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# Effect of different dates of sowing and varieties on yield and economics of wheat (*Triticum aestivum* L.)

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**Abstract**
This field experiment was conducted during *Rabi* seasons of 2023-24 at Research Farm, Vivekananda Global University, Jaipur. The treatments comprising three dates of sowing (15 November, 30 November and 15 December) and four varieties (Raj 4120, Raj 4079, PBW 527 and Raj 4238) respectively to main plot and sub plots were replicated four times in split plot design. Results revealed that sowing of wheat on 15 November gave higher grain, straw, biological yield Further, Results showed that variety Raj 4079 proved significantly superiority over Raj 4120, PBW 527 and Raj 4238 with respect to grain, straw and biological yields.

**Keywords:** Varieties, economics wheat, *Triticum aestivum* L

## Introduction
Wheat (*Triticum aestivum* (L.) emend. Fiori & Paol) is cultivated globally due to its broad adaptability and superior nutritional value compared to other staple crops. At present, wheat is grown across approximately 224.82 million hectares, yielding about 785 million tonnes with an average productivity of 3.26 tonnes per hectare. Since 1960, the global production of wheat and other cereal crops has tripled, and this trend is anticipated to continue through the mid-21st century. Wheat covers 17% of the total crop area worldwide and provides sustenance for around 40% of the global population. It serves as an excellent source of nutrition, containing 12.60% protein and 78.10% carbohydrates (Kumar *et al*., 2011) [5]. Variability in climate represents a significant environmental challenge for agriculture, particularly for the wheat crop. Global estimates suggest that approximately 50% of crop yield losses are due to various abiotic stresses resulting from changing climatic conditions (Trnka *et al*., 2004). Environmental factors such as soil moisture deficits, elevated temperatures, and low light intensity adversely impact the growth and productivity of wheat. Among these factors, temperature is a critical determinant of wheat's development and yield. The timing of wheat sowing is a crucial factor influencing the crop's phenological development and the effective conversion of biomass into economic yield. Optimal sowing schedules allow for the best growth conditions, leading to greater biomass accumulation compared to delayed sowing, which typically results in lower grain and overall yields (Singh and Pal, 2003) [9]. In contrast, late sowing exposes the wheat crop to suboptimal temperatures during establishment and excessively high temperatures during the reproductive stages, which can lead to premature maturation and reduced grain yield. Therefore, selecting the right variety and sowing at the appropriate time are essential for achieving maximum productivity.

## Methodology
### Grain yield (kg/ha)
The dried plant from each plot was threshed manually and winnowed. The clean seed obtained from individual plot were weighed and the weight recorded as grain yield in kg/ha.

### Straw yield (kg/ha)
Straw yield was obtained by subtracting the grain yield from biological yield. The grain and

straw yield recorded under each plot were converted into kg/ha.

**Biological yield (kg/ha)**
After complete sun drying, harvested bundles of each net plot were weighed for biological yield and converted in kg/ha.

**Harvest index**
The ratio of economic yield (grain yield) to the biological yield was worked out and expressed in percentage (Donald and Hamblin, 1976) [2].

Harvest index % = Economic yield Biological yield X 100

**Economics analysis**
**Cost of cultivation**
The expenses incurred for all the routine operations from preparatory tillage to harvesting including threshing, cleaning as well as the cost of inputs *viz*. seed, fertilizers, pesticides, irrigation etc. applied to each treatment were calculated on the basis of prevailing market rates and cost of cultivation was worked out.

**Net returns**
In order to evaluate the effectiveness of different treatments and ascertain the most remunerative treatment, total expenses incurred on cultural operations from preparatory tillage to harvesting including additional treatment cost for each treatment were computed and subtracted from the respective gross income to workout net monetary returns $ha^{-1}$. Gross income was computed taking prevailing market prices of the commodities. Thus, net returns were computed as.

Net returns = Gross returns – Total cost of cultivation

**Benefit: Cost ratio**
This was calculated for each treatment by dividing net return with cost of cultivation. The computation details of economics for each treatment are given in appendices at the end. B: C ratio is computed using formula

$$\text{B:C ratio} = \frac{\text{Gross returns (₹ ha}^{-1}\text{)}}{\text{Cost of cultivation (₹ ha}^{-1}\text{)}}$$

**Statistical analysis**
In order to test the significance of variation in experimental data obtained for various treatment effects, the data were statistically analyzed as described by Fisher (1950). The critical differences were calculated to assess the significance of treatment mean wherever the F' test was found significant at 5 per cent level of probability. To elucidate the nature and magnitude of treatment effects, summary tables along with SEm+ and CD (P=0.05) were prepared and are given in the text of the chapter. Experimental results and their analyses of variance are given in Appendices at the end.

**The following formula were used for standard error, critical difference and coefficient of variance estimations**

a) $SEm\pm = \sqrt{EMS/r}$
b) $C.D. = SEm\pm \times \sqrt{2} \times t\%$
c) $C.V.(\%) = \frac{\sqrt{EMS}}{\text{Grand mean}} \times 100$

Where,
r = Number of replications
t = Number of treatments
D.F. = Degree of freedom
SEm± = Standard error of mean
EMS = Error mean squares
C.D. = Critical difference
C.V. = Coefficient of variance

**Result and Discussion**
**Effect of Dates of Sowing**
Grain, straw and biological yield of wheat increased significantly when sowing of wheat on 15th November which was statistically at par with sowing on 30 November (Table 1). Grain, straw and biological yield decreased significantly as sowing was delayed from 15th November. This might be due to cumulative effect of poor expression of vegetative growth and yield contributing characters *i.e.* number of spikes, ear length, grains $spike^{-1}$ and test weight under late sown conditions accompanied with high temperature and hot winds which leads toward forced maturity of the crop and ultimately resulted in lower grain, straw and biological yield. The early sown crop, on the other hand, having favorable cool weather conditions for longer duration recorded better growth and yield attributes resulted in greater productivity. These findings are in close conformity to those of Jat *et al*., (2013) [4], Mumtaz *et al*., (2015) [8] and Marasini *et al*., (2016) [7].
The highest net return and benefit cost ratio obtained in the crop sown on 15th November followed by the crop sown on 30th November and 15th December, respectively (Table 2). It was due to significantly higher grain and straw yield on 15th November sown crop than the crop sown on 15th December, which resulted in higher net return and benefit cost: ratio. Similar results have been reported earlier by Singh *et al*., (2010) [10] and Hussain *et al*., (2015) [3].

**Effect of varieties**
Wheat yield is a complex process and governed by interaction between source (photosynthesis and availability of assimilates) and sink component (storage organs). Thus, as a consequence of marked improvement in both these regulative process as evidenced from higher accumulation of biomass and nutrients as well as yield components under variety Raj 4079 led to significant increase in grain yield. Further, the grain yield of wheat is dependent on two most important components namely spikes per unit area and weight of grains (test weight). Thus, due to more number of grains by virtue of increased number of spikes and more test weight under Raj 4079, increased the grain yield over PBW 527 and Raj 4120, and remained at par with variety Raj 4238. Since, biological yield is a sum of grain and straw yield produced by the crop, the increased grain yield under Raj 4079 might have resulted in higher biological yield in this variety. The variation among the varieties in relation to yield attributes could be due to their genetic makeup and somehow could be due to environmental conditions (Mahajan *et al.*, 2018). Varieties significantly influenced gross return, net return and B: C (Table 2). Variety Raj 4079 being at par with Raj 4238 resulted in significantly higher net return and B: C as compared to rest of the varieties which might be attributed to high yielding ability of the variety. The results are supported with those of Verma *et al.* (2015) [12] and Bachhao *et al.* (2018) [1].

**Table 2:** Effect of different date of sowing and varieties on net returns and B: C ratio of wheat

| Treatments | Net returns (Rs/ha) | B: C ratio |
|---|---|---|
| **Date of sowing** | | |
| $D_1$-15th November | 104358 | 2.86 |
| $D_2$-30th November | 94024 | 2.58 |
| $D_3$-15th December | 71465 | 1.96 |
| SEm± | 2003 | 7.39 |
| CD (P=0.05) | 6932 | 0.22 |
| **Varieties** | | |
| $V_1$-Raj 4120 | 72948 | 2.00 |
| $V_2$-Raj 4079 | 100289 | 2.75 |
| $V_3$-Raj 4238 | 96153 | 2.63 |
| $V_4$-PBW 527 | 90408 | 2.48 |
| SEm± | 2099 | 0.06 |
| CD (P=0.05) | 6090 | 0.18 |

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