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Response of different varieties and sowing methods on yield and economics of wheat (*Triticum aestivum* L.)

Rohit Gupta, AS Yadav, Ram Niwas and Ravindra Sachan

Abstract
A field experiment was conducted at an Agricultural Farm Rama University, Kanpur (U.P) India. The Central Plain zone of Uttar Pradesh, during Rabi season of 2020-21. The experiment comprised of 12 treatment combinations in factorial randomized block design with three replications consisted of four wheat cultivars *viz*. V_1: NW-5054, V_2: NW-4018, V_3: K-1006 and V_4: K-8804 and three sowing methods *viz*. M_1: Broadcasting, M_2: Line Sowing and M_3: Raised Bed methods. On the basis of the results emanated from present investigation, it could be concluded that variety K-1004 sowing by raised bed method have higher growth parameter i.e. plant height & dry matter accumulation and yield attributes i.e. length of spike, number of spike, number of grains per spike and test weight. Results also showed that variety K-1004 sowing by raised bed method significantly enhanced productivity parameters i.e. grain yield, straw yield. Higher values of economics *viz*., gross return (Rs. 11390 ha^{-1}), net return (Rs. 67014 ha^{-1}) and B:C ratio (1.51) in wheat was observed in the combination of variety K-1004 sowing by raised bed method.

Keywords: Economics, grain, nitrogen and yield

Introduction
Wheat (*Triticum aestivum* L.) have a place with family Poaceae is one of the main cereal harvest of the world that has been considered as basic part of food security arrangement of a few countries of the world. It is biggest developed grain on the planet and it supplements around 19% of our complete calories. It guarantees the food security and wide versatility in various Agro-climatic circumstances.

Wheat rank first in the world among the all cereals in respect of area (217.06 million hectare) and production (764.49 million metric tonnes) during the year 2019-20 (Anonymous, 2020, b) [1]. In India total area under wheat cultivation is 31.04 million hectare, with the production of 117.5 million tonnes during the year 2019-20 (Anonymous, 2020, a) [1].

Wheat have more nutritional quality when contrasted with different cereals. It has great nourishment profile with 12.1%. Protein, 1.8% lipids, 1.8% debris, 2.0% decreasing sugars, 6.7% pentose and gives 314 Kcal/100g of food. Wheat is additionally a decent wellspring of minerals and nutrients *viz*., calcium (37mg/100g), iron (4.1mg/100g), thiamine (0.45mg/100g), riboflavin (0.13mg/100g) and nicotinic corrosive (5.4mg/100mg). Not at all like different oats, has wheat contained a high measure of gluten, the protein that gives the flexibility important to great bread making. Hard wheat is high in protein (10-17%) and yields a flour wealthy in gluten, making it especially reasonable for yeast breads.

The use of suitable sowing methods significantly improves the yield of late-sown wheat. In general, cross and line sowing have been shown to be superior to other methods of sowing, however farmers are forced to scatter seed in the field instead of line sowing due to rising labour costs, labour shortages, lack of time for land preparation, and a variety of other problems (Dagash *et al*., 2014) [5]. In fact, seed broadcasting has become a highly popular method of sowing among farmers these days. In terms of wheat grain yield, the traditional broadcast approach was found to be inferior to other sowing methods.

Method and Material
Experiment site
The field experiment was conducted during *Rabi* season of 2020-2021 at Agricultural Research Farm, of Rama University, Mandhana, Kanpur Nagar (U.P.) which is situated in the alluvial tract of Indo - Gangatic Plain in central part of Uttar Pradesh between $25^0$26' to $26^0$58' North latitude, $79^0$31' to $31^0$34' East longitude and on the altitude of 125.9 meters.

The irrigation facilities are adequately available on this farm. The farm is situated in the main campus of the university.

Soil of Experimental Field

The experimental field is clay loam in texture, alkaline in reaction (pH 7.79), low inorganic carbon (0.42%), available N (185 kg ha^{-1}), medium in available P (13 kg ha^{-1}), and high in available K (174 kg ha^{-1}).

Study Design

The experiment was laid out in a factorial randomized block design (FRBD) assigning 12 treatment combinations in factorial randomized block design with three replications consisted of four wheat cultivars *viz*. V_1: NW-5054, V_2: NW-4018, V_3: K-1006 and V_4: K-8804 and three sowing methods *viz*. M_1: Broadcasting, M_2: Line Sowing and M_3: Raised Bed methods. Each treatment was randomly allocated within them. The row-to-row spacing was 21 cm.

Harvest Index

The harvest index was worked out with the help of following formula:

$$\text{Harvest index (\%)} = \frac{\text{Grain yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

Net Profit (ha^{-1})

The net profit from each treatment was calculated separately by using the formula given below.

$$\text{Net profit (ha}^{-1}) = \text{Gross return - Cost of cultivation}$$

Cost Benefit Ratio (C: B)

The benefit ratio for each treatment was calculated by using following formula.

$$\text{Cost Benefit Ratio} = \frac{\text{Cost of Cultivation}}{\text{Gross Return}}$$

Statistical Analysis

The data recorded during the course of the investigation were subjected to statistical analysis by "Analysis of variance technique". The significant and non-significant treatment effects were judged with the help of 'F' (variance ratio) table. The significant differences between the means were tested against the critical difference at 5% probability level.

Result and Discussion

Growth parameters

Plant Height

The data regarding plant height at 30, 60, 90 DAS and at harvest stage were depicted in Table-1**.** Plant height was significantly influenced by the date of sowing at all growth stages. Plant height at 30, 60, 90 DAS and at harvest stage was significantly higher in M_3 (Raised Bed) as compared to M_2 (Line Sowing) and M_1 (Broadcasting). Plant height of wheat significantly differ from variety to variety. Plant height at 30, 60, 90 DAS and at harvest stage was significantly higher in V_3 (K-1004) as compared to V_4 (K-8804), V_1 (NW-5054) and V_2 (NW-4018). Plant height increased significantly with the combine use of M×V at 30, 60, 90 DAS and at harvest stage. The minimum plant height were noted 22.3, 64.9, 91.0 and 94.2 cm at 30, 60, 90 DAS and at harvest stage in $M_1 \times V_2$ interaction. The maximum plant height were noted 32.5, 80.3, 100.1 and 110.3 cm at 30, 60, 90 DAS and at harvest stage in $M_3 \times V_3$ interaction. Results were also agreement with the findings of Khan *et al.* (2007) [9], Chauhdary *et al.* (2016) [2] and Chouhan *et al.* (2017) [4].

Dry Matter Accumulation

The data of dry matter accumulation (g m^{-2}) at 30, 60 and 90 DAS were depicted in Table-1**.** Dry matter accumulation was significantly influenced by the date of sowing at all growth stages. Dry matter accumulation at 30, 60 and 90 DAS was significantly higher in M_3 (Raised Bed) as compared to M_2 (Line Sowing) and M_1 (Broadcasting). Dry matter accumulation of wheat significantly varies from variety to variety. Dry matter accumulation at 30, 60 and 90 DAS was significantly higher in V_3 (K-1004) as compared to V_4 (K-8804), V_1 (NW-5054) and V_2 (NW-4018). Dry matter accumulation increased with the combine use of M×V were found significant at 30, 60 and 90 DAS. The minimum dry matter accumulation were noted 58.23, 503.50 and 850.32 at 30, 60 and 90 DAS respectively in $M_1 \times V_2$ interaction. The maximum dry matter accumulation were noted 67.30, 573.31 and 934.40 at 30, 60 and 90 DAS in $M_3 \times V_3$ interaction. Similar findings were reported by Khan *et al.* (2007) [9], Chauhdary *et al.* (2016) [2] and Chouhan *et al.* (2017) [4].

Table 1: Effect of different treatment combination on growth parameters

Treatments		Plant Height (cm)				Dry Matter Accumulation		
		30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS
T_1		23.1	65.3	92.3	95.3	59.59	510.10	861.12
T_2		22.3	64.9	91.0	94.2	58.23	503.50	850.32
T_3		25.3	68.3	95.3	96.5	60.90	520.20	878.35
T_4		24.2	66.7	94.4	95.9	60.10	513.21	869.24
T_5		28.2	75.6	97.2	100.2	62.22	532.40	892.11
T_6		26.0	71.3	96.1	97.1	65.67	560.88	922.61
T_7		29.5	77.2	98.0	103.4	61.20	526.31	886.49
T_8		28.6	76.8	97.9	102.1	64.56	544.76	909.12
T_9		30.8	78.2	98.6	105.6	63.44	538.56	900.22
T_{10}		27.1	74.6	96.8	98.9	64.98	553.10	916.65
T_{11}		32.5	80.3	100.1	110.3	67.30	573.31	934.40
T_{12}		31.6	79.4	99.2	107.2	66.20	566.20	928.35
CD at 5%	V	0.118	0.201	0.105	0.192	0.105	0.737	1.083
	M	0.102	0.174	0.091	0.167	0.091	0.638	0.938
	V×M	0.204	0.349	0.182	0.333	0.182	1.276	1.875

S.E(m)±	V	0.040	0.068	0.036	0.065	0.036	0.250	0.367
	M	0.035	0.059	0.031	0.056	0.031	0.216	0.318
	V×M	0.069	0.118	0.061	0.113	0.062	0.432	0.635

Yield attributes

The data of yield attributing characters *viz*. no. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g) were depicted in Table-3**.** Yield attributing characters *viz*. no. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g)was significantly influenced by the sowing methods at all growth stages. The dry no. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g) of wheat significantly varies from variety to variety. No. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g)was significantly higher in V_3 (K-1004) as compared to V_4 (K-8804), V_1 (NW-5054) and V_2 (NW-4018). Yield attributing characters *viz*. no. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g) increased with the combine use of M×V were found significant. The minimum no. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g) were noted 280.13, 274.00, 30, 7.92 and 36.22 respectively in $M_1 \times V_2$ interaction. The maximum no. of effective tillers (m^{-2}), no. of ear (m^{-1}), no. of grains ear^{-1}, length of ear (cm) and 1000 grain weight (g) were noted 305.94, 308, 40, 8.41 and 43.90 in $M_3 \times V_3$ interaction. The consequences of the current investigation are additionally in concurrence with the investigation of Gupta *et al.* (2017) [8], Razaq *et al.* (2016) [12] and El-Temsah (2017) [7].

Table 2: Effect of different treatment combinations on yield attributing characters

Treatments		No. of effective tillers (m^{-2})	No. of ear (m^{-1})	No. of grains ear^{-1}	Length of ear (cm)	1000 grain weight (g)
T_1		288.58	285	33	8.07	36.91
T_2		283.65	280	32	7.98	36.69
T_3		298.71	298	36	8.23	38.29
T_4		292.62	291	34	8.15	37.56
T_5		304.26	309	37	8.43	38.92
T_6		331.39	331	39	8.80	40.12
T_7		301.22	305	35	8.32	38.58
T_8		318.22	320	39	8.66	39.40
T_9		309.10	314	36	8.58	39.01
T_{10}		325.14	325	38	8.71	39.68
T_{11}		346.56	341	41	8.95	40.87
T_{12}		340.70	337	40	8.86	40.30
C.D. at 5%	V	0.758	0.719	0.101	0.010	0.040
	M	0.656	0.622	0.087	0.009	0.035
	V×M	1.312	1.245	0.174	0.018	0.069
S.E(m)±	V	0.257	0.243	0.034	0.003	0.014
	M	0.222	0.211	0.030	0.003	0.012
	V×M	0.445	0.422	0.059	0.006	0.024

Productivity parameters

The data of productivity parameters *viz*. grain yield, straw yield, biological yield and harvest index were depicted in Table 3. Productivity parameters *viz*. grain yield, straw yield, biological yield and harvest index was significantly influenced by the sowing methods at all growth stages. Productivity parameters *viz*. grain yield, straw yield, biological yield except harvest index were significantly higher in M_3 (Raised Bed) as compared to M_2 (Line Sowing) and M_1 (Broadcasting). All the productivity parameters *viz*. grain yield, straw yield, biological yield and harvest index of wheat significantly varies from variety to variety. Grain yield, straw yield and biological yield was significantly higher in V_3 (K-1004) as compared to V_4 (K-8804), V_1 (NW-5054) and V_2 (NW-4018). Productivity parameters *viz*. grain yield, straw yield, biological yield and harvest index increased with the combine use of M×V were found significant. The minimum grain yield, straw yield, biological yield and harvest index were noted 31.20, 42.88, 74.08 and 42.11 respectively in $M_1 \times V_2$ interaction. The maximum grain yield, straw yield, biological yield and harvest index were noted 47.56, 62.23, 109.79 and 43.31 in $M_3 \times V_3$ interaction. Comparative findings were detailed by Chourasiya *et al*. (2013) [3], Yadav *et al*. (2017) [3] and Punia *et al*. (2017) [11].

Table 3: Effect of different treatment combinations on productivity parameters

Treatments		Grain Yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biological Yield (q ha^{-1})	Harvest Index (%)
T_1		34.00	43.98	77.98	43.60
T_2		31.20	42.88	74.08	42.11
T_3		35.70	46.80	82.50	43.27
T_4		34.90	44.78	79.68	43.80
T_5		38.00	52.56	90.56	41.96
T_6		47.00	60.43	107.43	43.74
T_7		36.80	50.53	87.33	42.13
T_8		41.70	58.48	100.18	41.62
T_9		41.50	55.31	96.81	42.86
T_{10}		42.00	59.07	101.07	41.55
T_{11}		47.56	62.23	109.79	43.31
T_{12}		47.18	61.12	108.30	43.56
C.D. at 5%	V	0.198	0.255	0.454	0.031
	M	0.171	0.221	0.393	0.026
	V×M	0.343	0.442	0.786	0.053
S.E(m)±	V	0.067	0.086	0.154	0.010
	M	0.058	0.075	0.133	0.009
	V×M	0.116	0.150	0.266	0.018

Economics

The data revealed that effect of different combination of method of sowing and different cultivars of wheat significantly affect the cost of cultivation, gross return, net return and B: C ration of wheat crop. The maximum cost of cultivation recorded in treatments T_9 (M_3V_1), T_{10} (M_3V_2), T_{11} (M_3V_3) and T_{12} (M_3V_4) with Rs. 44376. The maximum gross return were noted Rs. 111390 in $M_3 \times V_2$ interaction. The maximum net return were noted Rs. 67014 in $M_3 \times V_3$ interaction. The maximum B: C Ratio were noted 1.51 in $M_3 \times V_3$ interaction. Similar finding were reported by Pandey *et al.* (2008) [10] and Dawadi and Chaudhary (2013) [6].

Table 4: Effect of different treatment combinations on economics of wheat crop

S.N.	Treatments	Cost (Rs./ha)	Gross Return (Rs./ha)	Net Return (Rs./ha)	B :C Ratio
1.	M_1V_1	42076	79505	37429	0.88
2.	M_1V_2	42076	73588	31512	0.74
3.	M_1V_3	42076	83635	41559	0.98
4.	M_1V_4	42076	81518	39442	0.93
5.	M_2V_1	42876	89710	46834	1.09
6.	M_2V_2	42876	109812	66936	1.56
7.	M_2V_3	42876	86784	43908	1.02
8.	M_2V_4	42876	98645	55769	1.30
9.	M_3V_1	44376	97450	53074	1.19
10.	M_3V_2	44376	99397	55021	1.23
11.	M_3V_3	44376	111390	67014	1.51
12.	M_3V_4	44376	110347	65971	1.48

Conclusion

On the basis of results of present investigation it can be concluded that variety K-1004 have been suitable for eastern plain zone of Uttar Pradesh. If the variety K-1004 have been sown by raised bed sowing method farmers should get more yield in comparison to other sowing methods subsequently gets more profits.

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