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Effects of interaction (Date of sowing X varieties) on wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was laid out during the *Rabi* season of 2019-20 at the Agronomy Research Farm of A.N.D. University of Agriculture & Technology Kumarganj, Ayodhya (UP) to find out the effect of dates of sowing and different varieties on growth and yield of wheat. The experiment consisted of 16 treatment combinations comprised of four dates of sowing and four varieties, tested in split plot design with three replications. The observation on different growth and yield parameters were recorded and analyzed statistically. The results indicated that different dates of sowing and varieties significantly influenced the growth, yield and nutrient uptake of wheat. Among the various dates of sowing, D2 (November 28) being at par with D1 (November 18) recorded highest plant height, number of tillers m-2, leaf area index, dry matter accumulation, number of spikes m-2, length of spike, grains spike-1, yield and nutrient uptake. The highest benefit: Cost ratio (2.64) in case of dates of sowing was obtained from sowing done on November 28 while in case of varieties highest benefit: cost ratio (2.46) was obtained from variety V4 (DBW-187).

Keywords: Uptake, replications, ratio

Introduction
In India, wheat occupies second place after rice. It is cultivated on an area of 29.58 million ha with the production of 99.70 million tones having productivity of 3.37 tonnes ha-1 (Anonymous, 2018) [1]. As per Indian Council of Agricultural Research, the demand for wheat in the country will reach 140 million tonnes by 2050. Most of this demand in production will have to manage by increasing productivity as the land area under wheat is not expected to expand. Efficient input management along with varietal improvement are the two basic element that can help in achieving the target.

Wheat is more nutritive as compared to the other cereals. It has good nutrition profile with 12.1 per cent protein, 1.8 per cent lipids, 1.8 per cent ash, 2.0 per cent reducing sugars, 6.7 per cent pentose's, and provides 314 Kcal/100g of food. Wheat is also a good source of minerals and vitamins *viz*., calcium (37 mg/100g), iron (4.1mg/100g), thiamine (0.45mg/100g), riboflavin (0.13mg/100g) and nicotinic acid (5.4mg/100mg). Unlike other cereals, wheat contains a high amount of gluten, the protein that provides the elasticity necessary for excellent bread making. Hard wheat is high in protein (10-17%) and yields a flour rich in gluten, making it particularly suitable for yeast breads.

Among the factors of crop production the sowing time is most important. It has been observed that early sowing gives high yield as compared to late sowing due to longer growing season (Tanveer *et al.* 2003). Delay sowing from 20th November Onward decreased the wheat grain yield @ 39 kg per hectare per day (Singh and Uttam 1994) [4, 10-12, 18]. From an agronomic point of view sowing time is a key factor, which is reflected in high production of wheat as well as understanding of early crop establishment factors (Soomroat *et al.* 2009).

India is blessed with both the rich land and extremely suitable weather climate for crop production. Therefore, the rate of wheat production is second highest in the world. There are still many factors, which are responsible for low average yield of wheat in this country. One of such environmental factors is untimely planting which affects the yield of wheat crop considerably.

Another important aspect is lack of improved varieties which are having short maturity and suitable under late sown condition due to relatively shorter growing period available to the crop. Moreover, varieties also vary both in yield and nutrient uptake under late sown condition.

Wheat area is decreasing every year and there is a very little scope for expansion of area in future. So, there is urgent need to vertical increase in yield per hectare to insure household food security. This yield increase requires a continuing supply of improved germplasm an appropriate agronomy in order to sustain enhanced productivity and preserve the natural resource base. However, global warming, as a result of climate change, may negatively affect wheat grain yields potentially increasing food insecurity and poverty, although it should be noted that current effects of climate change in relation to wheat are inconclusive and model dependent (Tubiello *et al.* 2000) [17]. More recent and extensive research on climate change effects predicts marked increases in both rainfall and temperature, with temperatures projected to rise by as much as 3-4 °C by the end of the century in South Asia (DEFRA, 2005). Predicted effects on wheat production include reduced grain yield over most of India, with the greatest impacts in the lower potential areas, for example in the eastern plains.

Materials and Methods

The experiment was conducted at the Agronomy Research Farm of the Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, (UP). The experimental site is situated in the main campus of the university, about 42 km away from Ayodhya district head quarter on Ayodhya-Raibareili road at 26047 N latitude and 82012 E longitude and an altitude of 113 meters above mean sea level.

Summary and Conclusion

Uptake studies: The uptake of nutrient by grain and straw is the resultant of nutrient content multiplied by yield.

Content (%) of N, P and K in grain and straw

The concentration of nutrients (NPK) in grain and straw was increased with delayed sowing as recorded higher values with December 18 sown crop. The higher concentration of NPK in plant sown in December might due to restricted plant growth under delayed sowing. While profused growth under November sown crop was mainly responsible for lower concentration of N, P and K in plants owing to dilution effect of nutrients. However, uptake of N, P and K in grain and straw was recorded higher with November 28 sown crop followed by November 18. The higher uptake with November sown crop was mainly attributed due to higher grain and straw yield.

Variety DBW-187 recorded lower content (%) of N, P and K but the uptake of N, P and K through grain and straw was recoded highest followed by HD-2967. The lowest uptake of N, P and K was registered with variety NW-5054 and NW-1012 sown crop. The higher grain and straw yield with DBW-187 was mainly responsible for higher uptake of N, P and K.

Economics

Economic viability is a function of gain or loss. Any practice in order to be economical viable must have a substantial balance over its cost. In order to assured profitability net return and B: C ratio was worked out. The highest net return (Rs.105081 ha-1) and benefit: cost ratio (2.64) was obtained from treatment D2 (28-11-2019) and in case of varieties highest net return (Rs.102581 ha-1) and benefit: cost ratio (2.46) was obtained from V4 (DBW 187) This was due to the increase in grain yield because of timely sowing and better genetic characters of variety.

Table 1: Nutrient uptake (kg/ha) affected by date of sowing and verities of wheat

Treatments	Nutrient uptake (kg/ha)					
	Grain			Straw		
	N	P	K	N	P	K
Dates of sowing						
Nov. 18	86.14	21.16	26.35	40.59	8.11	110.92
Nov. 28	89.68	22.36	27.73	42.09	9.13	117.46
Dec. 8	69.96	16.89	21.07	33.76	8.94	94.90
Dec. 18	64.00	15.48	19.56	32.27	8.88	90.26
S.Em ±	1.69	0.43	0.44	1.03	0.23	2.94
C.D. at 5%	4.28	1.09	1.12	2.61	0.59	7.45
Verities						
HD 2967	82.23	19.67	19.31	33.79	7.85	105.42
NW 1012	70.40	17.07	21.12	30.97	7.28	97.05
NW 5054	76.63	18.48	18.19	32.61	7.65	102.34
DBW 187	86.80	20.66	25.92	35.25	8.15	109.55
S.Em ±	1.89	0.44	0.47	0.84	0.19	2.19
C.D. at 5%	4.03	0.94	1.00	1.79	0.40	4.69

Table 2: Economics as affected by dates of sowing and varieties of wheat

Treatments	Cost of cultivation (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	Benefit: Cost ratio
Dates of sowing				
Nov.18	41639	146720.00	105081.00	2.52
Nov.28	41639	151637.50	109998.50	2.64
Dec.8	41639	114526.25	72887.25	1.75
Dec.18	41639	104776.25	63137.25	1.51
Varieties				
HD 2967	41639	134332.50	92693.50	2.22
NW 1012	41639	114543.75	72904.75	1.75
NW 5054	41639	124563.75	82924.75	1.99
DBW 187	41639	144220.00	102581.00	2.46

Conclusion

Wheat crop may be sown on November 28 to obtain maximum, growth, yield attributes, yield and net profit and benefit: cost ratio.

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