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Kiran Sahu
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Dinesh Pandey
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Geet Sharma
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Awaneet Kumar
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

NK Chaure
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Mala Singh
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Shriya Jagat
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Hemant Patel
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Corresponding Author:
Kiran Sahu
Section of Agronomy, BTC College of Agriculture and Research Station Bilaspur, Chhattisgarh, India

Performance of newly released wheat varieties under late sown irrigated conditions

Kiran Sahu, Dinesh Pandey, Geet Sharma, Awaneet Kumar, NK Chaure, Mala Singh, Shriya Jagat and Hemant Patel

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Abstract
A field experiment entitled "Performance of newly released wheat varieties under late sown irrigated conditions" was conducted during *Rabi 2024-25* at the Instructional-cum-Research Farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.). The treatment consisting of two dates of sowing as main plot *viz.*, D_1 (6th December) and D_2 (24th December) with seven genotypes as sub plots *viz.*, (V_1) CG1029 (c), (V_2) MP4010 (c), (V_3) GW556, (V_4) WSM138, (V_5) HI1634 (c), (V_6) DBW425, (V_7) HD2932 (c) were laid out in split plot design with three replications. 125 kg of seeds were used ha^{-1} for the crop, spaced 20cm apart in rows. Results revealed that growth parameters such as plant height (cm), number of tillers m^{-2}, dry matter accumulation (g plant^{-1}), crop growth rate (g plant^{-1} day^{-1}), and relative growth rate (g g^{-1} day^{-1}), as well as yield-attributing traits including ear length (cm), grains ear head^{-1}, test weight, grain yield (q ha^{-1}), straw yield (q ha^{-1}) and harvest index (%) were recorded maximum under the sowing date D_1 (6th December) and minimum value was recorded under sowing date of D_2 (24th December). Amongst the genotypes (V_1) CG1029 (c) recorded maximum for most growth and yield attributing parameters which was significantly superior over (V_4) WSM138, (V_5) HI1634 (c), (V_6) DBW425, (V_7) HD2932 (c) and (V_2) MP4010 (c) but was at par with (V_3) GW556. The genotype (V_1) CG1029 (c) recorded the highest B:C ratio (2.33), net return (76210.28 ₹ ha^{-1}) and gross return (108875.28 ₹ ha^{-1}) and while the genotype (V_5) HI1634 (c) recorded the lowest B:C ratio (1.69), net return (55351.51 ₹ ha^{-1}) and gross return (88016.51 ₹ ha^{-1}). Cost of cultivation was found in same in all treatments.

Keywords: Sowing dates, wheat, genotypes, yield, yield attributes

Introduction
Wheat (*Triticum aestivum* L.) Known as the "king of cereals," is farmed in irrigated, desert, and semi-arid regions all over the world. Originally from West Asia, this self-pollinating crop is regarded as the world's second most significant grain crop. It is a member of the poaceae family's genus "Triticum," which contains 17 species. Of these, only three are grown globally: 95% of the world's population grows bread wheat (*Triticum aestivum*), 4% grows macaroni wheat (*Triticum durum*), and 1% grows emmer wheat (Triticum dicocum). In the world most significant agricultural area is allocated to wheat with largest production quantity to any other crop (Ahmad *et al.* 2014).

In India, wheat (*Triticum aestivum* L.) has been under cultivation in 31.82 million ha annually, with a production of 113.29 million tonnes with national average productivity of 33.11 q ha^{-1} (2023-24). Wheat (*Triticum aestivum* L.) is grown on around 267.04 (000) ha of land in Chhattisgarh with a productivity of 1600 kg ha^{-1} during the year 2023-24. (Anonymous, 2023-24) [1].

Any region can sustain increased wheat (*Triticum aestivum* L.) productivity by choosing the right cultivars. Late sowing of some wheat (*Triticum aestivum* L.) types usually results in significant temperature stress, which ultimately has a negative impact on phenology, growth, and yield (Yusuf *et al.*, 2019) [12].

Over 50% of the wheat (*Triticum aestivum* L.) in Chhattisgarh is planted after the first week of December and experiences heat stress, which significantly lowers yield. Late-planted wheat (*Triticum aestivum* L.) yields significant losses, potentially as much as 40 to 50 percent. It has previously been demonstrated that heat stress significantly reduces wheat (*Triticum aestivum* L.) yield and quality.

For the best yield, it is essential to grow the right kind of plant at the right time. Selecting the right variety is crucial to maximizing yields under ideal input and management circumstances. Time commitment is a significant non-monetary factor that influences productivity. Controlling the planting season is necessary to ensure that the crop grows in the optimal climate and effectively utilizes the soil moisture stored in the profile for early growth and development. The wheat crop's growth, development, and yield are all impacted by variations in the planting date.

Materials and Methods

A field experiment entitled "Performance of newly released wheat varieties under late sown irrigated conditions" was conducted during *rabi* 2024-25 at the Instructional-cum-Research Farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.). The experimental soil was sandy clay loam with a pH of 7.2 and EC of 0.23 dS m^{-1} (0-30 cm depth), low in available nitrogen, medium in phosphorus, organic carbon, and potassium.

The recommended fertilizer dose was 90:60:40 kg $N:P_2O_5:K_2O$ ha^{-1}. the treatments nitrogen was applied in three splits *viz*., 1/3 as basal and the remaining 2/3 was top dressed equally after first and second irrigation. A uniform recommended dose of N (90 kg ha^{-1}), P2O5 (60 kg ha^{-1}) and K2O (40 kg ha^{-1}) were applied as basal in all the plots through urea, single super phosphate and muriate of potash, respectively.

Irrigation was applied immediately after sowing to facilitate germination and subsequent 5 irrigations were given during critical growth stages i.e., crown root initiation (21 DAS), late tillering (40 DAS), late jointing (60 DAS), flowering (80 DAS) and milk stage (90 DAS).

The crop in the net plot area of respective treatment was harvested manually at maturity by using sickle. After 2-3 days sun drying, the weight of total dry bundle from each net plot was recorded. After threshing, the produce was cleaned and weight of grains and straw per net plot was recorded and finally it was computed on hectare basis and expressed in q ha^{-1}.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Plant height (cm)

The results showed that, numerically, D_1 (late sown) had the maximum plant height, while D_2 (very late sown) had the lowest plant height. Amongst the varieties (V_1) CG 1029 (c) recorded the highest plant height, which was significantly superior over (V_4) WSM 138, (V_2) MP 4010 (c), (V_6) DBW 425, (V_7) HD 2932 (c) and (V_5) HI 1634 (c) but was at par with variety (V_3) GW 556. It was found that there was no significant interaction between genotypes and planting dates. A plant's height is a crucial determinant of its life. The crop in the current study benefited from late sowing treatments as opposed to very late sowing. The wheat crop was planted early, and the plot with the tallest plants at the end of the crop's life cycle had more sunlight, moisture, and nutrients available for growth, as well as less competition from weeds. Singh *et al*. (1995) also observed similar results.

Number of tillers (m^{-2})

The results showed that D_1 (late sown) had the most no. of tillers, while D_2 (very late sown) had the lowest no. of tillers. The quantity of tillers varied statistically among the seven genotypes that were the subject of the investigation. Amongst varieties (V_1) CG 1029 (c) recorded the highest no. of tillers, which was significantly superior over (V_5) HI 1634 (c), (V_2) MP 4010 (c), (V_4) WSM 138, (V_6) DBW 425 and (V_7) HD 2932 (c) but was at par with variety (V_3) GW 556. It was found that there was no significant interaction between genotypes and planting dates. The findings of Singh *et al*. (1995) and Prajapat *et al*. (2018) [10] supported these findings.

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

At every stage of growth, the total dry matter accumulation $plant^{-1}$ was greatly impacted by the different sowing dates. The plant developed in D_1 (late sown) showed the highest total dry matter accumulation $plant^{-1}$ at 30 DAS, which was noticeably better than D_2 (very late sown). Similar patterns were noted at harvest, 60, and 90 DAS. The data show that at 30 DAS, Amongst the varieties (V_1) CG1029 (c) recorded the highest dry matter accumulation which was significantly superior over (V_4) WSM 138, (V_2) MP 4010 (c), (V_6) DBW 425, (V_7) HD 2932 (c) and (V_5) HI 1634 (c) but was at par with variety (V_3) GW 556. At harvest, 60, and 90 DAS, similar patterns were seen. It was determined that the interaction between genotypes and the date of sowing was not significant These findings are consistent with the findings of Singh *et al*. (1995) and Singh *et al*. (1998).

Ear length (cm)

As per data different genotypes indicated that genotypes had significant difference in ear length. Amongst seven genotypes, maximum ear length was recorded in (V_1) CG 1029 (c), which was at par with (V_3) GW 556 and, while the minimum was recorded in genotype (V_5) HI 1634 (c). Interaction effect between sowing dates and genotypes of ear length (cm) was recorded non-significant at harvest. Similar result was reported by Prajapat *et al*. (2018) [10] on sowing dates 15th November with genotype GW 366.

Number of grains ear $head^{-1}$

The weight of grains in the $earhead^{-1}$ at crop harvest had a big impact on the sowing dates and genotypes. The crop sown on 6th December had the highest number of grains $earhead^{-1}$, while lowest number of grains $earhead^{-1}$ was recorded in plant sown on 24th December. Amongst different genotypes, maximum number of grains $earhead^{-1}$ was recorded in (V_1) CG 1029 (c), which was at par with (V_3) GW 556, while the minimum was recorded in genotype (V_5) HI 1634 (c) followed by (V_2) MP 4010 (c).

Interaction effect between sowing dates and genotypes of number of grains ear $head^{-1}$ was recorded to be non-significant. Due to the shortened growing period, there were fewer grains in $earhead^{-1}$ as compared to early sowing. These similar trend of result reported by Poonam and Uma (2015) [9] and Prajapat *et al*. (2018) [10].

Test weight (g)

The crop was grown on 6th December had the maximum test weight, while the lowest test weight was recorded under very late sown on 24th December. Amongst different genotypes (V_1) CG 1029 (c) was recorded with highest test weight, which was at par with (V_3) GW 556, while the minimum was recorded in (V_5) HI 1634 (c). Interaction effect between sowing dates and genotypes for test weight of wheat was recorded to be non-significant. The lowest seed weight with delayed sowing might be due to shorter vegetative growth period of the crop. When compared to early sowings, delayed sowings produced the

lowest test weight. Charanjeet Kaur (2017) [4] also reported similar finding.

Grain yield (q ha^{-1})

The plant developed in D_1 (late sown) produced highest grain yield, while the minimum grain yield was recorded in plant grown in D_2 (very late sown). As per data, different genotypes also indicated that genotypes had significant difference in grain yield. Amongst different genotypes, the highest grain yield (41.87 q ha^{-1}) was recorded in (V_1) CG 1029 (c) which was significantly superior over (V_4) WSM 138, (V_2) MP 4010 (c), (V_6) DBW 425, (V_7) HD 2932(c) and (V_5) HI 1634 (c) but at par with (V_3) GW 556. Interaction effect between planting dates and genotypes of grain yield was found non-significant. The wheat's appropriate use of moisture, nutrients, light, and space may be the cause of the higher grain yield under the aforementioned treatments; otherwise, the increase in yield may be attributed to the higher yield attributing characteristics, such as the number of effective tillers plant^{-1}, grain yield, and 1000 grains weight. These findings are consistent with those of Singh *et al*. (2021) [11], Chouhan *et al*. (2020), Mukherjee (2012) [6], and Kaur and Ram (2023) [5]. According to Shirpurkar *et al*., early wheat crop sowing (8 November) produced noticeably more grain than late sowing (20 December).

Straw yield (q ha^{-1})

The crop that was sown on December 6th produced the most straw, while the crop that was sown on December 24th produced the least amount. The genotype (V_1) CG 1029 (c) had the highest straw yield value (41.92 q ha^{-1}), which was at par with (V_3) GW 556 (41.15 q ha^{-1}). The genotype (V_5) HI 1634 (c) (35.24 q ha^{-1}) had the lowest straw yield value, followed by (V_2) MP 4010 (c) (36.87q ha^{-1}). The interaction between the genotypes of straw yield and the times of sowing was found to be non-significant. Higher vegetative growth, specifically increased plant height, number of tillers, and accumulation of dry matter, may be the cause of the higher straw production in the aforementioned treatments. These outcomes closely match the conclusions of Pathania *et al*. (2018) [8].

Table 1: Plant height (cm) of wheat influenced by different sowing dates and genotypes.

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
A. Sowing dates (Main-plot): 02				
D_1 - Late sowing (6th Dec)	33.65	71.33	95.96	93.67
D_2 - Very late sowing (24th Dec)	31.51	65.54	91.74	88.91
S.Em (±)	0.17	0.79	0.49	0.67
CD (5%)	1.03	4.79	3.01	4.07
B. Genotypes (Sub-plot): 07				
CG 1029 (c)	34.36	70.50	95.74	93.45
MP 4010 (c)	31.34	66.94	92.48	90.02
GW 556	33.87	69.63	95.08	92.35
WSM 138	33.23	69.10	94.73	91.75
HI 1634 (c)	30.70	66.32	91.40	89.71
DBW 425	31.89	67.92	93.38	90.47
HD 2932 (c)	32.67	68.63	94.13	91.28
S.Em (±)	0.86	1.27	1.17	1.08
CD (5%)	2.53	3.7	3.41	3.16

Table 2: Number of tillers (m^{-2}) of wheat influenced by different sowing dates and genotypes.

Treatments	Number of tillers (m^{-2})			
	30 DAS	60 DAS	90 DAS	At harvest
A. Sowing dates (Main-plot): 02				
D_1 - Late sowing (6th Dec)	180.88	273.19	282.55	280.09
D_2 - Very late sowing (24th Dec)	168.03	251.14	264.15	261.73
S.Em (±)	0.94	1.33	0.99	1.17
CD (5%)	5.75	8.10	6.03	7.14
B. Genotypes (Sub-plot): 07				
CG 1029 (c)	193.66	291.13	299.92	300.65
MP 4010 (c)	161.88	243.30	256.04	251.54
GW 556	186.86	280.85	290.55	290.26
WSM 138	178.72	268.51	279.08	277.57
HI 1634 (c)	157.09	236.07	249.47	243.95
DBW 425	167.74	252.08	264.82	260.45
HD 2932 (c)	175.22	263.21	273.56	271.94
S.Em (±)	2.02	1.77	1.11	1.17
CD (5%)	5.90	5.18	3.23	3.42

Table 3: Length of ear (cm), number of grains ear head$^{-1,}$ test weight (g), Grain yield (q ha^{-1}) and straw yield (q ha^{-1}) of wheat influenced by sowing dates and genotypes.

Treatments	Length of ear (cm)	Number of grains ear head^{-1}	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
A. Sowing dates (Main-plot): 02					
D_1 - Late sowing (6th Dec)	10.54	28.60	37.53	40.62	41.42
D_2 - Very late sowing (24th Dec)	8.76	25.56	35.58	35.21	36.73
S.Em (±)	0.14	0.31	0.10	0.44	0.55
CD (5%)	0.83	1.88	0.63	2.68	3.35
B. Genotypes (Sub-plot): 07					
CG 1029 (c)	10.73	29.95	38.19	41.88	41.92
MP 4010 (c)	9.05	25.34	35.36	35.53	36.87
GW 556	10.30	28.83	37.49	40.47	41.15
WSM 138	9.85	27.76	37.00	38.60	40.21
HI 1634 (c)	8.83	24.16	34.92	33.40	35.24
DBW 425	9.25	26.38	36.23	36.86	38.22
HD 2932 (c)	9.52	27.14	36.69	38.07	39.93
S.Em (±)	0.30	0.88	0.45	1.12	1.08
CD (5%)	0.88	2.57	1.31	3.27	3.14

Table 4: Dry matter accumulation (g plant^{-1}) of wheat influenced by different sowing dates and genotypes.

Treatments	Dry matter accumulation			
	30 DAS	60 DAS	90 DAS	At harvest
A. Sowing dates (Main-plot): 02				
D_1 - Late sowing (6th Dec)	0.71	7.67	20.34	25.72
D_2 - Very late sowing (24th Dec)	0.57	6.16	16.84	21.29
S.Em (±)	0.01	0.12	0.26	0.32
CD (5%)	0.04	0.73	1.56	1.96
B. Genotypes (Sub-plot): 07				
CG 1029 (c)	0.70	7.64	20.54	25.97
MP 4010 (c)	0.60	6.48	17.42	22.03
GW 556	0.68	7.38	19.84	25.09
WSM 138	0.65	7.04	18.93	23.93
HI 1634 (c)	0.57	6.20	16.67	21.08
DBW 425	0.62	6.72	18.08	22.85
HD 2932 (c)	0.64	6.94	18.67	23.60
S.Em (±)	0.02	0.33	0.28	0.29
CD (5%)	0.06	0.98	0.81	0.85

Table 5: Sowing dates and genotypes on economics of wheat (*Triticum aestivum* L.) cultivation.

Treatments	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C Ratio
A. Sowing dates (Main-plot): 02				
D_1 - Late sowing (6th Dec)	32665	105321.15	72656.15	2.22
D_2 - Very late sowing (24th Dec)	32665	91414.82	58749.82	1.80
B. Genotypes (Sub-plot): 07				
CG 1029 (c)	32665	108875.28	76210.28	2.33
MP 4010 (c)	32665	92010.99	59345.99	1.82
GW 556	32665	105141.52	72476.52	2.22
WSM 138	32665	100335.50	67670.50	2.07
HI 1634 (c)	32665	88016.51	55351.51	1.69
DBW 425	32665	95456.47	62791.47	1.92
HD 2932 (c)	32665	98740.34	66075.34	2.02

Conclusion

The findings of the current study allow for the important deduction of the following conclusion:

The research concludes that the optimal time to plant wheat for increased yield and financial gain was on December 6th and the suitable variety was CG 1029 (c). In terms of crop growth metrics, yields, and economic returns, (V_1) CG 1029 (c) superior to the other genotypes, which was at par with (V_3) GW 556. The highest gross, net return, and B:C ratio were noted under D_1 (sowing date) and were also discovered under the (V_1) CG 1029 (c) genotype.

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