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Screening of New Wheat Varieties (*Triticum aestivum* L.) Suitable for Late-sown Conditions, High Yield Potential, and Favorable Economics in the Central Plain Zone of Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during Rabi season of 2020-21 at the Student's Instructional Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur U.P. India., The objectives were to screen out the new wheat varieties suitable for late sown condition, to find out the nutritive status and yield potentiality of varieties sown under late sown condition, and to find out the economics. The eight varieties (V_1K307, V_2 K9107, V_3 KD9851, V_4 K7903, V_5 K1006, V_6 K1317, V_7 K8434, & V_8 K 424) were tested in Randomized Block Design with three replications. Result showed that wheat variety V_5 (K1006) gave significantly the highest grain yield (52.50 q/ha) and net income (Rs. 96988/ha) in comparison to all other varieties. The minimum grain yield (27.80 q/ha) and net income (Rs.34005/ha) was recorded for the variety V_6 (K1317).

Keywords: Wheat crop; K 1006; and yield. cultivation.

1. INTRODUCTION

"Wheat *(Triticum aestivum* L.*)* is considered one of the most important cereal crops not only in India but also in the world. Wheat (*Triticum aestivum* L.) comes under the family "Poaceae" and genus "*Triticum*". Cultivation of wheat started after 8000 BC. It is a crop of temperate climate with winter season crop and hot summers being very favorable for its growth and maturity. The wheat occupied total area in the world is 215.29 million hectares with production of 763.93 million tons and productivity are 3390 Kg ha^{-1} annually". (Anonoymous, 2019-20). The largest producer of wheat worldwide is the European Union followed by China, India, and United States of America. The consumption of wheat crop constantly increased during the last 15 years with the increase in population. Wheat is cultivated globally; the major wheat producer countries are China, India, USA, Russia, Canada and Australia.

In India, the total cultivated area under the wheat crop is 30.6 million hectares (mha) with production of 106.21 million tons and the average productivity of 3216 Kg ha^{-1} which have second position in production of wheat in the world after China. Important wheat producing states are Utter Pradesh (30MT), Punjab (16.4MT), Haryana (11.6MT), with an area of 9.6 mha, 3.5 mha, 2.5 mha, respectively. Uttar Pradesh has first position in area (9.6mha) and production of wheat in India (9.8MT). Although productivity of wheat (2561 Kg ha^{-1}) is still less than the national average (Anonymous, 2019-20)

Unlike other cereals, wheat contains higher amount of gluten, and protein that provides the elasticity necessary for excellent bread making. It has a good nutrition profile with 12.1 percent protein, 1.8 per cent lipids, 1.8 percent ash, 2.0 per cent reducing sugars, 6.7 percent pentose's, 59.2 percent starch, 70 percent total carbohydrates and provides 314 KCal/100g of food. It is also a good source of minerals and vitamins viz., calcium (37 mg/100g), iron (4.1 mg/100g), thiamine (0.45mg/100g), riboflavin (0.13mg/100g) and nicotinic acid (5.4mg/100mg) (Lorenz and Kulp, 1991). Hard wheat had high protein (10-17%) and yields flour rich gluten, making it particularly suitable for yeast breads. The low-protein (6 to 10%) softer type yields flour lower in gluten and therefore, suited better for tender baked products, such as biscuits, pastries and cakes. Micronutrient deficiency is also known as Hidden Hunger, is one of the most important challenges facing humanity today (White and Broadley, 2009).

"To evaluate the effect of rate, method, time and source of potassium (K) fertilization on yield attributes, yield and economics of wheat (*Triticum aestivum* L.). Potassium supply enhanced the yield attributes (spike weight, spike length, grains/spike, fertility %) and yield (grain and straw) significantly" (Kumar *et al 2*019).

Seasonal fluctuations in temperature have potential impacts on the phasic development and grain yield of crops. Wheat, being a winter cereal, requires specific environmental conditions for better emergence, growth and flowering (Dabre *et al.,* 1993) and is more venerable if exposed to high temperatures during reproductive stages (Kalra *et al.,* 2008). Too early sowing produces weak plants with poor root system, which leads to irregular germination, frequent death of the embryo and decomposition of endosperm due to activities of bacteria or fungi (Paul, 1992). While, late planting affects germination, growth, and grain development (Haq & Khan, 2002). Singh & Uttam, (1999) estimated yield loss @ 39 kg ha^{-1} day^{-1} in each

delay in sowing from the optimum sowing time. Normal sowing prolongs the duration of tillering (Ishag, 1994) producing a greater number of tillers, number of spikes, grains spike^{-1} and grain weight that ultimately boosts up grain and straw yields (Qasim *et al.,* 2008). Rajput & Verma, (1994) also observed that normal sowing time gave higher grain yield than late sowing.

"In late sown wheat, all the growth stages, such as tillering, flowering, and grain filling, are adversely affected by the shortened growing period. The reduction in the optimum growth period caused by a rise in temperature leads to leaf senescence resulting in a photosynthetic rate that is too low to meet plant economy" (Hensel *et al.,* 1993; Sharma *et al.,* 2006). As a result, it affects two important yield parameters, i.e., the number of grains per spike and grain weight (Ugarte *et al.,* 2007).

2. MATERIALS AND METHODS

The field experiment was laid out in the field No. 38 at Student Instructional Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) India during Rabi season 2020-21. The farm is in the main campus of university. The field was well levelled, having good irrigation and drainage facilities. The stubble of previous crop and weeds were removed from the field by manual practice.

The University is situated in Indo-Gangetic alluvial tract of Central Plain Zone of U.P. that comes in an Agro-climatic zone-V. To determine the physio-chemical characteristics and fertility status of experimental field, the soil samples were collected randomly from the six places of the field to the depth of 0-15 cm with the help of soil auger prior to fertilizer application. The soil samples of all the places were mixed to form a composite sample for mechanical and chemical analysis. The soil analysis was done in the Agronomy Department of this university.

The climate of Kanpur is sub-tropical, semi-arid with hot dry summer and severe cold in winter. The maximum temperature during summer reaches up to 46°C, while during winter it fall up to 4°C. The mean annual precipitation of the district is about 815.6 mm which is mostly received in the month of July to mid-September with occasional few showers of cyclonic rains during December and January. The total rainfall received 5.60 mm during crop growth period. The weather parameters collected for crop period from meteorological observatory of the university. During the experiment period the maximum and minimum temperature varied from 39.6 ^{0}C to 17 ^{0}C and 20.1 ^{0}Cto 6.8 ^{0}C, respectively. Humidity 93.00 to 31.00 % and rainfall 0.00 during the crop season.

The varieties tested in the experiment were K307, K9107 KD9851, K7903, K1006, K1317, K8434, K424. The wheat crop was fertilized @120:60:40 Kg NPK/ha. Half of nitrogen, full dose of Phosphorus and potash was applied at the time of sowing and remaining half of the Nitrogen was applied after first irrigation at proper moisture conditions. The NPK requirement was fulfilled by urea, DAP and Muriate of Potash. There were 3 replications by using RBD design for field trail. RBD design for field was used for statistical analysis. The following field observations were recorded. Total Dry Matter Production (Biological Yield, Grain Yield, Straw Yield, Harvest Index, Gross return, Net return, B:C Ratio (Benefit cost ratio).

3. RESULTS AND DISCUSSION

3.1 Total Dry Matter Production (Biological yield) (q/ha)

The total dry matter production is the total harvest from the net Plot which was recorded in Kg per net plot and converted into the quintal/ha .and analysis of variance have been included in. Thus, it is clear from the Table 1 maximum total dry matter production (Biological yield) has been observed in V_5 (K1006) i.e. 132.40 q/ha which was significantly superior over the rest of the treatments and lowest total dry matter production (Biological yield) has been observed in V_6 (K1317) 75.400 q/ha.

3.2 Grain Yield (q/ha)

It is clear from Table 1 that the maximum grain yield has been observed in V_5 (K1006) i.e. 52.50 q/ha and significantly superior over the rest of the treatments and lowest grain yield has been observed in V_6 (K1317) 27.800 q/ha.

3.3 Straw Yield (q/ha)

The maximum straw yield has been observed in V_5 (K1006) i.e. 79.09 q/ha (Table 1) which was assessed significantly superior over the rest of treatments. Of course, the lowest straw yield has been observed in V_6 (K1317) 47.600 q/ha.

Table 1. Biological yield (q/ha), Grain yield (q/ha), Straw yield (q/ha), Harvesting index (%) for the tested wheat varieties

Symbol	Treatment	Biological yield (q/ha)	Grain yield (q/ha)	Straw yield (q/ha)	Harvesting index (%)
V_1	K307	121.160	47.600	73.560	39.280
V_2	K9107	125.530	48.697	76.700	38.890
V_3	KD9851	99.060	38.400	60.660	38.750
V_4	K7903	81.800	30.660	51.000	37.650
V_5	K1006	132.400	52.500	79.090	39.640
V_6	K1317	75.400	27.800	47.600	36.860
V_7	K8434	87.030	33.630	53.400	38.640
V_8	K424	107.760	40.500	67.260	37.570
	SE m±	**2.1483**	**0.8604**	**0.4078**	**0.1291**
	CD at 5%	**6.5160**	**2.6096**	**1.2374**	**0.3903**

Table 2. Cost of cultivation, Gross income, Net income and Benefit cost ratio for the tested wheat varieties

Symbol	Treatment	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	Benefit cost ratio
V_1	K307	48320	127112	78792	2.63
V_2	K9107	48320	130954	82634	2.71
V_3	KD9851	48320	103137	54817	2.13
V_4	K7903	48320	83503	35183	1.72
V_5	K1006	48320	139278	90958	2.88
V_6	K1317	48320	76325	28005	1.57
V_7	K8434	48320	90449	42129	1.87
V_8	K424	48320	110254	61932	2.28

3.4 Harvest Index (%)

The Harvest Index represents the grain and total biomass production ratio which is calculated in percentage. The data produced in Table 1 clearly indicated that the maximum harvesting index has been observed in V_5 (K1006) i.e. 39.64% which was par with V_1 (K307) and significantly superior over the rest of the treatments and lowest harvesting index has been observed in V_6 (K1317) 36.860 %.

3.5 Cost of Cultivation (Rs/ha)

It is clear from Table 2 in that the costs of cultivation are the same in all treatments, i.e. Rs 48320 because no extra input was used in any treatment.

3.6 Gross Income (Rs/ha)

It is clear from Table 2 that the highest gross income was found in V_5 (K1006) i.e. Rs.139,278 followed by other treatment whereas the lowest gross income was found in V_6 (K1317) Rs.76325.

3.7 Net Income (Rs/ha)

It is clear from Table 2 that among all the treatment, highest net income was obtained in V_5 (K1006) i.e., Rs.96958 followed by other treatments and lowest income obtained in V_6 (K1317) Rs.34005.

3.8 Benefit: Cost Ratio (B:C ratio)

The data pertaining to Benefit: Cost ratio of different treatments was summarized in Table 2. The highest B:C ratio was found in V_5 (K1006) 2.88 followed by other treatments whereas the lowest B:C ratio was found in V_6 (K1317) 1.57.

The cost economic analysis of various treatments in the present study has shown that cost of cultivation is the same in all treatment (Rs.48320) while highest gross return (Rs.139, 278) was obtained in V_5 (K1006). The treatments V_5 (K1006) recorded comparatively higher returns and B: C ratio (2.88) over other treatments.

4. CONCLUSION AND SUMMARY

The highest biological, grain and straw yield found in wheat cultivar K1006 i.e. 132.40 q/ha, 52.50 q/ha, and 79.09 q/ha, respectively followed by K9107 (125.5 q/ha, 48.70 q/ha, and 76.70 q/ha, respectively), K307 (121.16 q/ha, 47.60 q/ha and 73.06 q/ha, respectively) and K424 (107.76 q/ha, 40.50 q/ha, and 67.26 q/ha, respectively). Cost of cultivation was the same in all treatments (48320Rs/ha), gross income (139278 Rs/ha), net income (96958 Rs/ha), and B:C ratio (2.88) were obtained by K1006 variety. While lowest gross income (76325 Rs/ha), net income (34005), and B:C ratio (1.57) was recorded in K1317 variety.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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