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EFFECT OF DIFFERENT SOWING DATES ON GROWTH AND YIELD ATTRIBUTES OF WHEAT IN UDHAM SINGH NAGAR DISTRICT OF UTTARAKHAND, INDIA

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Abstract

Globally, wheat is a major staple crop and it is also significant for India. After rice its is second most important staple crop in India. Because of its wider adaptability, its is grown from temperate irrigated to dry and high rainfall areas and from warm humid to dry cold environment. Optimum date of sowing is an impotant parameter, which affect the growth and yield attributes of wheat among other cultivation practices. To find out optimum date of sowing for wheat variety UP-2565 an experiment was conduted at at experimental farm of N.E. Borlaug Crop Research Centre of the G. B. Pant University of Agriculture and Technology, Pantnagar, district Udham Singh Nagar (Uttarakhand). From the experiment, it was found that no. of days to attain different phenological stages, leaf area index, dry matter, grain yield as well as biological yield was significantly influenced. The crop sown under late sown condition took less number of days to attain maturity in comparison to the crop sown timely. Maximum reduction in grain yield and dry matter was found for the crop sown on 6th December. Reduction in dry matter, grain yield and biological yield was more in the year 2015-16 in comparison to 2014-15 probably because of high temperature at the reproductive stage during the crop growing season.

Key words : Globally, dry matter, phenological stages, december, environment.

Introduction

Globally, wheat is a major staple crop and it is also significant for India. After rice its is second most important staple crop in India. Because of its wider adaptability its is grown from temperate irrigated to dry and high rainfall areas and from warm humid to dry cold environment. Because of its complex genome nature it has wider adaptability. Being a C_3 type crop, it thrives well in cool environment.In India it is grown on 30.2 million hectares area with total production of 87.9 million tones during the season 2014-15(Anonymous). In case of wheat date of sowing is most important factors that governs the phenological development of crop and also efficient conversion of biomass into economic yield. It has been observed that the wheat crop sown at normal date usually have longer crop duration thus they get an opportunity to accumulate more biomass as compared to late sowing and thus it finally resulted in higher grain yield and biological yield. In case of delayed sowing the wheat crop is exposed to low temperature at the time of establishment and exposed to high temperature at the reproductive phase that finally leads to forced maturity. Optimum date of sowing is an impotant parameter which affect the growth and yield attributes of wheat among other cultivation practices. Temperture is an important weather parameter that influence the growth and phenophases of wheat.Plants have definite temperature requirement before attaining a certain phenological stages. Being a temperature sensitive crop, it has been observed that in case of late sowing the maturity of crop is accelerated and crops are forced to mature early in North Indian condition. Therefore, the optimization of sowing time is an important parameter to attain maximum yield and efficient conversion of biological yield into economic yield. The optimization of exact date of sowing can be done through a comprehensive study on days taken to attain different phenophases, growing degree days requirement and yield response of wheat crop during *rabi* season. Therefore, an experiment was planned to have knowledge the exact date sowing in Udhamsinghnagar district of Uttarakhand, India.

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Materials and Methods

The present investigation were carried out at experimental farm of N.E. Borlaug Crop Research Centre of the G. B. Pant University of Agriculture and Technology, Pantnagar, district Udham Singh Nagar (Uttarakhand), India. Geographically this centre is situated at 29°N latitude and 79.3°E longitude. The elevation of this place from mean sea level is 243.83 meter. The area lies in ''*Tarai*" belt located in foot hills of the Himalayas. The area falls under sub humid and sub tropical zone with four distinct seasons. The climate of Pantnagar comprises of sub humid to sub tropical with hot dry summers and cool winters. Generally, the monsoon sets in around third week of June and lasts upto September end. The mean annual rainfall is 109 cm. May is the hottest month of the year and temperature generally rises up to 45.5±1.5°C. However, minimum temperature can be low as 1.5±1.0°C in the month of January.The experiment was conducted during rabi season of 2014-15 and 2015-16. The experiment was laid in randomized plot design (RBD) with three replcation. Size of each plot was 4 × 4 m^2. Sowing of wheat variety UP-2565 was done at three different dates *viz*. 1st December, 20th December and 6th January with row spacing of 22.5 cm as per treatments. Four irrigations (5cm water in each irrigation) were applied at four critical phenological stages of wheat. The crop was fertilized at the rate of 120 kg Nitrogen, 60 kg P_2O_5 and 40 kg K_2O. Out of which, 1/3rd N and full dose of P_2O_5 and K_2O were applied as basal dose at the time sowing by broadcasting method. The remaining 2/3rd dose of N was applied in two splits at CRI and late tillering stages. The phenophases *viz*. emergence, CRI, tillering, jointing, 50% flowering, milking and physiological maturity were noted by regular field inspection method. Total number of tillers, no. of effective tillers were recorded from one metre row length and later it is presented in per square metre. For study of spike characteristic 10 spikes were randomly selected from each plot at the time of maturity for recording following spike characteristics. The length of sampled spike was measured from the node at the base of the spike to the tip of the topmost spikelet and spike length was reported in centimeters per spike by averaging them. All the 10 spikes were manually threshed and numbers of total grains were counted after cleaning. The number of grains per spike was computed by averaging them. The sample of 1000-grains collected from each plot, weighted and presented as gram. Total bundle weight was recorded from each plot at the time of harvesting. The crop was threshed and grain were weighted and presented in quintal/hectare.Meteorological data, *viz*., maximum and minimum temperature, relative humidity, bright sunshine hours, day length etc.were recorded from Agrometeorological observatory of GBPUA & T, Pantnagar University.

Results and Discussion

Effect of different sowing dates on number of days taken to attain different phenophases

From the experiment, it was found that date of sowing has significant influence on growth and yield attributes. The number of days taken to attain different phenophases decreases with delay in sowing that resulted into reduced life span of late sown crop. Similar findings have been also reported by Pande *at al*. (2009). Crop sown on 1st December (table 1) took maximum number of days to attain different phenophases *viz*. emergence, CRI, tillering, anthesis and physiological maturity as compared to other two dates of sowing. The maximum number of days was recorded to attain emergence, CRI as well as tillering with 20th December sowing as compared to 1st December and 6th January sowing. In case of jointing, 50% flowering, milking and physiological maturity the crop sown on 1st December took more number of days as compared to rest other two dates of sowing.

Effect of different sowing dates on growing degree days (GDD)

Among different dates of sowing maximum GDD (1488.6 ^{0}C days in 2014-15 and 1545.7^{0}C days in2015-16) were recorded for the crop sown on 06th January. GDD was found to increase with delay in sowing during both the years. The probable reason for it is, during earlier phenophases low temperature prevail and at advanced stages of crop growth high temperature prevailed. Kumari *et al*. (2009) also reported that with delay in sowing GDD value increases. Maximum number of tillers m^{-2} at maximum growth stages and number of effective tillers m^{-2} was significantly higher for the crop sown on 1st December (520 and 479; 429 and 384 maximum and effective number of tillers/m^2 in 2014-15 and 2015-16 respectively) followed by the crop sown on 20th December and 06th January. As a result of late sowing reduction in number of tillers have also been reported by Tripathi (2003). It was observed that leaf area index increases successively upto 75 DAS and thereafter decreased successively for all dates of sowing during both the years.

Effect of different sowing dates on leaf area index (LAI)

Data revealed that leaf area index was significantly influenced by different dates of sowing. Maximum leaf area index were reported for the crop sown on 1st

December (fig. 1) at all growth stages in both the years. Delay in sowing significantly reduced the LAI at all stages. Probably because of reduction in rate of photosynthesis and poor development of leaves. Tripathi (2003) and Pande (2009) also reported that timely sown crop has higher LAI in comparison to late sown crop. Leaf area index was found to decrease due to senescence of leaves 75 days after sowing. Between emergence to jointing, higher GDD were recorded with 1st December sowing than 20th December sowing while lowest GDD were observed with crop sown on 06th January during both the years. From 50% flowering to physiological maturity higher GDD were recorded with 6th January sowing followed by 1st December and 20th December sowing during both the years.

Effect of different sowing dates on dry matter accumulation (g/m²)

Differences in sowing dates have significant influence on dry matter at all phenological stages of wheat during both the years. Data revealed that date of sowing significantly influenced dry matter production at all crop growth stages from 15 DAS to harvest. Maximum dry matter accumulation was found for the crop sown on 1st December than the crop sown on 20 December and 06th January during both the years. Ram *et al.* (2004) also reported similar finding. They also found that delay in sowing results in reduction in dry matter production. In late sown condition there is cold stress during early phenophases of crop growth, but at advanced stages of crop growth severe heat stress caused reduction in dry matter production. The accumulation of dry matter was less for the cropping season 2015-16 because throughout the growing period temperature was higher in comparison to the year 2014-15. Higher temperature results in reduction in duration of completion of different phenophases and thus crop get less time for dry matter accumulation.

Effect of different dates of sowing on yield and yield attributing character

Effect of dates of sowing on number of spikes per plant was significant during both the years. The crop sown

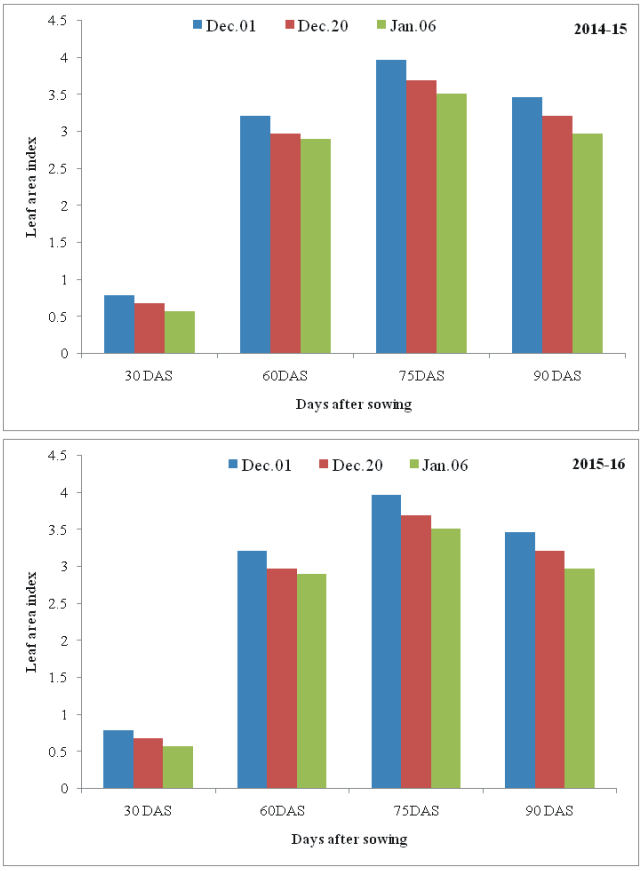

Fig. 1 : Effect of sowing date on leaf area index under late sown wheat in the year 2014-15 and 2015-16.

on 1st December (table 3) was found to have more number of spikes per plant (5.23 in 2014-15 and 4.75 in 2015-16) followed by the crop sown on 20th December (4.68 in 2014-15 and 4.25 in 2015-16) and 06th January (4.23 in 2014-15 and 43.85 in 2015-16). Patil *et al.* (2003) also reported that delay in sowing resulted in lesser number of spikes per plant. Effect of dates of sowing on number of spikelets per spike also was found significant during both the years. The maximum number of spikelets per plant was highest for the crop sown on 1st December (16.8 in 2014-15 and 16.3 in 2015-16) during both the years followed by the crop sown on 20th December (15.8 in 2014-15 and 15.5 in 2015-16), 06th January (14.86 in 2014-15 and 14.6 in 2015-16). Maximum number of

Table 1 : Effects of dates of sowing on days taken to various phenophases of wheat crop.

Dates of sowing	2014-15							2015-16						
	Emergence	CRI	Tillering	Jointing	50% flowering	Milking	Physiological maturity	Emergence	CRI	Tillering	Jointing	50% flowering	Milking	Physiological maturity
December 01	7	21	27	52	92	107	125	6	20	26	48	87	103	124
December 20	9	23	29	48	87	101	118	7	22	28	45	84	99	115
January 06	7	22	26	46	83	98	112	8	21	25	44	82	96	113

Table 2 : Dry matter accumulation (g/m^2) of wheat as affected by different dates of sowing.

Dates of sowing	Dry matter accumulation (g/m^2)							
	2014-15				2015-16			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
Dec. 01	44.3	385.0	925	1028.3	35.2	310.8	759.6	894.9
Dec. 20	40.7	378.6	835	988.8	25.8	305.6	790.5	852.6
Jan. 06	32.0	368.7	742	821.0	25.5	275.2	618.5‘	746.5
S.Em.±	2.98	14.22	22.56	12.56	1.58	15.84	23.56	13.85
CD at 5%	14.49	59.22	83.6	53.21	13.68	58.42	95.48	54.86

Table 3 : Yield and yield component of wheat as affected by different dates of sowing.

Date of sowing	2014-15				2015-16			
	No. of spikes per plant	No. of spikelets per spike	No. of grains per spike	Test weight (g)	No. of spikes per plant	No. of spikelets per spike	No. of grains per spike	Test weight (g)
01st December	5.23	16.8	32.3	40.5	4.75	16.3	30.8	39.82
20 December	4.68	15.5	30.8	39.4	4.25	15.8	29.68	38.68
06 January	4.23	14.86	29.5	38.6	3.85	14.6	28.54	36.8
SEm±	0.03	0.17	0.39	037	0.062	0.18	0.24	0.35
CD at 5%	0.168	0.68	1.51	1.42	0.215	NS	0.84	NS

Table 4 : Effects of dates of sowing on grain yield (kg/ha), straw yield (kg/ha) and biological yield (kg/ha) of wheat crop.

Date of sowing	2014-15				2015-16			
	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index
Dec. 01	4480.3	5069.4	9549.7	46.9	4030	4968.2	8998.2	44.7
Dec. 20	3984	5001.8	8985.8	44.3	3900	4961.8	8861.8	44.0
Jan. 06	3486	4486.2	7972.2	43.7	3422	4688.2	8210.2	42.89
S. Em. ±	56.54	100.23	139.68	0.038	52.24	70.18	128.6	0.001
CD at 5%	225.6	392.29	545.6	0.01	227.6	272.6	498.6	0.002

grains per spike (32.3 in 2014-15 and 30.8 in 2015-16) were found for the crop sown on 1st December during both the years followed by the crop sown on 20th December (30.8 in 2014-15 and 29.8 in 2015-16), 06th January (29.5 in 2014-15 and 28.54 in 2015-16). Different sowing dates significantly influenced the test weight of wheat grains during both the years. The test weight decreased during both the years as the sowings were delayed. Crop sown on 1st December recorded significantly highest test weight (40.5 in 2014-15 and 39.82 in 2015-16) while the test weight (38.6 in 2014-15 and 36.8 in 2015-16) was found to be lowest for the crop sown on 6th January during both the years.

Data revealed that delay in sowing decreased test weight during both the years. Delay in sowing caused poor vegetative growth. Low leaf area index is associated with low photosynthetic rate (Meena, 2009) caused poor canopy development and it limits the assimilate availability for development, which finally resulted into reduced number of grains or reduction in test weight. Reduction in test weight was more for the crop grown in the year 2015-16 because of higher temperature, grain filling duration get reduced, seed setting could not take place properly resulted in shriveled grain. Crop sown on 1st December resulted in highest grain yield as well as biological yield during both the years. Grain yield (kg/ha) recorded with crop sown on 1st December (4480.0 kg/ha in 2014-15 and 4030 kg/ha in 2015-16, respectively) was significantly higher than the crop sown on 20th December (3984 kg/ha in 2014-15 and 3900 kg/ha in 2015-16 respectively) and 06th January (3486 kg/ha in 2014-15

and 3522 in 2015-16, respectively). Reduction in yield was due to delay in sowing has also been reported by Ram *et al.* (2004), Barman (2007) and Dubey *et al.* (2008). Delay in sowing resulted in reduction of grain yield probably because of exposure of crop to high temperature which reduces length of growing duration has also been reported by Ouda *et al*. (2005). The reduction in grain yield was more for the year 2015-16 because second fortnight of March is important for wheat crop as during this period the above normal temperature caused a reduction in productivity of wheat irrespective of dates of sowing. Crop sown on 1st December reported significantly higher biological yield (9549.7 kg/ha in 2014-15 and 8998.2 kg/ha in 2015-16 respectively) than 20th December sowing (8985.8 kg/ha in 2014-15 and 8861.8 kg/ha in 2015-16 respectively), while biological yield recorded with 06th January sown crop was lower. These findings were well in confirmity with findings of Ram *et al.* (2004) and Dubey *et al.* (2008). The harvest index was more for the crop sown on 1st December during both the years (46.9 in 2014-15 and 44.7 in 2015-16).Lowest harvest index were recorded for the crop sown on 20th December during both the years (43.7 in 2014-15 and 42.89 in 2015-16).The harvest index was poor during the cropping season 2015-16 because of poor grain yield, straw yield and biological yield.

Conclusion

Different dates of sowing has significant influence on growth as well as yield characteristic of wheat. During both the year yield was found to reduce under late sown condition. More reduction was in the year 2015-16 because during the crop season 2015-16 the temperature condition were not conducive.

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