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Neha Stuti Kerketta
M.Sc., Department of Agriculture and Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Dr. Umesha C
Assistant Professor, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, India

Ankit Kumar Gupta
MBA Agribusiness, Department of Agricultural Economics, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Neha Stuti Kerketta
M.Sc., Department of Agriculture and Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Agronomic evaluation of wheat (*Triticum aestivum* L.) Genotypes on growth and yield

Neha Stuti Kerketta, Dr. Umesha C and Ankit Kumar Gupta

Abstract
A field experiment was conducted to find out growth and yield of nine wheat genotypes in the *Rabi* 2020-2021 at Wheat Breeding experimental Field, Naini Agriculture Institute, SHUATS, Prayagraj (U.P.). Soil of experimental plots was sandy loam in texture with neutral soil reaction (pH 6.7). Experiment consists of nine genotypes NETS-101, NETS-102, NETS-103, NETS-104, NETS-104, NETS-105, NETS-106, NETS-106, NETS-107, NETS-108 and NETS-109 which are replicated four times in Randomized Block Design whose evaluation was recorded. The results showed that growth parameters *viz*, higher plant height (110.15 cm), number of effective tillers/hill (11.65), dry weight (60.83 g) and and yield attributing parameters *viz*, number of effective tillers (7.55), spike length (10.75 cm), number of grains/spike (41.77) test weight (39.53 g) and yield parameters *viz*, grain yield (4.30 t/ha), straw yield (6.73 t/ha) were recorded significantly higher with NETS-105 genotype. Physiological observations *viz*, days to 50% flowering (99%) and days to maturity (127) was recorded higher with NETS-105 among all the genotypes. From the above findings gross return (98,900 INR/ha), net return (68,281 INR/ha) and Benefit cost ratio (2.22) with NETS-105 genotype was found to be more potential as well as economically viable and productive over rest of the genotypes.

Keywords: Genotypes, productive, viable, evaluation

Introduction
Wheat belongs from family "Gramineae" or "Poaceae" and genus "Triticum". Many species of wheat which together make the genus Triticum the foremost widely grown wheat (*Triticum aestivum* L.). Also known as the "king of cereals". The wheat cultivation has also been symbol of green revolution, self-sufficiency in food and sustained production. Wheat is world's leading cereals crop cultivated over an area about 218.28 million ha and its global production is about 761.9 Mt second after maize crop, and it is the most adaptable crops among the cereal family which stood third in position after rice with respect to area and productivity globally. Present position of India in wheat production is second after China with a production of 341.56 in Lakh Mt during 2019-2020 in an area of 29.8 million ha. In terms of area Uttar Pradesh (32%), Madhya Pradesh (18.75%), Punjab (11.48%), Rajasthan (9.74%), Haryana (8.36%), Bihar (6.82%), Uttarakhand, Chandigarh, Himachal Pradesh, Maharashtra and Gujarat are the Wheat growing states in the country. And in production Uttar Pradesh stands fourth position after Punjab, Madhya Pradesh and Haryana, Rajasthan. It contains food security in 94 countries and delivers almost 21% of our food calories and 20% of protein for more than 4.5 million people. Uttar Pradesh is the leading producer of wheat (25.03 Mt) followed by Punjab and Haryana, while Punjab ranks first in productivity with 4207 kg per ha.
Prayagraj (Allahabad) is the Southern Eastern part of the state Uttar Pradesh, where sowing of wheat is done in first week of November to late December. During winter month from December to January temperatures drop down to as low as 5 ^{o}C. In Allahabad optimum temperature for germination of wheat seed is 20-25 ^{o}C, 16-20 ^{o}C for tillering, 20-23 ^{o}C for growth, 23-25 ^{o}C in grain filling stage for successful growth and yield. Vegetative stages of wheat are germination or seedling, crown root initiation (CRI), tillering and jointing. Reproductive and post anthesis stages are booting, heading, flowering (anthesis), grain filling (milk, soft dough and hard dough), ripening and maturity. Time span of each development stages depends on genotypes, temperature, day- length and sowing date.
The important reasons for low productivity in India are delayed sowing, aberrant weather conditions, weed infestation, inadequate use of balanced fertilizer and improper irrigation schedule. Increase in temperature cause shortened heading period and stress at maturity in wheat crop.

Some efforts have been made to increase the yield by introducing high yielding varieties, balanced fertilizer application and efficient use of irrigation facilities. New develops genotypes or varieties have potential to replace old establishment varieties in area recommended.

Selection of high yielding genotypes with midrange of adaptability to edaphic and environmental condition is essential to increase yield per hectare. Genetic variations and different varieties of crop may differ in growth and development behaviour and response to different management practices. Similarly wheat genotypes play vital role under different temperature situations. The new wheat genotype needs to evaluate for their agronomic performance under irrigated and different environmental conditions.

Material and Methods

Experimental Site

An experiment was carried out during *Rabi* season of 2020-2021 at Wheat Breeding Experimental Field, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25º24' 33" N latitude, 81º51'12 " E longitude and 96m altitude above the main sea level. The area is situated on the right side of river Yamuna by the side of Prayagraj, Rewa Road about 5 km away from Prayagraj (Allahabad) city.

Soil of the experimental field

Before layout of experiment the soil samples were collected randomly from 0 to 15 cm depth from 5 spots of the experimental field. Which was later used for analysing to determine the physio-chemical properties of the soil. In which results found that soil of experimental plots was sandy loam in texture with neutral soil reaction (pH 6.7).

Climate and weather conditions

Prayagraj (Allahabad) belongs to sub-tropical and semi-arid climatic condition. With both extreme temperature, i.e. summer and winter. Maximum (22 ^{0}C) and minimum (19.85 ^{0}C) temperature whereas, rainfall (18.4 mm) was recorded during the vegetative growth period of experimental crop.

Details of Fertilizer Application

Recommended dose of fertilizer for experimental crop is N: P: K (150:60:40 kg/ha) in which basal dose of fertilizer was applied before sowing and nitrogen application is given in 3 split doses wheras, MOP and DAP was also applied as basal dose.

Results and Discussion

Growth parameters

Plant height

At harvest, there was a significant higher plant height (110.15 cm) was recorded with NETS-105 among all other genotypes whereas, significantly lower plant height (86.45 cm) was recorded with NETS-107 genotype.

The statistical analysis of data between different Genotypes indicates that significant effect on plant height was mainly due to genetic potential of Genotypes and can also affected by environmental factors like temperature, water, sunlight and nutrient uptake during its cropping period. Similar results were also reported by Reddy *et al.*, (2020) [20].

Number of tillers/hill

A significant result was recorded At harvest with higher tillers count (11.65 tillers/hill) with NETS- 105 whereas, significantly lower tillers count (8.25 tillers/hill) was recorded with NETS-107 genotype.

Increase in growth parameters depends on irrigation by 90 per cent and nutrient uptake during vegetative stage, it is an importance factor during tillers formation stage and yield depends on number of tillers developed during vegetative stage which is mainly due to genetic diversity and higher inheritance of character of seeds. Tillers may contribute negatively or positively to wheat productivity which is maximum in early stages and decrease at harvest Elhani *et al.*, (2007) [6] also reported similar result.

Dry weight

At harvest, the significantly higher plant dry weight (110.15 g) was recorded with NETS- 105 whereas, NETS-107 recorded significantly lower plant dry weight (86.45 g) dry weight.

Due to exposure to light and adequate supply of nutrients and photosynthetic activity increases which results in maximum dry weight of plant. Increase in dry matter production with increase in growth stages which reached maximum at harvest. Different seed rate of wheat may affect the dry matter accumulation in different varieties of wheat these results were supported by Hussain *et al.*, (2010) [8].

Physiological observations

Among all the genotypes higher number of days to 50% flowering was recorded with NETS-105 (99%) wheresas, a lower day to 50% flowering was recorded with NETS-107 (82%). And days to maturity was higher (127) with NETS-105 and lower (119) days to maturity with NETS-107 genotypes.

Yield attributing parameters

Number of effective tillers/hill

Effective tillers/hill was significantly affected by different genotypes which was recorded higher number of effective tillers/hill (7.55 tillers/hill) with NETS-105 over rest of the genotypes whereas, significantly lower number of effective tillers/hill (5.55 tillers/hill) was recorded with NETS-107 genotype.

Maximum yield per plant under irrigated condition is determined by tillers and high tillering capacity recognized to be a good criterion to produce high grain yields. Tillers allow plants to produce more grains per spike which helps in producing higher grain yield. Significant variation between new Wheat lines for morphological and yield components similar results was recorded by Aliu and Fetahu (2010) [2].

Spike length

Higher spike length was recorded statistically significant with NETS-105 with higher spike length (10.75 cm) among all the genotypes whereas, significantly lower spike length (9.12 cm) was recorded with NETS-107 genotype.

Number of grains/spike

Different genotypes result varied on number of grains/spike. Which is recorded significant with NETS-105 with higher number of grains/spike (41.77) and significantly lower grains/spike (37.30) was recorded with NETS-107 genotype.

Test weight

Test weight was recorded significant among all the genotypes with significant higher number of test weight (39.53 g) with

NETS-105 whereas, NETS- 107 recorded significantly lower test weight (36.62 g).

Test weight influence by genetic factor and number of irrigation, nutrient requirement, and time of sowing are the factors which can positively or negatively affect the test weight of different genotypes similar finding were reported by Banker *et al.,* (2018).

Yield parameters

Grain yield

Genotype produces significantly higher grain yield (4.30 t/ha) with NETS-105 was recorded among all the genotypes whereas, significantly lower grain yield (2.66 t/ha) was recorded with NETS-107 genotype.

Straw yield

Straw yield of wheat was also affected by number of tillers/hill whereas, genotype NETS-105 produce significantly higher straw yield (6.73 t/ha) and significantly lower straw yield (4.90 t/ha) was recorded with NETS-107genotype.

Increase in tillers count during growth stages of wheat crop significantly improve in producing high grain yield and straw yield Reddy *et al.,* (2020) [20] also reported the same.

Table 1: Evaluation of wheat genotypes on the basis of growth parameters

Genotypes	Plant height (cm)	Number of tillers/hill	Dry weight (g)
NETS-101	100.70	11.05	43.00
NETS-102	109.20	11.25	55.91
NETS-103	98.35	10.70	47.66
NETS-104	92.30	8.95	41.58
NETS-105	110.15	11.65	60.83
NETS-106	93.55	9.65	43.00
NETS-107	86.45	8.25	40.83
NETS-108	101.05	11.20	50.41
NETS-109	94.40	9.65	47.58
SEM (±)	2.33	0.62	3.49
CD (p=0.05)	6.81	1.82	10.18

Table 2: Evaluation of wheat genotypes on the basis of physiological observations during growth period

Genotypes	Days to 50% flowering	Days to maturity
NETS-101	92	124
NETS-102	96	126
NETS-103	92	123
NETS-104	83	119
NETS-105	99	127
NETS-106	83	122
NETS-107	82	119
NETS-108	93	126
NETS-109	83	123

Table 3: Evaluation of wheat genotypes on the basis of yield attributing and yield parameters

Genotypes	Number of effective tillers/hill	Spike length (cm)	Number of grains/spike	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
NETS-101	6.72	10.37	40.70	38.12	3.84	6.48
NETS-102	7.50	10.67	41.10	38.65	4.23	6.60
NETS-103	6.65	10.07	40.00	37.75	3.75	6.26
NETS-104	5.77	10.00	39.15	37.07	3.44	4.96
NETS-105	7.55	10.75	41.77	39.53	4.30	6.73
NETS-106	6.55	10.02	39.47	37.40	3.47	5.11
NETS-107	5.55	9.12	37.30	36.62	2.66	4.90
NETS-108	7.25	10.57	40.05	38.53	4.21	6.52
NETS-109	6.62	10.07	39.65	37.72	3.64	5.48
SEM (±)	0.36	0.21	0.54	0.47	0.12	0.14
CD (p=0.05)	1.06	0.61	1.59	1.37	0.34	0.42

Conclusion

It is concluded that genotype NETS-105 was found to be more desirable for producing significantly higher grain yield (4.30 t/ha), straw yield (6.73 t/ha). And gross return (98,900 INR/ha), net return (68,281 INR/ha), benefit cost ratio (2.22). Findings are based on research done in one season in Prayagraj (Allahabad) U.P. further trails may be required for considering it for recommendation.

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