Influence of different sowing dates and nutrient management on dry matter accumulation and correlation study for grain yield of wheat(*Triticum aestivum.* L.)

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_1 (25^{th} October), D_2 (5^{th} November), D_3 (15^{th} November) and D_4 (25^{th} November) as main plot and three fertilizer rates *viz*., NM_1 (RFD), NM_2 (150% RFD + FYM 15 t ha^{-1}) and NM_3 (150% RFD + FYM 15 t ha^{-1}+ Growth regulators) as sub plot treatments. The crop sown on 5^{th} November and NM_3 (150% RFD + FYM 15 t ha^{-1} + 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 earand test weight) and yield (grain yield) of wheat crop sown on 5^{th} 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 $ear^{-1}$and test weight) were recorded the treatment NM_3 (150% RFD + FYM 15 t ha^{-1}+ Growth regulators), which was at par with NM_2 (150% RFD + FYM 15 t ha^{-1}).Thedata revealed that grain yield of wheat was significantly and positively correlated withbiomass yield, test weight, number of grain ear^{-1} head, spike length, grain weight ear^{-1} head.

Keywords: Wheat, Sowing date, Fertilizer rate, Correlation, Dry matter accumulation and Yield.

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 (Anonymous, 2019–20). 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^{-1} (USDA, 2021). In Chhattisgarh, wheat occupies an area about 112 (000, ha), with a production of 150 (000, t) and average productivity of 1340 Kg ha^{-1} (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 (Kumar *et al*., 2011).

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 (Stone & Nicolas 1995). 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 (Singh and Pal 2003).

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 (Zhang *et al*., 2017).

The use of growth retardants was found to be most effective for managing the problem of lodging (Zhang *et al.*, 2017). Wheat is an importantcereal crop and requires a good supply of nutrients especially nitrogen for its growth (Mandal*et al*., 1992). Under such conditions integrated use of chemical and organic fertilizer/manurescan play an important role in sustaining soil fertility and crop productivity.

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^{o}C to 30.63^{o}C during whole crop growing period. The total rainfall of 41.70mm 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_1 (25th October), D_2 (5th November), D_3 (15th November) and D_4 (25th November) as main plot and three fertilizer rates *viz*., NM_1 (RFD), NM_2 (150% RFD + FYM 15 t ha^{-1}) and NM_3 (150% RFD + FYM 15 t ha^{-1}+ 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^{-1}and 20 cm row to row, respectively. A recommended fertilizer dose of 120:60:40:20 N:P:K kg ha^{-1} was applied through urea, Single super phosphate andmurate 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).

Results and Discussion

Effect of sowing dateand fertilizer rates on growth of wheat crop

Dry matter accumulation (g plant^{-1})

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^{-1} were recorded at 30, 60, 90 DAS and atthe time of harvest. Plants continued to acquire dry matter with their advancing growth stages, but ingeneral the rate of increase in dry weight was more from 60 DAS on words. The differentdate of sowing and nutrient managements treatments were significantly affected the dry matterproduction at all growth stages of wheat. Among different date of sowing at 30 days' stage,sowing date 5thNovember (D_2) produced higher dry weight which was at par with 15thNovember (D_3) and 25thNovember (D_4). At 60 days' stage, sowing date 5thNovember (D_2)produced higher dry matter accumulation followed by 15thNovember (D_3) date of sowingtreatment, but significantly heavier dry matter production then the date of sowing 25thOctober (D_1). Similar results were observed at 90 days' stage and harvest. Similar resultswere reported by Yadav *et al*., (2017) who reported, that the date of sowing of 15thDecember gave significantly higher growth attribute *viz*., plant height, fresh weight, dryweight, number of tillers m^{-2}, productive tillers m^2 and unproductive tillers m^2 over restsowing dates during both the year except plant population and second year unproductivetillers m^2.

Among different nutrient managements practices for dry matter production at 30 DASstage no significant differences were found. Observation recorded at 60 DAS stage showedthat treatment application of 150% RFD + FYM 15 t ha^{-1}+ Growth regulators (NM_3)produced higher dry matter accumulation, which was significantly superior then othernutrient managements practices. At 90 DAS and harvest treatment 150% RFD + FYM 15 tha^{-1}+ Growth regulators (NM_3) produced higher dry matter accumulation followed 150%RFD + FYM 15 t ha^{-1} (NM_2). The lowest dry matter accumulation was observed under RFD(NM_1) treatment at all the stages. Bindia,*et al* (2005) found that application of FYM increasedry matter production.

Crop growth rate (g day^{-1} plant^{-1})

Crop growth rate of wheat was assessed for 30-60 DAS, 60-90 DAS and 90DAS to harvestingintervals. The same has been presented in fig. 1. The higher crop growth rate was recordedat 30-60DAS interval, their after growth rate almost declines till maturity under different dateof sowing and nutrient managements treatments. Highest crop growth rate was observedunder 5thNovember (D_2) date of sowing next to 15thNovember (D_3) date of sowing at 30-60,60-90 and 90DAS to harvesting intervals. Lower crop growth rate was observed under25thOctober (D_1) which was almost equal to 25thNovember (D_4) date of sowing at allstages.

Among the nutrient managements practices treatment 150% RFD + FYM 15 t ha-1+Growth regulators (NM_3) recorded higher crop growth rate and treatment application of (RFD) (NM_1) had the lower crop rate in all the intervals. As it is discussed before thatavailability of more nutrients coupled with improved soil physicochemical and biologicalenvironment might have resulted in higher CGR and better performance under treatment150% RFD + FYM 15 t ha^{-1}+ Growth regulators (NM_3). It was due to better plant growth anddry matter accumulation at early stages by active cell division and elongation and improvedchlorophyll synthesis.

Relative growth rate (g g^{-1} day^{-1})

The data presented in Figure 2 revealed that, higher relative growth rate wasrecorded when crop sown on 5thNovember (D_2) followed by 15thNovember (D_3) and lowestrelative growth rate observed under crop sown on 25th October (D_1) at all intervals. RGRrepresents the rate of dry matter accumulation over existing dry matter within a definiteperiod; therefore, it was significantly more under (D_2).

Among the nutrient managements, higher relative growth rate was recorded theapplication of 150% RFD + FYM 15 t ha^{-1} + Growth regulators (NM_3) followed by 150%
RFD+ FYM 15 t ha^{-1} (NM_2) and lower relative growth rate under RFD (NM_1) in all thegrowth stages of the crop. Higher interception and absorption of radiant energy thus greaterphotosynthesis and ultimately increased in dry matter production is the cause of enhancement inthis parameter.

Effect of sowing date and fertilizer rateson yield attributes and yield of wheat crop

Weight of grains ear^{-1} 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 5thNovember (D_2) recorded higher weight of grainsear^{-1} head which was significantly superior then other date of sowing. The lowest weight ofgrains ear^{-1} head was recorded under 25thOctober (D_1). Similar results were reported byKumar *et al* (2017).

The application of 150% RFD + FYM 15 t ha^{-1}+ Growth regulators (NM_3) recordedhighest weight of grain ear^{-1} head which was at par with 50% RFD + FYM 15 t ha^{-1} (NM_2).The lowest grains weight of ear^{-1} head recorded under RFD (NM_1). Thus similar result foundby Borse *et al*., (2019) and Saikia and Kalita (2021).

Test weight

weight of 1000 seed of wheat was higherunder 5thNovember (D_2) date of sowing followed by 15thNovember (D_3) and lowest 1000grain weight was observed under 25th October (D_1). The findings are in agreement with theresults of Islam *et al.* (2008).

Among different nutrient managements 150% RFD + FYM 15 t ha^{-1}+ Growthregulators (NM_3) recorded heavier grains which was statistically at par with RFD (NM_1) and150% RFD + FYM 15 t ha^{-1} (NM_2).

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^{-2}), Number of fertile grains panicle^{-1} and test weight. The averageyield varied from 37.20 to 46.33 q ha^{-1} in different date of sowing treatment 5thNovember(D_2) produced appreciably higher seed yield (46.33q ha^{-1}), as compare to 25thOctober (D_1)and 25thNovember (D_4), but significantly at par with 15thNovember (D_3) (44.28 q ha^{-1}).Higher grain yield of wheat under 16th November have also reported by Goverdhan*et al*(2019) and Randhawa *et al* (1977).

Among different nutrient managements grain yield was higher under treatment150%RFD + FYM 15 t ha^{-1}+ Growth regulators (NM_3) (44.83 q ha^{-1}) followed by 150% RFD +FYM 15 t ha^{-1} (NM_2) (43.46 qha^{-1}) the lowest grain yield was obtained under RFD (NM_1) (37.36 q ha^{-1}). Similar results were reported by Convertry*et al.* (2011), who reported thatapplication of inorganic fertilizer RDF (120:26.4:50 NPK ha^{-1}) along with organic manureFYM 5t ha^{-1}, bio fertilizer *i.e*. Azotobactor, PSB and VAM recorded 22% more grain yieldthan RDF. The result also confirmed the finding by Kushwaha and Singh (2002).

Correlation and regression studies

Simple correlation (r) and regression coefficient (b) were worked out to study theextent and type of relationship between yield and yield parameters (Table 3). A perusal ofdata revealed that grain yield of wheat was significantly and positively correlated withbiomass yield, test weight, number of grain ear^{-1} head, spike length, grain weight ear^{-1}head.Since the correlation coefficient was found to be significant, therefore linear relationshipappeared to have existed between grain yield and yield parameters. The quantum of change ingrain yield for a unit change in yield parameters.

Conclusion

From the present investigation it is concluded that treatment 5th November(D_2) and treatment 150% RFD + FYM 15 t ha^{-1}+ Growth regulators (NM_3)recorded was found to be the best treatment among the different treatments with growth, yield attributes and yields under Bilaspur, Chhattisgarh region.

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

	Dry matter production (g plant^{-1})			
Treatment	**30 DAS**	**60 DAS**	**90 DAS**	**At harvest**
Date of sowing				
D_1(25thOct)	0.44	4.84	14.23	20.22
D_2(5thNov)	0.55	6.06	17.39	23.05
D_3(15thNov)	0.49	5.24	15.81	21.63
D_4(25thNov)	0.47	5. 00	15.01	21.12
SEm ±	**0.02**	**0.25**	**0.48**	**0.53**
C.D.(P=0.05)	**0.08**	**0.86**	**1.65**	**1.82**
Nutrient Management				
NM_1(RFD)	0.48	4.62	14.64	20.03
NM_2(150%RFD+FYM 15t ha^{-1})	0.49	5.25	15.93	21.95
NM_3(150%RFD+FYM 15t ha^{-1}+ GR)	0.50	6.00	16.27	22.53
SEm ±	**0.03**	**0.23**	**0.44**	**0.52**
C.D.(P=0.05)	**NS**	**0.69**	**1.33**	**1.55**
Interaction (A × B)				
SEm ±	**0.05**	**0.16**	**0.89**	**1.03**
C.D.(P=0.05)	**NS**	**NS**	**NS**	**NS**

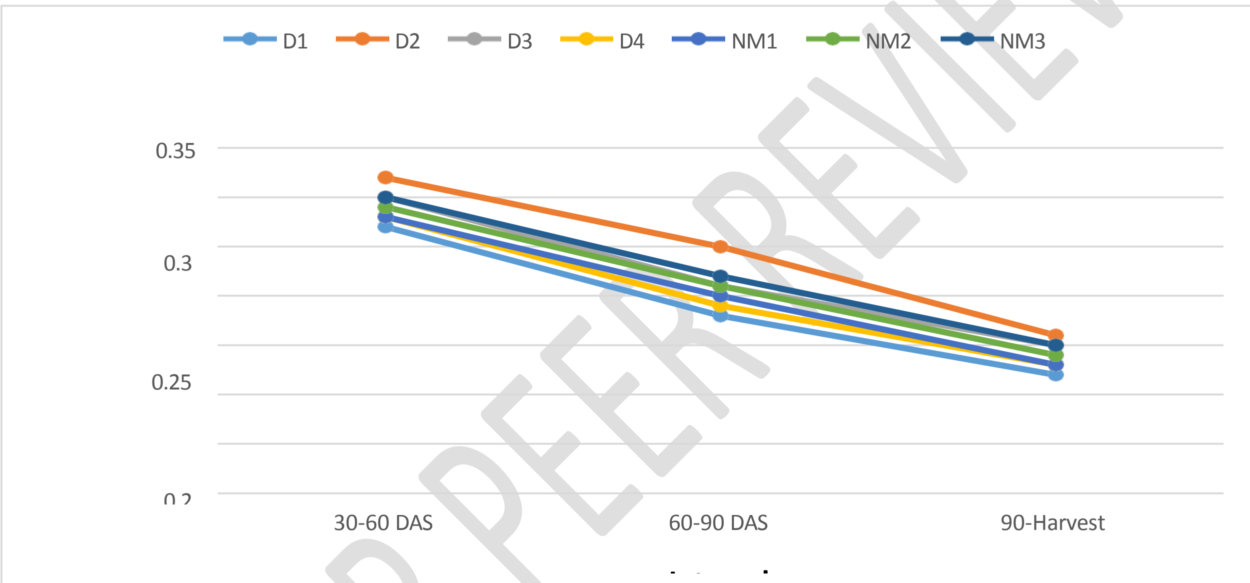

Fig.1.Cropgrowthrate(gday^{-1}plant^{-1})atdifferentintervalsofwheatasinfluenced by sowing dates and nutrient managements.

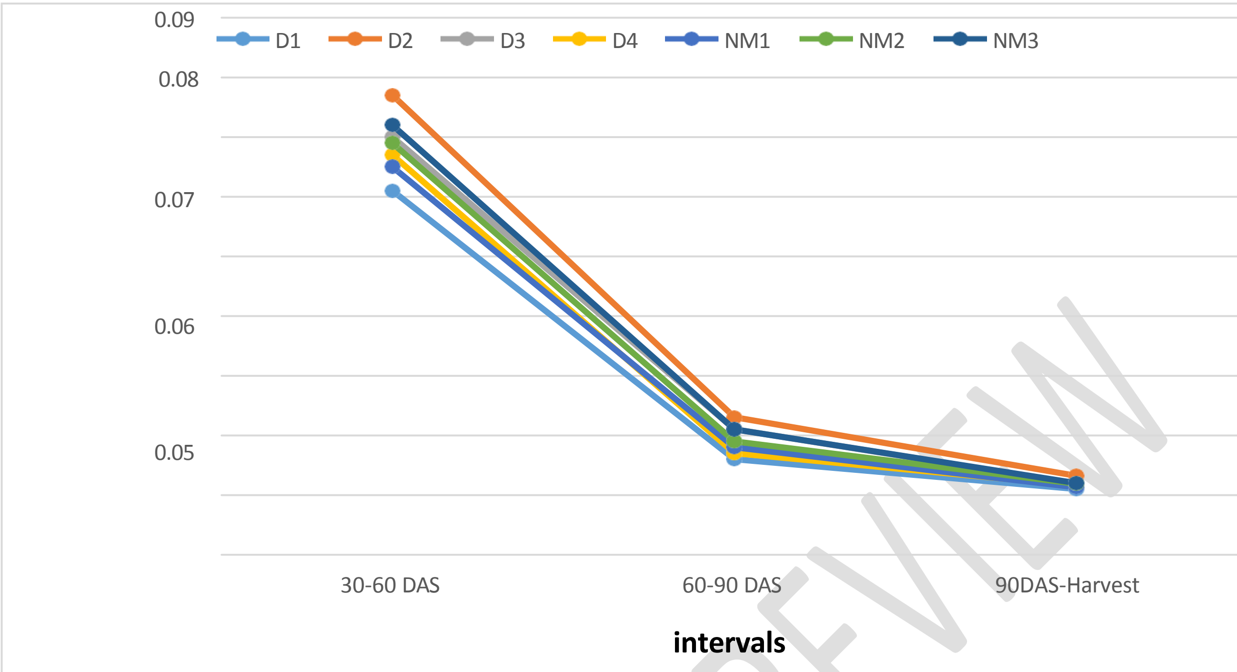

Fig.2 Relativegrowthrate(gg^{-1}day^{-1})atdifferentintervalsofwheatasinfluencedby sowing dates and nutrient managements

Table 2: Effect of different sowing date and fertilizer rates of weight of grains ear^{-1} head, test weight and yield of wheat

Treatment	weight of grains ear^{-1} head	Test weight (g)	Grain yield (q ha^{-1})
Date of sowing			
D_1(25thOct)	1.20	41.86	37.20
D_2(5thNov)	1.30	45.08	46.33
D_3(15thNov)	1.25	44.13	44.28
D_4(25thNov)	1.23	42.11	39.72
SEm ±	**0.01**	**0.66**	**1.13**
C.D.(P=0.05)	**0.03**	**2.28**	**3.90**
Nutrient Management			
NM_1(RFD)	1.21	41.84	37.36
NM_2(150%RFD+FYM 15t ha^{-1})	1.25	43.56	43.46
NM_3 (150%RFD+FYM 15t ha^{-1}+ GR)	1.28	44.48	44.83
SEm ±	**0.02**	**0.65**	**0.85**
C.D.(P=0.05)	**0.05**	**1.95**	**2.55**
Interaction (A × B)			
SEm ±	**0.03**	**1.29**	**1.70**
C.D.(P=0.05)	**NS**	**NS**	**NS**

Table 3: Correlation coefficients and regression equations for grain yield (q ha^{-1}) withyield attributes on sowing date and nutrient managements

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

- **5% level of significant**

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