

Effect of Sowing Time and Seed Rate on Productivity and Quality of Wheat (*Triticum aestivum* L.) Under Late Sown Conditions

Avik Banerjee, Satyajeet, R. K. Nanwal

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Abstract An experiment was conducted during 2013-14 to study the effect of sowing time and seed rate on productivity and quality of wheat (*Triticum aestivum* L.) under late sown conditions. The results indicated that among different sowing times, sowing at 2nd December in wheat recorded maximum grain yield (53.03 q/ha), which was statistically significant than all other treatments. Significantly highest grain yield (56.87 q/ha) was recorded with 137.5 kg/ha seed rate under sowing date of 2nd December. Crop sown at 2nd January produced highest protein and gluten content in grain which was at par with value obtained from 23rd December sowing. Different levels of seed rate failed to influence the quality characters.

Keywords Wheat, Sowing time, Seed rate, Productivity, Quality.

Introduction

Wheat (*Triticum aestivum* L.) is a major cereal crop, which plays an important role in food and nutritional security. It shares upto 40% of total food grain production of the country. In India, total area under wheat is 29.5 mha, with production of 93.62 mt and the productivity 3.1 t/ha [1]. Normally wheat grain contains 60–68% carbohydrates, 8–15% protein, 1.5–2% fat, 2–2.5% cellulose and 1.5–2% minerals. It also contain high amount of vitamins like niacine and thiamine. Wheat is staple food which is eaten in the forms of chapattis, upmas and puris.

Various other items like biscuit, cakes, flakes, leavened breads, are made from wheat. Traditional Indian dishes like Dalia, Halwa are also made from wheat. Wheat straw is a good source of feed for a large population of cattle in our country.

Generally sowing of wheat get delayed in Haryana due to late harvesting of cotton, rice or unprecedented incessant rain in December and thus the rice fields do not come to optimum moisture condition before mid-January. The delayed sowing further cause supra-optimal thermal stress at reproductive phase which results in forced maturity [2]. Time of sowing is major agronomic practice in wheat contributing towards its productivity. Under late sown condition wheat may be sown up to 15th December in Haryana. After that there is drastic reduction in yield despite of best management practices [3]. Seed rate is

A. Banerjee*, Satyajeet, R.K. Nanwal
Department of Agronomy,
CCS Haryana Agricultural University,
Hisar 125004, India
e-mail : avikagro91@gmail.com
*Correspondence

Table 1. Effect of sowing time and seed rate on growth and yield attributing characters of wheat.

Treat- ments	Plant height at harvest (cm)	Plant row length at 15 DAS	Dry matter popu- lation/ lulation		Effec- tive tiller (per mt. row length)	Ear- head length (cm)	Spike- lets/ earhead
			accumu- lation (g/mt row length)	ation (g/mt row length)			
Sowing time							
2 nd Dec	83.29	27.83	363.11	97.92	9.60	18.08	
9 th Dec	79.95	27.42	343.15	90.75	9.35	17.42	
16 th Dec	73.02	16.50	245.86	83.42	8.56	15.33	
23 rd Dec	65.41	14.33	184.08	77.17	8.03	14.17	
2 nd Jan	59.33	14	170.83	71.75	7.55	11.92	
SEm±	1.03	0.53	6.23	1.51	0.08	0.43	
CD at 5%	3.43	1.74	20.64	5.01	0.26	1.41	
Seed rate							
100 kg/ha	74.72	17.27	221.51	78.93	8.58	15.33	
112.5 kg/ha	74.89	18.05	223.25	81.33	8.47	15.53	
125 kg/ha	72.32	21.07	256.06	86.73	8.58	15.60	
137.5 kg/ha	72.81	23.60	265.29	89.80	8.63	15.07	
SEm±	1.06	0.23	2.89	0.93	0.07	0.58	
CD at 5%	NS	0.78	10.21	3.28	NS	NS	

also a major agronomic practice in wheat cultivation. Under normal sown condition 100 kg per hectare seed is needed [3]. Recommended row spacing limits the yield under late sown condition. Under such condition there is need to explore possibilities of increasing plant population per unit area for obtaining higher yields. To obtain higher yield potential of wheat under late-sown condition, higher seed rate is another important factor, which compensates the low tillering in wheat because of low temperature prevailing in December and January. Present study was, therefore, undertaken to assess the optimum sowing time and find the possibility of seed rate to compensate late sowing.

Materials and Methods

The experiment was conducted during 2013-14 at farm of Krishi Vigyan Kendra Fatehabad, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana (India). Fatehabad has semi-arid climate with

Table 2. Effect of sowing time and seed rate on yield and harvest index of wheat

Treatments	Grain yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
Sowing time			
2 nd Dec	53.03	111.83	47.42
9 th Dec	49.75	108.38	45.90
16 th Dec	43.16	101.46	42.54
23 rd Dec	38.33	100.73	38.05
2 nd Jan	36.28	99.21	36.57
SEm±	0.27	0.68	0.9
CD at 5%	1.01	2.22	3.01
Seed rate			
100 kg/ha	41.29	97.89	42.18
112.5 kg/ha	43.26	102.41	42.24
125 kg/ha	45.95	109.81	42.23
137.5 kg/ha	46.92	110.89	42.31
SEm±	0.28	0.32	0.06
CD at 5%	1.03	1.09	NS

severe cold during winter and hot dry and desiccating winds during summer. Weekly maximum and minimum temperature ranges were 17.0–35.5°C and 1.0–18.7°C, respectively. During the crop period, total amount of rainfall was 25.4 mm. The weekly mean wind velocity range for the crop season was 1.4–7.5 km per hour with almost increasing magnitude with the advancement of the crop season. The weekly mean sunshine hour range for the crop season was 1.7–9.3 h per day, evaporative demand was highest during April with 5.4 mm per day; whereas the lowest open pan evaporation was recorded during January with 1.2 mm per day.

The texture of the surface soil of the experimental field was sandy loam, containing 56.4% sand, 20.8% silt and 22.8% clay. The basic infiltration rate was 4.6 mm/h. It contained 20.1 and 7.3% moisture, on weight basis, at -0.03 and -1.5 M Pa, respectively. Available soil moisture in 0–90 cm soil layer was 15 cm. It was neutral (pH 7.4) in nature. The organic carbon content was 0.38% in the upper layer and decreased sharply to lower layers. Soil was low in available N (180 kg/ha), medium in available P (7.25 kg/ha) and high in available K (183 kg/ha).

The experiment was laid out in strip plot design

Table 3. Interaction effect of sowing time and seed rate in wheat.

Sowing time	Seed rate			
	100 kg/ha	112.5 kg/ha	125 kg/ha	137.5 kg/ha
2 nd Dec	49.4	52.13	53.7	56.87
9 th Dec	47	49.37	50.73	51.8
16 th Dec	40.63	42.43	44.03	45.53
23 rd Dec	35.37	36.9	39.53	41.53
2 nd Jan	34.03	35.47	36.87	38.77
SEm±		0.22		
(sowing time × seed rate)				
CD at 5%		0.64		

with 1st treatment having 5 levels and 2nd treatment having 4 levels and they were replicated thrice. The treatment-1 is date of sowing (D₁-2nd December; D₂-9th December; D₃-16th December; D₄-23rd December; D₅-2nd January). Treatment-2 is seed rates (S₁-100 kg/ha; S₂-112.5 kg/ha; S₃-125 kg/ha; S₄-137.5 kg/ha). Recommended levels of nitrogen, phosphorus and zinc sulfate (150:60:25 kg N, P₂O₅ and Zn SO₄ per ha) were applied as per standard package of procedure. Wheat variety WH 1021 was sown with seed rate as per treatment-1 and on sowing dates as per treatment-2. Four irrigation were applied to the crop. Recommended package of practices were followed for other production and protection operations. Quality studies i.e. hectoliter weight, sedimentation value, protein content and gluten content were analyzed by standard procedures.

Results and Discussion

Growth studies

The plant height increased with the advancement of crop growth up to harvest (Table 1). At maturity, shortest plants were recorded under 2nd January sowing and tallest plants under 2nd December sowing time. Similar results were reported earlier [4]. The plant height remained non-significant with progressive increase in seed rate observed at harvest. Similar results were reported earlier [5] who stated that increase in the seeding rate resulted in a non-significant increment in the height of the plants. The plant population/meter row length recorded at 15 DAS affected

Table 4. Effect of sowing time and seed rate on quality characters of wheat.

Treatments	Hectoliter weight (g)	Sedimentation value	Protein content (%)	Gluten content (%)
Sowing time				
2 nd Dec	83.75	28.73	11.43	29.03
9 th Dec	83.46	28.78	11.41	28.94
16 th Dec	83.39	28.57	11.69	29.46
23 rd Dec	83.46	28.39	11.92	30.25
2 nd Jan	83.42	28.60	11.87	30.26
SEm±	0.16	0.18	0.08	0.08
CD at 5%	NS	NS	0.25	0.27
Seed rate				
100 kg/ha	83.48	28.45	11.69	29.55
112.5 kg/ha	83.37	28.51	11.62	29.62
125 kg/ha	83.49	28.65	11.67	29.54
137.5 kg/ha	83.49	28.83	11.68	29.65
SEm±	0.14	0.13	0.08	0.23
CD at 5%	NS	NS	NS	NS

significantly due to different sowing times and seed rates. During observation it was found that highest number of plant population takes place under sowing at 2nd December among the sowing time treatments. Similar results were reported earlier [6]. Among the seed rates, significantly higher number of plant population were recorded under 137.5 kg/ha seed rate. It was supported by Sadeghipour [7] who stated that by increasing seed rate delayed sowing could be ameliorated by increasing germination count/m². Dry matter is the important growth parameters of the crop which is to be considered while assessing the effect of different treatments and competitive ability of the crop with nutrients. Among different sowing times, sowing of wheat at 2nd December recorded significantly higher dry matter accumulation at harvest, it was at par with sowing at 9th December and it was followed by sowing at 16th December and 23rd December. Lowest dry matter accumulation was recorded under 2nd January sowing. Similar results were reported earlier [8]. Increased seed rate resulted in increase in dry matter accumulation. With the successive increase in seed rate from 100 kg/ha to 112.5 kg/ha there was no significant increase in dry matter accumulation at harvest, while seed rate from 112.5 kg/ha to 125 kg/ha, there was significant increase in dry matter accumulation at harvest. While there is no significant in-

crease in dry matter accumulation with increase in seed rate from 125 kg/ha to 137.5 kg/ha. Ahamed et al. [8] also reported that increase in seed rate from 100 to 150 kg/ha enhanced the dry matter production of wheat by 10.4 and 16.9% at 60 DAS and 3.7 and 7.7% at 90 DAS.

Among various yield attributing characters, 2nd December sowing in wheat recorded significantly higher number of effective tillers per meter row length followed by sowing at 9th December and 16th December. Significantly, lowest effective tillers per meter row length were recorded under sowing at 2nd January. It is also revealed that earhead length of crop sown at 2nd December was significantly higher (9.6 cm) which was at par with crop sown at 9th December. Sowing at 2nd January resulted lowest earhead length which was significantly lower than all other treatment. Significantly higher number of spikelets per earhead (18.08) was recorded in crop sown at 2nd December. However, number of spikelets per earhead was found statistically at par in crop sown at 9th December. Crop sown at 2nd January produced significantly less number of spikelets per earhead than other sowing times. Similar results were also reported by Tomar et al. [4]. Increase in seed rate showed remarkable effect in increasing effective tillers/meter row length. The significantly higher value of effective tillers was found under 137.5 kg/ha seed rate which was at par with 125 kg/ha seed rate and significantly lower value was recorded under 100 kg/ha seed rate. The length of earheads and number of spikelets per earhead did not improved significantly with increasing seed rate from 100 kg/ha to 137.5 kg/ha. Similar results were reported by Nizamani et al. [9].

Yield studies

Grain yield of wheat, as influenced by different sowing time and seed rate data revealed that among different sowing times, sowing at 2nd December in wheat recorded maximum grain yield (53.03 q/ha), which was statistically significant than all other treatments (Table 2). The increase in yield at 2nd December sowing was found to the tune of 6.6, 22.9, 38.4 and 46.2% higher over sowing at 9th December, 16th December, 23rd December and 2nd January. The pattern of increase in biological yield with successive levels of sowing time

was found similar to the pattern of increase in grain yield with successive levels of sowing time. Tomar et al. [4] showed that early sowing (14th November) gave 12.80% higher grain yield in comparison to that of 21th November date of sowing. The delayed sowing (8th December) reduced the grain yield (38.19 q/ha) which was 19.30% lower than that of 14 November date of sowing. Similar findings were reported by Ram et al. [2]. With each successive level of seed rate from 100 kg/ha to 137.5 kg/ha recorded higher grain yield. Among different seed rate, grain yield was found highest with application of 137.5 kg/ha seed which was at par with 125 kg/ha seed application. Application of 137.5 kg/ha seed was found to produce 13.6 and 8.5% higher grain yield over 100 kg/ha and 112.5 kg/ha seed rate, respectively. The pattern of increase in biological yield with successive levels of seed rate was found similar to the pattern of increase in grain yield with successive levels of seed rate. Similar findings were also reported by Ram et al. [2]. The data showed that significantly higher value of harvest index (47.42) was recorded in crop sown at 2nd December. However, it was found statistically at par in crop sown at 9th December. Crop sown at 2nd January produced significantly less value of harvest index than other sowing times. The value of harvest index did not improve significantly with increasing seed rate from 100 kg/ha to 137.5 kg/ha. The results corroborate the findings of Alam et al. [10].

Interaction studies

The interaction effect of different sowing time and seed rate on grain yield of wheat was found significant (Table 3). The data on grain yield revealed that all the five sowing times brought about significant increase in the grain yield. Under same level of seed rate, grain yield was found highest at 2nd December sowing. Grain yield was found to increase significantly in sowing at 9th December compared to 16th December, 23rd December and 2nd January sowing. Significantly higher grain yield (56.87 q/ha) was recorded with 137.5 kg/ha seed rate under sowing date of 2nd December. Similar results were reported earlier [6].

Quality studies

The different sowing time and seed rates failed to

produce significant difference in hectoliter weight and sedimentation value in wheat grain (Table 4). Different sowing time produced significant difference in protein content in wheat grain. Crop sown at 2nd January produced highest protein content in grain which was at par with value obtained from 23rd December sowing. Lowest value of protein content in grain obtained from crop sown at 2nd December. The different seed rates failed to produce significant difference in protein content in wheat grain. Different sowing time produced significant difference in gluten content in wheat grain. Crop sown at 2nd January produced highest gluten content in grain which was at par with value obtained from 23rd December sowing. Lowest value of gluten content in grain obtained from crop sown at 2nd December. The different seed rates failed to produce significant difference in gluten content in wheat grain. It is also supported by the findings of Eslami et al. [11].

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