Original Research Article

Performance of Wheat (*Triticum aestivum* L.) Genotypes, their Growth and Yield under Irrigated Condition of Prayagraj

ABSTRACT - A field experiment was carried out during *Rabi* season, 2021 at Wheat Breeding experimental Field, Naini Agricultural institute, SHUATS, Prayagraj (U.P). The experiment was laid out in Randomized Block Design and nine genotypes were replicated fourfold. Study revealed that the genotype G_2 i.e., NETS-102 recorded significantly higher plant height (112.02 cm), number of tillers/hill (7.7/hill), plant dry weight (31.41 g/hill), length of the spike (12.79 cm), number of grains per spike (63.41/spike), grain yield (4.26 t/ha) and Straw yield (6.04 t/ha). It was evident that the performance of genotype NETS-102 was proved to be viable and productive.

Keywords: Genotype, Viable, Productive, Performance.

INTRODUCTION

Wheat is considered as one of the major cereal crops which belongs to the grass family (Shewry, 2009). Wheat is the direct source of food for human beings and hence known as king of cereals. After rice and maize, wheat is the third most important crop under cultivation. But in terms of human consumption it ranks second. Wheat is the staple food in more than 40 countries of the world (Sharma *et al.* 2019). Wheat is highly a diversified crop which is grown in different agro-ecological zones and environments with different production potentials. The three main species of wheat viz., *Triticum aestivum*, *Triticum durum* and *Triticum dicocum* L. are being cultivated in India.

Wheat is produced under irrigated conditions within the country, but low rainfall and late heat stress conditions are the constraints to achieve the specified results. Proper irrigation scheduling is crucial for the efficient use of water, energy and other production inputs. Irrigation water should be applied in numerous critical stages of wheat for successful wheat production. Availability of adequate amount of moisture at critical stages of plant growth not only optimizes the metabolism in plant cell but also increases the effectiveness of the mineral nutrients applied to the crop. Water requirements may vary depending on the stages of development.

Genotype plays an important role in producing high yield varieties of wheat. Different varieties responds differently for their genotypic characters, input requirement, growth process and the diversified environmental during growing season. Quality traits of the wheat also should be considered by breeders to improve high nutritional genotypes. These emerging varieties should be more productive with the limited inputs and should maintain the economical trend for the farmers.

Therefore, these promising genotypes were developed under prayagraj condition and the present investigation was carried out with the objective ‘‘Performance of Wheat (*Triticum aestivum* L.) Genotypes, their Growth and Yield under Irrigated Condition of Prayagraj’’.

MATERIALS AND METHODS

A. Site Seclection

The experiment entitled ‘‘Performance of Wheat (*Triticum aestivum* L.) Genotypes, their Growth and Yield under Irrigated Condition of Prayagraj’’ was carried out during *Rabi* season of 2021 at Wheat Breeding Experimental Field, Naini Agricultural Institute, Sam Higginbottom University of Agriculture and Sciences, Prayagraj (U.P.) which is located at 250 24' 33" N latitude, 810 51' 12" E longitude (Google, 2022) and 96 m altitude above the mean sea level. All the facilities required for the crop cultivation were available.

B. Experimental Design

The experiment was conducted in Randomized block design consisting of nine genotypes replicated four times each and was allocated randomly in each replication. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.7). The wheat was sown on 20th November 2021 with plant geometry of 20 x 10 cm. The nutrient application was given @ 150:60:40 kg/ha (N:P:K). Pre-harvest observations were recorded from the tagged hills with time intervals of 25, 50, 75, 100 DAS and at harvest. Five plants per plot were uprooted randomly at each interval. The samples were oven dried for 72 h at 70-80°c and weights were taken with weighing balance. From the dry weight of different plants, crop growth rate and relative growth rate were calculated by classical techniques of growth analysis. And at the time of harvest only post-harvest observations were recorded. The genotypes were G_1 - NETS-101, G_2 - NETS-102, G_3 - NETS-103, G_4 - NETS-104, G_5 - NETS-105, G_6 - NETS-106, G_7 - NETS-107, G_8 - NETS-108, G_9 - NETS-109 respectively.

C. Statistical analysis

The experimental data recorded was subjected to statistical analysis by adopting the Fishers method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The data collected from the experiment was subjected to statistical analysis using ICAR WASP software. Critical difference (CD) and standard error of mean (SEm) values were calculated by the 'F' test was found significantly at 5% level.

RESULTS AND DISCUSSION

A. Growth Parameters

Plant height (cm)

Data pertaining the plant height (cm) of wheat are presented in Table 1. Significantly higher plant height (112.02 cm) was recorded in the genotype G_2. There was a significant increase in the growth in all the growth stages of the wheat genotype. However, the genotypes G_9 (111.5 cm), G_1 (108.89 cm) and G_7 (108.55 cm) were at par with the genotype G_2. The higher plant height in the G_2 genotype was may be due to the maximum leaf area index, chlorophyll content and etc., The plant height is mostly associated with the genetic makeup of the parental material of each genotype. Each genotype has its own feature from the growth viewpoint and variation in plant height was recorded as their genetic character. Similar findings were reported by Bhutto *et al.* (2020).

Number of Tillers per hill

Genotype G_2 was recorded with higher number of tillers per hill (7.7) over all other genotypes and was tabulated in Table 1. However, the genotype G_9 (7.25) was at par with the genotype G_2. Tillers ultimately affect the yield indirectly. In most of the cereals the yield is determined by the number of tillers. Maximum number of tillers was recorded at 75 DAS interval when compared to 100 DAS and at harvest. This is due to the perishable nature of the tillers after the vegetative phase (mainly non-productive tillers). These findings were found to be consistent with those of Ghanbari and Malidarreh (2010).

Plant dry weight (g/hill)

Data on plant dry weight (g/hill) was presented in the Table 1. Significantly higher plant dry weight (31.41 g/hill) was recorded in the genotype G_2. However, the genotype G_9 with the plant dry weight (29.86 g/hill) maintained to stay at par with the genotype G_2. Initial growth stages exhibited low dry weight when compared with the later stages. Later on, the wheat crop gradually achieved the ultimate plant dry weight. This is due to the accumulation of dry matter and the further growth of the plant. These results are in agreement with the findings of Singh *et al*. (2020).

Crop growth rate (g/m^2/day)

Data regarding the crop growth rate is presented in the Table 1. The results pertaining to the study of crop growth rate indicated significant difference among the genotypes at 25, 50, 75, 100 DAS and at harvest. The genotype G_2 during 25 - 50 DAS interval dominated all the other genotypes with maximum crop growth rate (8.58 g/m^2/day). The genotypes G_9, G_1 and G_7 with respective crop growth rates (8.43 g/m^2/day, 7.66 g/m^2/day and 7.14 g/m^2/day) were at par with the genotype G_2. There was an increase in the crop growth rate of the wheat from 25 DAS to 100 DAS. But, later on it was a sudden decline in the crop growth rate after 100 DAS and is presented in Fig 1. Initially, the increase in the grow rate is gradual and happened to be rapid later on. This is due to the maximum growth during the vegetative phase and maximum production of dry matter in the early growth stages of the Plant. When the wheat crop achieved the maturity stage the growth rate declines immediately. These results were in match up with those reported by Alam (2013).

Relative growth rate (g/g/day)

There was no significant variation among the genotypes at different intervals during all the crop growth stages. Higher relative growth rate was recorded in initial growth stages during 25 - 50 DAS in all the genotypes and is presented in Table 1. The genotype G_9 recorded maximum relative growth rate (0.087 g/g/day) during 25 - 50 DAS. During the further intervals there was more reduction trend observed in the relative growth rate when compared to the initial intervals. This is due to the crop maturity and sudden halting in the vegetative growth. There was a declining growth rate trend recorded in all the genotypes. The studies of Akhtar *et al*. (2018) showed similar outcomes.

Yield and Yield Attributes

Length of the spike (cm)

The length of the spike was recorded and presented in Table 2. There was a significant variance observed in the spike length among all the wheat genotypes. The longer spike length (12.79 cm) was recorded in the genotype G_2. However, the genotype G_9 with the spike length (12.19 cm) was at par with the genotype G_2. Length of the spike is a genetic character and indirectly involves in the crop yield. Longer spike may aid in more number of grains that leads to higher yield. These results were in line with those reported by Gobinda *et al.* (2017).

Number of Grains per Spike

Data related to number of grains/spike was embodied in Table 2. Significantly higher number of grains per spike (63.41) was recorded in the genotype G_2. However, the genotypes G_9 (62.83) and G_1 (60.08) were at par with the number of grains per spike to the genotype G_2. Increase in the number of irrigations favours the percentage increase in the filled grains per spike (Ahmad and Kumar 2015). Number of grains per spike is a yield attributing character and affects the grain yield. Many factors influence the number of grains/spike mainly at genotypic level and also at environmental level. Similar findings were reported by Omar *et al*. (2017).

Grain Yield (t/ha)

The genotypic effect on grain yield is found to be significant in the wheat crop among all the genotypes and is presented in Table 2. The genotype G_2 dominated all the other genotypes with higher grain yield (4.26 t/ha). However, the genotypes G_9 (4.01 t/ha) and G_1 (3.96 t/ha) with their respective grain yield were found to be at par with the genotype G_2. Higher grain yields are usually associated with delayed maturity (Zhang *et al*., 2015). The Higher grain yield in the genotype G_2 was due to the longer spike, maximum number of grains and other higher records of yield attributes. Karman and Akhtas (2020) observed compatible findings.

Straw Yield (t/ha)

Data related to straw yield was evaluated and tabulated in Table 2. The genotype G_2 was recorded with higher straw yield (6.04 t/ha). However, the genotypes G_9 and G_1 with the straw yield (5.83 t/ha and 5.82 t/ha) were at par with the genotype G_2. The better vegetative growth might have obviously resulted into higher straw yield. Higher plant height, maximum number of tillers and higher dry matter accumulation results in the higher straw yield. Maintenance of favourable soil moisture balance in the crop root zone may also results in higher biomass accumulation. These results were in similar to the observations recorded by Nayak *et al*. (2015).

CONCLUSION

This study concluded that the wheat genotype NETS-102 was found to be productive and more effective in cultivation with higher growth and yield attributes. As the cost of cultivation is same for all the genotypes, NETS-102 genotype will be economically viable due to higher yield in wheat.

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Table 1: Evaluation of Wheat genotypes on Growth attributes

Genotypes	Plant height (cm)	Number of Tillers per hill	Plant Dry weight (g/hill)	Crop Growth Rate ($g/m^2/day$)	Relative Growth Rate (g/g/day)
NETS-101	108.89^{ab}	6.2^{b}	27.82^{bc}	16.11^{ab}	0.085
NETS-102	112.02^{a}	7.7^{a}	31.41^{a}	16.5^{a}	0.079
NETS-103	99.9^{c}	5.25^{c}	22.24^{e}	9.69^{d}	0.066
NETS-104	100.96^{c}	5.47^{c}	24.58^{cde}	14.15^{d}	0.061
NETS-105	106.52^{b}	5.77^{bc}	24.74^{cde}	14.08^{cd}	0.067
NETS-106	100.25^{c}	5.6^{bc}	22.64^{de}	12.3^{cd}	0.066
NETS-107	108.55^{ab}	6.15^{b}	26.13^{c}	16.26^{abc}	0.078
NETS-108	107.78^{b}	5.85^{bc}	25.7^{cd}	16.46^{bcd}	0.075
NETS-109	111.5^{a}	7.25^{a}	29.86^{ab}	16.48^{a}	0.087
SEm (±)	1.24	0.23	1.13	1.58	0.00
CD (P=0.05)	3.62	0.67	3.31	4.61	-

Table2: Evaluation of Wheat genotypes on Yield and Yield attributes

Genotypes	Spike length (cm)	No. of Grains/spike	Grain Yield (t/ha)	Straw Yield (t/ha)
NETS-101	11.8^{b}	60.08^{abc}	3.96^{abc}	5.82^{abc}
NETS-102	12.79^{a}	63.41^{a}	4.26^{a}	6.04^{a}
NETS-103	10.38^{f}	51.49^{e}	3.3^{e}	5.5^{d}
NETS-104	10.88^{def}	54.99^{cde}	3.43^{de}	5.57^{cd}
NETS-105	11.15^{cde}	55.16^{cde}	3.66^{cd}	5.57^{bcd}
NETS-106	10.83^{ef}	53.99^{de}	3.39^{de}	5.56^{d}
NETS-107	11.69^{bc}	58.16^{bcd}	3.84^{bc}	5.76^{bcd}
NETS-108	11.47^{bcd}	55.16^{cde}	3.73^{bcd}	5.59^{bcd}
NETS-109	12.1^{ab}	62.83^{ab}	4.01^{ab}	5.83^{ab}
SEm (±)	0.22	1.74	0.12	0.09
CD (P=0.05)	0.65	5.09	0.35	0.26

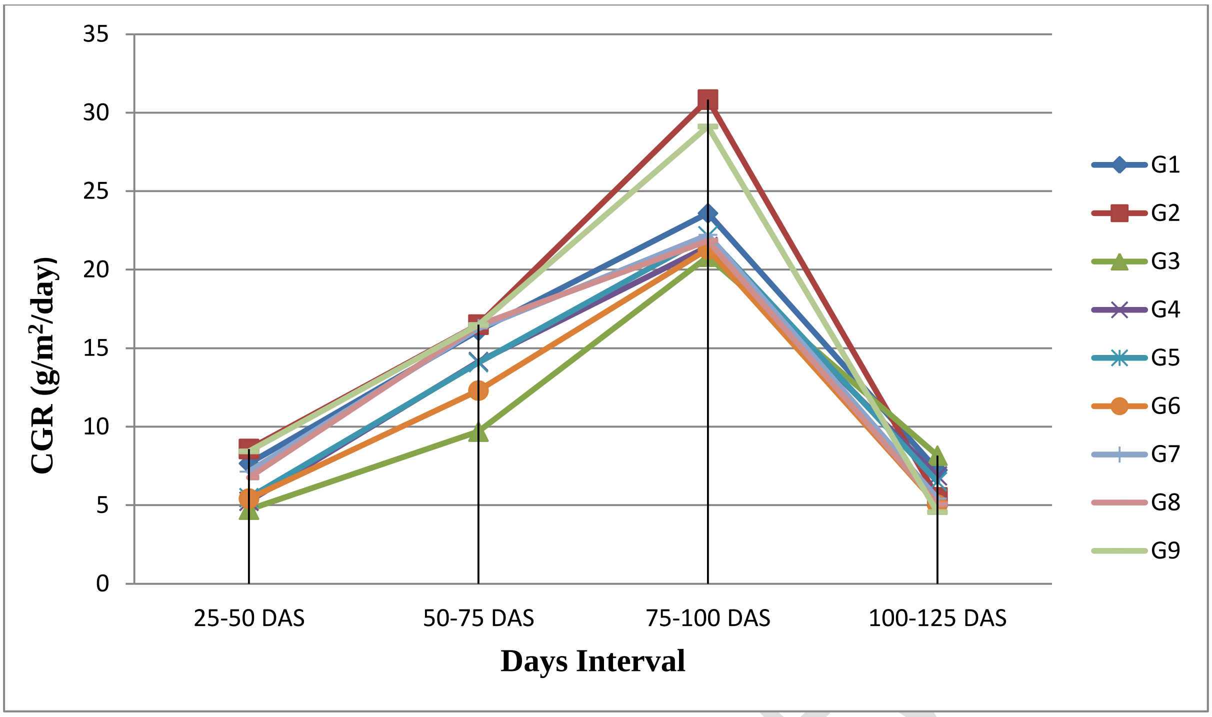

Fig 1: Crop growth rate (g/m^2/day) in different wheat genotypes

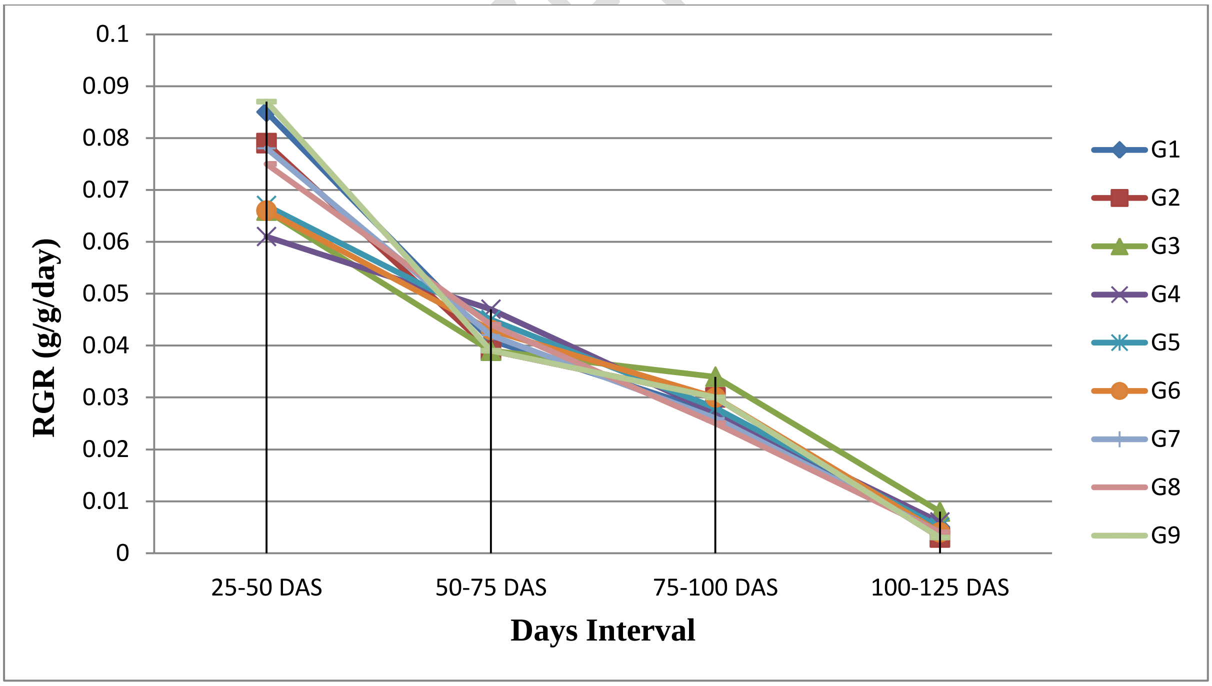

Fig 2: Relative growth rate (g/g/day) in different wheat genotypes