through inorganic source over 100 per cent through organic source and 50 per cent RDN through inorganic + 50 per cent RDN through organic source at different days after sowing. At 30 DAS, 100 per cent RDN through organic source was at par with 50 per cent RDN through inorganic source + 50 per cent RDN through organic source (Table 2). Among varieties non significant differences were observed in respect of crop growth rate except at 31-60 days after sowing, where significantly higher CGR was observed under variety WH-1105 over rest of the varieties except HD-2967 and HD-3086. The differences in growth and development may be due to the genetic constitution or environmental factors. The genetic factors refer to genes, the genomes and the chromosomes which determined the phenotype of plant. In other words, a plant displays unique traits which make such trait inherent in plant. Similar results reported by Mondal *et al.* (2015) and Singh *et al.* (2018). Among the nitrogen sources, application of 100 per cent RDN through inorganic influenced the crop growth rate significantly higher over 100 per cent through organic source, which did not differ significantly with 50 per cent RDN through inorganic + 50 per cent RDN through organic source at 31-60, 91-120 DAS but it observed non significantly at 61-90 DAS and at maturity (Table 3). The variation in growth indices may be due to availability of nitrogen from various sources for proper growth of plant

which necessity for vegetative growth because nitrogen is major constitute of chlorophyll, protein and cellulose required for the process of photosynthesis and tissue build up for growth and development of any plant (Ali *et al.* 2012). Neither the varieties nor the nitrogen sources had any significant effect on relative growth rate, attraction index and harvest index (Table 4 and 5).

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