



# Influence of Different Sowing Dates and Nutrient Management on Dry Matter Accumulation and Correlation Study for Grain Yield of Wheat (*Triticum aestivum*. L.)

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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 carried out during the *rabi* season of 2020-21 in the Instructional farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Chhattisgarh, to study the "Influenced of different sowing date and nutrient management on dry matter accumulation and Correlation and regression equations for grain yield of wheat (*Triticum aestivum*. L.)". The experiment was laid out in split plot design with three replications with keeping four sowing dates viz., D<sub>1</sub> (25<sup>th</sup> October), D<sub>2</sub> (5<sup>th</sup> November), D<sub>3</sub> (15<sup>th</sup> November) and D<sub>4</sub> (25<sup>th</sup> November) as main plot and three fertilizer rates viz., NM<sub>1</sub> (RFD), NM<sub>2</sub> (150% RFD + FYM 15 t ha<sup>-1</sup>) and NM<sub>3</sub> (150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators) as sub plot treatments. The crop sown on 5<sup>th</sup> November and

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NM<sub>3</sub> (150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators) was significantly influenced by higher dry matter accumulation, CGR, RGR. Results revealed that, the maximum growth *i.e.* (higher dry matter accumulation, CGR and RGR), yield attributes (weight of grains per ear and test weight) and yield (grain yield) of wheat crop sown on 5<sup>th</sup> November as compared to other sowing dates. Among the fertilizer rates, maximum growth *i.e.* (dry matter accumulation, CGR and RGR), yield parameters (weight of grains ear<sup>-1</sup> and test weight) were recorded the treatment NM<sub>3</sub> (150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators), which was at par with NM<sub>2</sub> (150% RFD + FYM 15 t ha<sup>-1</sup>). The data revealed that grain yield of wheat was significantly and positively correlated with biomass yield, test weight, number of grain ear<sup>-1</sup> head, spike length, grain weight ear<sup>-1</sup> head.

**Keywords:** *Wheat; sowing date; fertilizer rate; correlation; dry matter accumulation; yield.*

## 1. INTRODUCTION

Following rice, wheat (*Triticum aestivum* L.) is the second most significant food grain in India. Wheat is regarded as the supreme cereal. The term "Green revolution" refers to the series of agricultural changes that occurred as a result of the use and exploitation of the Norin10 dwarfing gene in wheat after 1965. India became self-sufficient in the production of food grains as a result of the green revolution. Wheat is a self-pollinating plant from the Poaceae family. India is the second-largest producer of wheat in the world, accounting for about 12 percent of worldwide production, and it also consumes the most wheat after China, with a big and rising demand [1]. Nearly 82-85% of the crop grown in India is irrigated, while the remaining is cultivated under rain-fed ecology. In India, wheat has covered an area of 31.76 million hectares with a total production of 109.52 million tonnes and productivity 3464 Kg ha<sup>-1</sup> [2]. In Chhattisgarh, wheat occupies an area about 112 (000, ha), with a production of 150 (000, t) and average productivity of 1340 Kg ha<sup>-1</sup> (Director's Report, 2020-21). Wheat is a great food for your health, with 9.2 g of fat, 44.7 g of carbohydrate, 28.7 g of starch, 16.0 g of total sugar, 22 mg of vitamin E, 45 mg of niacin, 0.72 mg of riboflavin, and 2.01 mg of thiamin per 100 g [3].

The timing of the sowing procedure is one of the most important non-monitored inputs that influence the production of wheat crop yields. Nearly 50% of the wheat in Chhattisgarh is planted after the first week of December suffers from heat stress, which significantly lowers yield. Late planting of wheat results in significant yield losses that may be as high as 40–50%. Wheat yield and quality decline due to heat stress have already been demonstrated [4]. In addition to meeting all other conditions, the wheat crop needs a favorable winter of about 100 to 110 days in order to produce its maximum yields.

Temperature is one of the primary climatic variables that affect when to sow a crop, how long certain phenophases last, and ultimately how productive a crop is. The date of planting is a crucial management decision to maximize wheat grain yield. In comparison to late sowing, normal sowing has a longer growth period, which allows for the accumulation of more biomass, leading to better grain and biological yields [5].

Wheat production is influenced by the soil's ability to supply nutrients and the fertilizers that are applied there. High yielding wheat types have been discovered to respond quite well to nitrogen fertilization, one of the key nutrients. However, nitrogen is not used when phosphorus is absent. Lodging, which frequently reduces photosynthetic capacity and biomass production, degrades seed quality, and complicates harvest operations, is a persistent global barrier to the sustainable production of wheat [6].

The use of growth retardants was found to be most effective for managing the problem of lodging [6]. Wheat is an important cereal crop and requires a good supply of nutrients especially nitrogen for its growth [7]. Under such conditions integrated use of chemical and organic fertilizer/manures can play an important role in sustaining soil fertility and crop productivity.

## 2. MATERIALS AND METHODS

A field experiment was carried out during *rabi* season of 2020-21 in the Instructional farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Chhattisgarh. Bilaspur is located at 22.09° N latitude and 82.15° E longitude and an altitude of 298 m above the mean sea level. Chhattisgarh state is classified into three agro-climatic zones, of which Bilaspur comes under the Chhattisgarh plains zone of the state. The soil of experimental site

was sandy clay soil in texture and neutral in reaction, medium in organic carbon content, low in available nitrogen and medium in available phosphorus and available potash. The average temperature was ranged from 14.96°C to 30.63°C during whole crop growing period. The total rainfall of 41.70 mm was received during crop season *rabi* 2020-21 and the highest rainfall (22.60 mm) was recorded during the meteorological week number 7 (February, 15-21). The experiment was laid out in split plot design with three replications with keeping four sowing dates *viz.*, D<sub>1</sub> (25<sup>th</sup> October), D<sub>2</sub> (5<sup>th</sup> November), D<sub>3</sub> (15<sup>th</sup> November) and D<sub>4</sub> (25<sup>th</sup> November) as main plot and three fertilizer rates *viz.*, NM<sub>1</sub> (RFD), NM<sub>2</sub> (150% RFD + FYM 15 t ha<sup>-1</sup>) and NM<sub>3</sub> (150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators) as sub plot treatments. The cultivars used in the study were GW 366 (wheat). The recommended seed rates and spacing were 100 kg ha<sup>-1</sup> and 20 cm row to row, respectively. A recommended fertilizer dose of 120:60:40:20 N:P:K kg ha<sup>-1</sup> was applied through urea, Single super phosphate and murate of potash respectively. 50% nitrogen with full dose P and K was applied as basal dose at sowing time and remaining 50% nitrogen was applied in two equal split *i.e.* ¼ at after first irrigation (CRI) and second dose at second irrigation in all the treatments. The data obtained on growth and yield was statistically analyzed for computing the critical difference (CD) at 5% significant level as per the technique commonly used for split plot design (Gomez and Gomez, 1984).

### 3. RESULTS AND DISCUSSION

#### 3.1 Effect of Sowing Date and Fertilizer Rates on Growth of Wheat Crop

##### 3.1.1 Dry matter accumulation (g plant<sup>-1</sup>)

The data pertaining to the wheat growth significantly affected by varying date of sowing and fertilizer rates and are presented in Table 1. Observation on dry matter production plant<sup>-1</sup> were recorded at 30, 60, 90 DAS and at the time of harvest. Plants continued to acquire dry matter with their advancing growth stages, but in general the rate of increase in dry weight was more from 60 DAS onwards. The different date of sowing and nutrient managements treatments were significantly affected the dry matter production at all growth stages of wheat. Among different date of sowing at 30 days' stage, sowing date 5<sup>th</sup> November (D<sub>2</sub>) produced higher dry weight which was at par with 15<sup>th</sup> November (D<sub>3</sub>)

and 25<sup>th</sup> November (D<sub>4</sub>). At 60 days' stage, sowing date 5<sup>th</sup> November (D<sub>2</sub>) produced higher dry matter accumulation followed by 15<sup>th</sup> November (D<sub>3</sub>) date of sowing treatment, but significantly heavier dry matter production than the date of sowing 25<sup>th</sup> October (D<sub>1</sub>). Similar results were observed at 90 days' stage and harvest. Similar results were reported by Yadav et al., [8] who reported, that the date of sowing of 15<sup>th</sup> December gave significantly higher growth attribute *viz.*, plant height, fresh weight, dry weight, number of tillers m<sup>-2</sup>, productive tillers m<sup>2</sup> and unproductive tillers m<sup>2</sup> over rest sowing dates during both the year except plant population and second year unproductive tillers m<sup>2</sup>.

Among different nutrient managements practices for dry matter production at 30 DAS stage no significant differences were found. Observation recorded at 60 DAS stage showed that treatment application of 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) produced higher dry matter accumulation, which was significantly superior than other nutrient managements practices. At 90 DAS and harvest treatment 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) produced higher dry matter accumulation followed 150% RFD + FYM 15 t ha<sup>-1</sup> (NM<sub>2</sub>). The lowest dry matter accumulation was observed under RFD (NM<sub>1</sub>) treatment at all the stages. Bindia, et al. (2005) found that application of FYM increase dry matter production.

##### 3.1.2 Crop growth rate (g day<sup>-1</sup> plant<sup>-1</sup>)

Crop growth rate of wheat was assessed for 30-60 DAS, 60-90 DAS and 90 DAS to harvesting intervals. The same has been presented in Fig. 1. The higher crop growth rate was recorded at 30-60 DAS interval, their after growth rate almost declines till maturity under different date of sowing and nutrient managements treatments. Highest crop growth rate was observed under 5<sup>th</sup> November (D<sub>2</sub>) date of sowing next to 15<sup>th</sup> November (D<sub>3</sub>) date of sowing at 30-60, 60-90 and 90 DAS to harvesting intervals. Lower crop growth rate was observed under 25<sup>th</sup> October (D<sub>1</sub>) which was almost equal to 25<sup>th</sup> November (D<sub>4</sub>) date of sowing at all stages.

Among the nutrient managements practices treatment 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) recorded higher crop growth rate and treatment application of (RFD) (NM<sub>1</sub>) had the lower crop rate in all the intervals. As it is discussed before that availability of more nutrients coupled with improved soil

physicochemical and biological environment might have resulted in higher CGR and better performance under treatment 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>). It was due to better plant growth and dry matter accumulation at early stages by active cell division and elongation and improved chlorophyll synthesis.

### 3.1.3 Relative growth rate (g g<sup>-1</sup> day<sup>-1</sup>)

The data presented in Fig. 2 revealed that, higher relative growth rate was recorded when crop sown on 5<sup>th</sup> November (D<sub>2</sub>) followed by 15<sup>th</sup> November (D<sub>3</sub>) and lowest relative growth rate observed under crop sown on 25<sup>th</sup> October (D<sub>1</sub>)

at all intervals. RGR represents the rate of dry matter accumulation over existing dry matter within a definite period; therefore, it was significantly more under (D<sub>2</sub>).

Among the nutrient managements, higher relative growth rate was recorded the application of 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) followed by 150% RFD + FYM 15 t ha<sup>-1</sup> (NM<sub>2</sub>) and lower relative growth rate under RFD (NM<sub>1</sub>) in all the growth stages of the crop. Higher interception and absorption of radiant energy thus greater photosynthesis and ultimately increased in dry matter production is the cause of enhancement in this parameter.

**Table 1. Effect of different sowing date and fertilizer rates of dry matter production of wheat**

Treatment	Dry matter production (g plant <sup>-1</sup> )			
	30 DAS	60 DAS	90 DAS	At harvest
<b>Date of sowing</b>				
D <sub>1</sub> (25 <sup>th</sup> Oct)	0.44	4.84	14.23	20.22
D <sub>2</sub> (5 <sup>th</sup> Nov)	0.55	6.06	17.39	23.05
D <sub>3</sub> (15 <sup>th</sup> Nov)	0.49	5.24	15.81	21.63
D <sub>4</sub> (25 <sup>th</sup> Nov)	0.47	5.00	15.01	21.12
<b>SEm ±</b>	<b>0.02</b>	<b>0.25</b>	<b>0.48</b>	<b>0.53</b>
<b>C.D.(P=0.05)</b>	<b>0.08</b>	<b>0.86</b>	<b>1.65</b>	<b>1.82</b>
<b>Nutrient Management</b>				
NM <sub>1</sub> (RFD)	0.48	4.62	14.64	20.03
NM <sub>2</sub> (150%RFD+FYM 15t ha <sup>-1</sup> )	0.49	5.25	15.93	21.95
NM <sub>3</sub> (150%RFD+FYM 15t ha <sup>-1</sup> + GR)	0.50	6.00	16.27	22.53
<b>SEm ±</b>	<b>0.03</b>	<b>0.23</b>	<b>0.44</b>	<b>0.52</b>
<b>C.D.(P=0.05)</b>	<b>NS</b>	<b>0.69</b>	<b>1.33</b>	<b>1.55</b>
<b>Interaction (A × B)</b>				
<b>SEm ±</b>	<b>0.05</b>	<b>0.16</b>	<b>0.89</b>	<b>1.03</b>
<b>C.D.(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

**Table 2. Effect of different sowing date and fertilizer rates of weight of grains ear<sup>-1</sup> head, test weight and yield of wheat**

Treatment	Weight of grains ear <sup>-1</sup> head	Test weight (g)	Grain yield (q ha <sup>-1</sup> )
<b>Date of sowing</b>			
D <sub>1</sub> (25 <sup>th</sup> Oct)	1.20	41.86	37.20
D <sub>2</sub> (5 <sup>th</sup> Nov)	1.30	45.08	46.33
D <sub>3</sub> (15 <sup>th</sup> Nov)	1.25	44.13	44.28
D <sub>4</sub> (25 <sup>th</sup> Nov)	1.23	42.11	39.72
<b>SEm ±</b>	<b>0.01</b>	<b>0.66</b>	<b>1.13</b>
<b>C.D.(P=0.05)</b>	<b>0.03</b>	<b>2.28</b>	<b>3.90</b>
<b>Nutrient Management</b>			
NM <sub>1</sub> (RFD)	1.21	41.84	37.36
NM <sub>2</sub> (150%RFD+FYM 15t ha <sup>-1</sup> )	1.25	43.56	43.46
NM <sub>3</sub> (150%RFD+FYM 15t ha <sup>-1</sup> + GR)	1.28	44.48	44.83
<b>SEm ±</b>	<b>0.02</b>	<b>0.65</b>	<b>0.85</b>
<b>C.D.(P=0.05)</b>	<b>0.05</b>	<b>1.95</b>	<b>2.55</b>
<b>Interaction (A × B)</b>			
<b>SEm ±</b>	<b>0.03</b>	<b>1.29</b>	<b>1.70</b>
<b>C.D.(P=0.05)</b>	<b>NS</b>	<b>NS</b>	<b>NS</b>

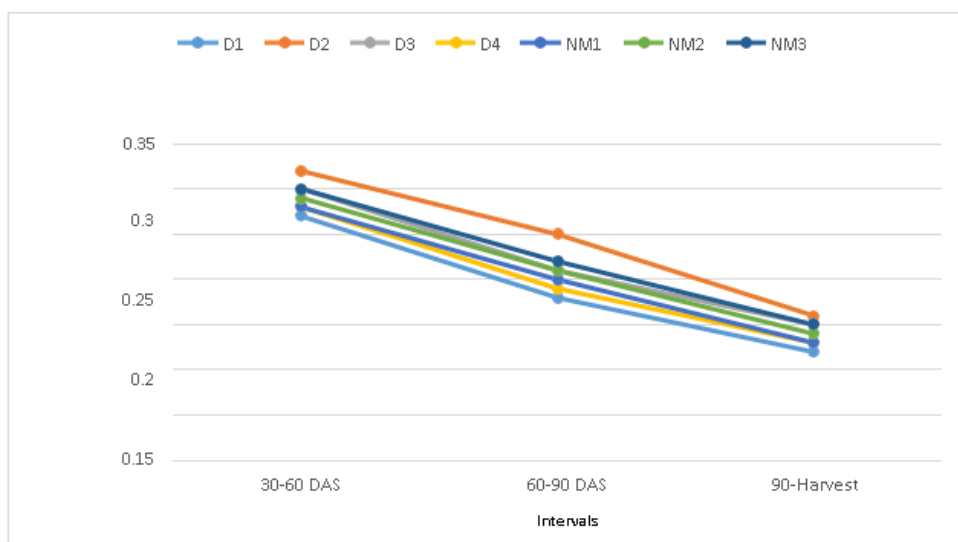


Fig. 1. Crop growth rate ( $\text{g day}^{-1}\text{plant}^{-1}$ ) at different intervals of wheat as influenced by sowing dates and nutrient managements

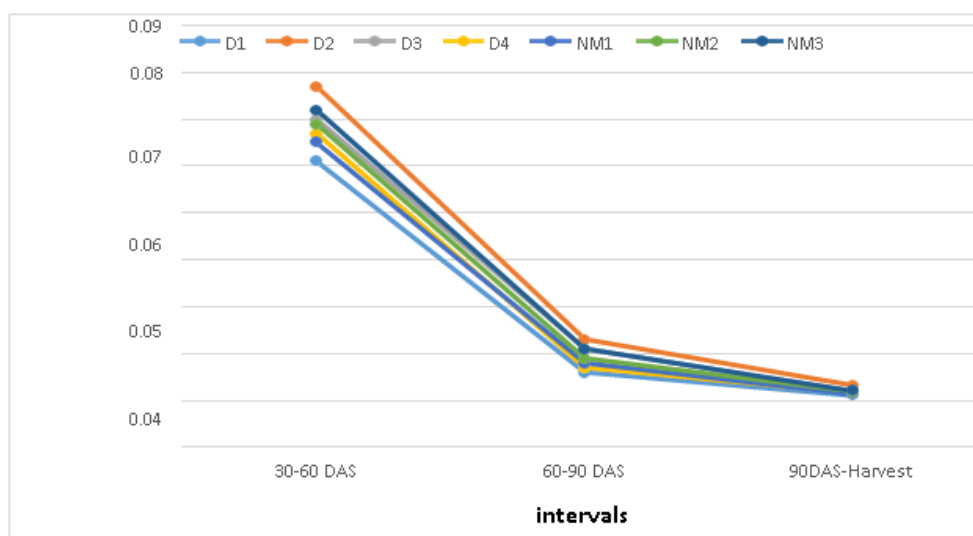


Fig. 2. Relative growth rate ( $\text{g g}^{-1}\text{day}^{-1}$ ) at different intervals of wheat as influenced by sowing dates and nutrient managements

Table 3. Correlation coefficients and regression equations for grain yield ( $\text{q ha}^{-1}$ ) with yield attributes on sowing date and nutrient managements

Dependent variable (Y)	Independent variable (X)	Correlation coefficient (r)	Regression coefficient (b)
Grain yield ( $\text{q ha}^{-1}$ )	Grain yield ( $\text{q ha}^{-1}$ )		-22.307
	Straw yield ( $\text{q ha}^{-1}$ )	0.270*	0.01
	Biomass yield ( $\text{q ha}^{-1}$ )	0.989*	0.401
	Test weight (g)	0.969*	0.543
	No. of grain ear <sup>-1</sup>	0.946*	-0.169
	Spike length (cm)	0.818*	-0.175
	Grain weight ear <sup>-1</sup> head (g)	0.913*	14.699
	Plant population ( $\text{m}^{-2}$ )	0.743*	-0.068

• 5% level of significant

### 3.2 Effect of Sowing Date and Fertilizer Rates on Yield Attributes and Yield of Wheat Crop

#### 3.2.1 Weight of grains ear<sup>-1</sup> head

The data pertaining to the wheat yield attributes was significantly affected by varying date of sowing and fertilizer rates and are presented in Table 2. Among different date of sowing 5<sup>th</sup> November (D<sub>2</sub>) recorded higher weight of grains ear<sup>-1</sup> head which was significantly superior than other date of sowing. The lowest weight of grains ear<sup>-1</sup> head was recorded under 25<sup>th</sup> October (D<sub>1</sub>). Similar results were reported by Kumar et al. [3].

The application of 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) recorded highest weight of grain ear<sup>-1</sup> head which was at par with 50% RFD + FYM 15 t ha<sup>-1</sup> (NM<sub>2</sub>). The lowest grains weight of ear<sup>-1</sup> head recorded under RFD (NM<sub>1</sub>). Thus similar result found by Borse et al., [9] and Saikia and Kalita [10].

#### 3.2.2 Test weight

weight of 1000 seed of wheat was higher under 5<sup>th</sup> November (D<sub>2</sub>) date of sowing followed by 15<sup>th</sup> November (D<sub>3</sub>) and lowest 1000 grain weight was observed under 25<sup>th</sup> October (D<sub>1</sub>). The findings are in agreement with the results of Islam et al. [11].

Among different nutrient managements 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) recorded heavier grains which was statistically at par with RFD (NM<sub>1</sub>) and 150% RFD + FYM 15 t ha<sup>-1</sup> (NM<sub>2</sub>).

#### 3.2.3 Grain yield

The data pertaining to the wheat yield grain, straw yield and harvest index was significantly affected by varying date of sowing and fertilizer rates and are presented in Table 2. The grain yields were the function of yield attributing characters like number of effective tillers (m<sup>-2</sup>), Number of fertile grains panicle<sup>-1</sup> and test weight. The average yield varied from 37.20 to 46.33 q ha<sup>-1</sup> in different date of sowing treatment 5<sup>th</sup> November (D<sub>2</sub>) produced appreciably higher seed yield (46.33 q ha<sup>-1</sup>), as compare to 25<sup>th</sup> October (D<sub>1</sub>) and 25<sup>th</sup> November (D<sub>4</sub>), but significantly at par with 15<sup>th</sup> November (D<sub>3</sub>) (44.28 q ha<sup>-1</sup>). Higher grain yield of wheat under 16<sup>th</sup> November have also reported by Goverdhan et al. [12] and Randhawa et al. [13].

Among different nutrient managements grain yield was higher under treatment 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) (44.83 q ha<sup>-1</sup>) followed by 150% RFD + FYM 15 t ha<sup>-1</sup> (NM<sub>2</sub>) (43.46 q ha<sup>-1</sup>) the lowest grain yield was obtained under RFD (NM<sub>1</sub>) (37.36 q ha<sup>-1</sup>). Similar results were reported by Convery et al. [14], who reported that application of inorganic fertilizer RDF (120:26.4:50 NPK ha<sup>-1</sup>) along with organic manure FYM 5t ha<sup>-1</sup>, bio fertilizer *i.e.* Azotobactor, PSB and VAM recorded 22% more grain yield than RDF. The result also confirmed the finding by Kushwaha and Singh [15].

#### 3.2.4 Correlation and regression studies

Simple correlation (r) and regression coefficient (b) were worked out to study the extent and type of relationship between yield and yield parameters (Table 3). A perusal of data revealed that grain yield of wheat was significantly and positively correlated with biomass yield, test weight, number of grain ear<sup>-1</sup> head, spike length, grain weight ear<sup>-1</sup> head. Since the correlation coefficient was found to be significant, therefore linear relationship appeared to have existed between grain yield and yield parameters. The quantum of change in grain yield for a unit change in yield parameters [16-18].

### 4. CONCLUSION

From the present investigation it is concluded that treatment 5<sup>th</sup> November (D<sub>2</sub>) and treatment 150% RFD + FYM 15 t ha<sup>-1</sup> + Growth regulators (NM<sub>3</sub>) recorded was found to be the best treatment among the different treatments with growth, yield attributes and yields under Bilaspur, Chhattisgarh region.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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