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COMPARATIVE STUDIES ON WHEAT (*Triticum aestivum* L.) VARIETIES AND DATE OF SOWING UNDER LATE SOWN CONDITIONS

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ABSTRACT

A field experiment was conducted at the Students Instructional Farm of C. S. Azad University of Agriculture and Technology, Kanpur-208002 (U.P.) during Rabi 2011-2012 and 2012-2013 to the see response of wheat varieties and date of sowing under late sown conditions. Results revealed that the date of sowing of 15 December gave significantly higher growth attribute viz., plant height, fresh weight, dry weight, number of tillers/m^2, productive tillers/m^2 and unproductive tillers/m^2 over rest sowing dates during both the year except plant population and second year unproductive tillers/m^2. The highest all observed yield attributes, yields viz. seed yield of 49.23 and 45.75 q/ha and straw yield of 64.11 and 58.33q/ha; maximum economics viz. net return of Rs. 50588 and Rs. 60862/ha and B:C ratio of 1.62 and 1.75 were obtained with 15 December sowing over delayed sowing dates of 25 December (Rs. 37874 and Rs.54622/ha and B:C ratio of 1.19 and 1.57) and 05 January (Rs. 29151 and Rs.46725 and B:C ratio of 0.92 and 1.34. The response of Unnat Halna were found significant in respect of tillers/m^2 and productive tillers/m^2 at maturity stage of crop over rest varieties of wheat during both year, respectively. The variety of Unnat Halna gave significantly higher all yield attributes and yields viz. grain yield (47.98 and 47.98 q/ha), straw yield (59.73 and 59.24q/ha), economics viz. net return of Rs. 46226 and Rs.62022/ha and B: C, ratio of 1.50 and 1.78 than Mandakini (K-9351), Naina (K-9533) and Halna (K-7903) varieties during both the year under late sown conditions, respectively.

Keywords: Wheat, late sown, date of sowing, comparative study

Linnaeus in 1753 first classified wheat. Wheat (*Triticum aestivum* L.) is one of the most important food grain crops in the world. In our country, it is placed just after rice in terms of production and consumption. It is the most important staple food of about two billion people (36% of the world population). It is consumed mostly in the form of bread as “chapati”. Wheat straw is used for feeding the cattle. Wheat grain contains more protein (12%) than other cereals and has a relatively high content of niacin and thiamine. It is basically concerned in providing the characteristics substance “glutin” which is very essential for bakers. Based on the present rate of population growth of 1.5 per cent and per capita consumption of 180g of wheat per day in the country, the demand for wheat is expected to be around 109 million tons by 2020. Under specific circumstances wheat is sown in the month of December too. In late sown wheat, only short duration varieties should be sown because there is comparatively less reduction in their yields compared to long duration varieties. In spite of the development of the best production technology, late sowing usually results in a poor stand as well as the inadequate vegetative growth of the crop. The reproductive development in late sown wheat is also poor on account of the quick rise of ambient temperature towards the maturity stage. In view of this, the present investigation has been made to assess the wheat varieties in relation to different date of sowing under late sown conditions.

MATERIALS AND METHODS

The present investigation was conducted at Students Instructional Farm (SIF) at C.S. Azad University of Agriculture and technology, Kanpur (U.P.) during two consecutive *Rabi* seasons of 2011-12 and 2012-13. Geographically, Kanpur is situated in the central part of U.P. and subtropical tract of North India. The seasonal rainfall of about 816 mm received mostly from IInd Fortnight of June or first Fortnight of July to mid October with a few showers in winter season. The soil of the experimental field was well levelled, sandy loam in texture with pH of 7.5 and E.C. of 0.25mm/ha/cm at 25°C. It contained 0.5%, organic carbon, 170kg available N/ha, 17.8kg/ha available phosphorus and 165kg/ha available potassium. The trial was conducted with 3 dates of sowing viz. Ist (15 Dec.), IInd (25 Dec.) and IIIrd (5 Jan.) and with 4 varieties of wheat viz. Ist (Mandakini or K-9351), IInd (Naina or K-9533), IIIrd (Unnat Halna or K-9423) and IVth (Halna or K-7903) The experiment was laid out in a “Split Plot Design” with three replications. In which dates of sowing in main plot and varieties were allocated in sub plots. Crop was fertilized uniformly at a rate of 120 kg N+60 kg P_2O_5+40 kg K_2O. Sowing was done by hand

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behind the country plough with uniform seed rate of 100 kg/ha in normal sowing dates and 25 % excess seeds in late sowing. Seed of wheat variety was sown at row spacing of 20cm. The crop was harvested at field maturity according to sowing dates starting from 17, 24 and 29 April 2012 and 2013. The observations were recorded on growth characters, yield attributes and yields of crop. Economics of treatments was also worked out on the basis of market process of different inputs and crop produce.

RESULTS AND DISCUSSION

Growth Attributes

Effect of sowing date

The data indicated in Table-1 that the plant population/m^2 was also significantly higher in 25th December of sowing in first year and the economically maximum in 25th December in second year of experiment and the minimum number of plant population was recorded in 15th December and 05th January respectively during both the year. Significantly highest plant height was measured in 15th December sowing than others date of sowing at 25th December and 05th January, respectively during both the year. The fresh weight/ plant and dry weight/ plant significantly affected were recorded in 15th December sowing than 25th December and 05th January sowing of wheat, respectively during both the year. The lowest fresh weight and dry weight was recorded in 05th January sowing in first and second year experiment trial respectively. The date of sowing of 15th December gave significantly higher total number of tillers/m^2 and productive tillers/m2 than 25thDecember and 05th January date of sowing in both field trial of study, while the minimum total number of tillers/m^2 and number of effective tillers/m^2 was recorded in 05th Jan. sowing date during both the year, respectively. The unproductive tillers/m^2 showed significantly higher due to delayed sowing of 25 December and 05 January in first and second year field trial, respectively. On an average it gave 1.76 and 3.70cm, 2.32 and 3.58g, 1.28 and 2.43g, 46.41 and 87.70m^2 and 46.90 and 84.79/m^2 higher plant height, Fresh weight, dry weight, total number of tillers/m^2 and productive tillers/m^2 than delayed sowing of 25 December and 05January during both the year, respectively. It was also reported by Kumar *et al*. (2010) that in the delayed sowing, the growth attributing characters were significantly reduced.

Effect of varieties

Data presented in Table-1 showed that the significant difference was not observed among different wheat varieties, whereas, K-7903, variety gave more plant population/m^2 than used other varieties of wheat in both field experimentation of study. The plant height was significantly higher in Unnat Halna variety of wheat while, numerically at par in Halna (K-7903) variety over K-9351 (Mandakini) and K-9533 (Naina), respectively in second year only. Fresh and dry weight/plant was significantly recorded in Unnat Halna variety of wheat in second year field experimentation of study whereas, in first year significantly response was not observed among used of wheat varieties. The minimum fresh and dry weight/plant was noted in Mandakini (K-9351) during both the year. The use of Unnat Halna (K-9423) variety of wheat enhanced significantly the tillers/m^2 and effective tillers/m^2 over Naina (K-9533), Mandakini (K-9351) and Halna (K-7903) during both the year, respectively. The lowest tillers/m^2 and productive tillers/m2 was recorded in Halna (K-7903) in first and second year experimentation trial of study.

The wheat variety was showed significantly more with Unnat Halna (K-9423) over used other varieties of Naina (K-9533), Mandakini (K-9351) and Halna (K-7903), respectively in first year except second year experimentation trail but numerically the highest numbers of unproductive tillers/m^{2}was observed in Naina (K-9523) followed by Halna (K-7903), Mandakini (K-9351) and Unnat Halna (K-9423) variety of wheat in second year trial of study. While, Pal *et al.* (2010) reported that the cultivars U.P. - 2003 being at par with PBW- 343 and UP-2383 recorded significantly higher LAI than all other cultivars.

Yield Attributes

Effect of sowing date

The data revealed (Table-2) that the length of spike (ear) at 15 th December sowing was significantly more than 25th December and 05th January sowing, respectively during both the year. The number of spikelet/ ear at 15th December sowing was significantly higher than late sowing date of 25th December and 05th January, respectively in first and second year experimentation trail of the study. **S**ignificantly highest number of grains per ear was counted in 15th December sowing over all other dates of sowing during both the year. It is also clear from the data that number of grains/ ear were reduced in each dates of sowing very firstly on each delay of sowing by margin of 1.05 (1.88%) and 3.16 grains (5.97%) and 2.39 (4.37%) 2.62 grains

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(5.21%) over dates of sowing on 25th December and 05th January, respectively during both the year. This may be due to the better establishment of plants under first date as compared to remaining two dates of sowing and reason behind unfavorable weather condition which restrict pollination and grain formation under very delayed sowing. The results were confirmed by Dhiman (2012) and Kumar *et al.* (2010).

The similar trend was also on weight/ ear, grains weight/ ear and test weight showed significant variation due to date of sowing. The date of sowing of 15th December gave significantly higher ear weight, grains weight and test weight than late sowing times of 25th December and 05th January during both the year, respectively. Therefore, on an average reduction was observed in each delay of sowing dates from 15th December by a margin of 0.22g (7.53%) and 0.29g (10.18%) in respect of weight/ ear, 0.15g (6.30%) and 0.24g (10.48%) in respect of grains weight/ ear and 1.03g (2.56%) and 2.26g (5.80%) in respect of test weight 25th December and 05th January sowing time in first and second year, respectively. Since the plants had larger vegetative growth an account of better root development and congenial moisture situations the seed size must have been increased due to more carbohydrate, synthesis etc., under first date, poor test weight of wheat under delayed of sowing may be due to poor development of grains mainly such as hot winds and forced maturity. The similar findings were also reported by Singh *et al.* (2008) and Pahwa and Gill (2010).

Effect of varieties

Data vividly showed in Table-2 that Unnat Halna (K-9423) produced significantly lengthier spike over Naina (K-9533), Halna (K-7903) and Mandakini (K-9351) use of wheat varieties during both the year, respectively. Varieties showed that highest spikelet/ ear was recorded in Unnat Halna (K-9423), which is significantly more over other used varieties of Halna (K-7903),Naina (K-9533),Mandakini (K-9351). The minimum spikelets/ear was observed in Mandakini (K-9351) in first and second year experimentation of study, respectively.

The number of grains/ear was showed significant variation due to wheat varieties. The variety of Unnat Halna (K-9423) gave significantly higher grains per ear than Halna (K-7903) Naina (K-9533), and Mandakini (K-9351) varieties of wheat, during both the year, respectively. It is also clear from mean basis data that grains/ear was increased in Unnat Halna (K-9423) by a margin of 8.38 (16.47%), 5.20 (9.61%) and 5.91grains (11.06%) over Halna, Naina and Mandakini variety of wheat, respectively. The that Unnat Halna (K-9423) variety of wheat increased the ear weight and grain weight/ ear and test weight significantly over rest varieties of Halna (K-7903), Naina (K-9533) and Mandakini (K-9351) during both the year, respectively. While in Naina (K -9533) and Halna (K-7903) it was at par to each others in first year only. The varietal variations in wheat in respect to different yield attributes have also been reported by Pal *et al*. (2010).

Yield and Economics

Effect of sowing date

It is clear from Table-3 that the biological yield as influenced by dates of sowing of 15th December (104.75 q/ha) was produced significantly more than each delay in sowing dates of 25th December and 05th January during both the year, respectively. The reduction in biomass production was started after each delay of sowing dates but the maximum reduction was observed in 05th January (30.38 and 13.58q/ha) sowing while, minimum reduction in biomass production was observed in 25th December (17.80 and 7.19 q/ha) in first and second year experimentation trial of study. The grain and straw yield was significantly higher at 15th December than delay in sowing on 25th December and 05th January during both the year, respectively.

The significantly highest grain yield (49.23 and 45.75q/ha) was obtained at 15th December sowing which was higher by a margin of 6.92q/ha (16.36%) and 2.19q/ha (6.79%) and 12.62q/ha (34.47%) and 5.37q/ha (13.29%) as compare to 25th December and 05th January sowing in first and second year of study, respectively. The significant increase in straw yield of wheat in 15th December sowing as compared to other date of sowing by a margin of 10.88q/ha (20.44%) and 17.44q/ha (37.37%) in first year and 4.28q/ha (7.92%) and 8.21q/ha (16.38%)in second at 25th December and 05th January sowing, respectively. Here the significant differences was not observed among different sowing dates, though numerically 15th December sowing gave lower harvest index (%) than other sowing dates in first and second year of study. It may be attributed to more plant height, higher fresh and dry weight and higher productive tillers of experimentation as result of which and also because of higher test weight there had been considerable increase in biological, grain and yields.

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These results are in accordance to those of Ghose and Patra (2004) and Singh *et al.* (2008).

The gross income of varying dates of sowing was influenced significantly. The highest gross income was calculated in 15th December sowing (Rs. 82545/ha and Rs.95712/ha) while, minimum gross income (Rs. 61095/ha and Rs.81553/ha) was received in 05th January sowing during both the year, respectively. Gross income in 15 December sowing was higher by a margin of Rs. 1271/ha (18.21%) and Rs.6240/ha (6.97%) and Rs. 21450/ha (35.11%) and Rs.14159/ha (17.36%) compare to 25th December and 05th January sowing during both the year, respectively. The significantly highest net profit was obtained in 15th December (Rs.50588/ha and Rs.60862/ha) sowing over sowing of 25th December (Rs.37874 and Rs.54621/ha) and 05th January (Rs.29151/ha and Rs.46725/ha) in first and second year of experimentation trail, respectively. The net return in 15th December sowing was more by a margin of Rs.12714/ha (33.57%) and Rs. 21437/ha (73.54%) in first year and Rs.4241/ha (11.42%) and Rs. 14137/ha (30.26%) in second year of study over delay sowing of 25th December and 05th January, respectively. The benefit cost ratio significantly increased under 15th December over 25th December and 05th January sowing during both the year, respectively. The reduction in return per rupee was started after each delay of sowing dates. The maximum return per rupee was received in 15th December sowing of 16.2 and 1.75 and minimum return per rupee of ratio 0.92 and 1.34 was received in 05th January sowing of wheat crop in first and second year, respectively. Under late sown conditions, first sowing date proved to be the optimum as it produced higher total biomass and thereafter economics as gross and net income and return per rupee than delayed sowing. The results were supported by Dhiman, (2012).

Effect of varieties

The data given in Table- 3 revealed that the significant response to use of varieties was observed at Unnat Halna (K- 9423) in respect of biological, grain and straw yield in study of both the year. The variety Unnat Halna gave significantly higher biomass than Naina (K-9533), Halna (K-7903) and Mandakini (K-9351), varieties of wheat during both the year, respectively. It is also clear from the data that biomass was increased in Unnat Halna by a margin of 14.93q/ha (16.29%), 8.00q/ha (8.11%) and 14.28q/ha (15.47%) in first year and 16.97q/ha (18.78%), 7.95q/ha (8.00%) and 15.80q/ha (17.26%) in second year experimentation trial over Mandakini, Nain and Halna varieties, respectively. It is clear from the results that grain and straw yield was significantly increased in Unnat Halna (K-9423) which was more than other all used varieties of wheat as Mandakini (K-9351), Naina (K-9533) and Halna (K-7903). The significantly more grain yield in Unnat Halna variety was by a margin of 8.16q/ha (20.49%), 6.12q/ha (14.62%) and 6.26q/ha (15.01%) in first year and 7.78q/ha (19.35%), 5.85 q/ha (13.88%) and 6.40q/ha (15.39%) in second year field trail over Mandakini, Naina and Halna, respectively. The variety of Unnat Halna (59.73 and 59.24q/ha) gave significantly more straw yield than Mandakini (51.85 and 50.15q/ha), Naina (56.11 and 57.24q/ha) and Halna (50.59 and 49.94q/ha) varieties of wheat during both the year, respectively but Unnat Halna and Naina variety of wheat statistically at par to each other in first year only. The response to applied varieties was confined to Halna (K-7903) which was significantly more than other varieties in respect of harvest index but statistically at par Halna & Unnat Halana and Naina & Mandakini to each other in first year and Halna, Unnat Halna and Mandakini variety of wheat in second year of experimentation trial.

The variety of Unnat Halna gave significantly higher gross income, net income and return per rupee than rest variety of Mandakini, Naina and Halna. The minimum gross income (Rs.66793/ha and Rs.81355/ha) and net return per rupee of Rs.34830 and Rs.46504/ha was achieved in Mandakini variety in both the year, respectively. The net return (Rs/ha) in Unnat Halna was higher by a margin of Rs.11396/ha (32.72%), 7496/ha (19.35%) and Rs.9197/ha (24.84%) in first year and Rs.15518/ha (33.37%) and Rs.5936/ha (10.58%) Rs.10357/ha (20.05%) in second year over Mandakini (K-9351), Naina (K-9533) and Halna (K-7903) varieties of wheat, respectively. The significant response was noted with Unnat Halna which gave significantly more return (1.50 and 1.75) per rupee in comparison to other rest varieties of wheat during both the year, respectively. The minimum return per rupee was recorded in Mandakini (K-9351) of 1.09 and 1.33 during both the year under late sown condition. Under the varietal effect the higher biological, grain and straw yield and thereafter resulted higher gross income, net income, B:C ratio were recorded significantly superior over remaining wheat varieties under late sown conditions. Since the grain weight/ear, test weight and number of grains/ear were maximum under the variety of Unnat Halna, the ultimate result i.e. yield and economic are

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Table-1: Effect of Treatments on Initial plant population, Plant height (cm), Fresh weight/ plant (g), Dry weight/ plant (g), Number of tillers/m^2, Productive tillers/m^2 and Unproductive tillers/m^2 under late sown condition

Treatments	Plant Population		Plant Height (cm)		Fresh Weight (g)		Dry Weight (g)		Total Number of Tillers/m^2		Productive Tillers/m^2		Unproductive Tillers/m^2	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Date of sowing														
15th December	121.29	119.67	82.43	83.40	21.74	24.58	19.71	22.42	428.43	389.33	385.85	363.83	31.26	25.40
25th December	124.20	120.42	80.81	81.51	19.73	21.94	18.70	20.87	348.24	376.69	306.52	349.36	41.72	27.33
05th January	120.36	119.61	79.15	79.29	18.26	20.89	17.14	20.13	284.72	357.64	250.51	329.59	42.58	28.05
S.E. (d)	1.725	1.540	0.529	1.000	0.235	0.450	0.249	0.357	17.402	7.500	13.384	7.500	0.976	0.400
C.D. at 5%	0.625	N.S.	1.461	2.761	0.648	1.243	0.686	0.984	8.042	20.706	36.951	20.706	2.694	1.103
Varieties														
Mandakini (K-9351)	122.36	119.44	77.98	78.21	18.89	20.47	17.41	19.44	322.01	362.40	287.30	335.62	30.78	26.78
Naina (K-9533)	121.24	119.00	80.92	80.50	19.68	23.12	18.29	21.65	346.12	364.23	305.72	336.65	40.40	27.57
Unnat Halna (K-9423)	121.61	119.67	81.88	83.88	25.35	23.43	19.00	22.70	403.61	404.13	357.21	377.64	46.40	26.38
Halna (K-7903)	122.60	121.48	82.40	83.01	20.72	22.87	19.35	20.75	393.94	367.43	306.94	340.47	36.75	26.97
S.E. (d)	1.057	2.626	1.779	1.687	0.737	0.801	0.767	0.631	20.629	12.426	15.821	12.951	1.902	0.709
C.D. at 5%	N.S.	N.S.	N.S.	3.545	N.S.	1.683	N.S.	1.325	43.348	26.112	33.245	27.214	3.997	N.S.

Table-2: Effect of Treatments on Length of ear, Spikelet/ ear, Grains/ ear, Ear of weight, Grain weight and Test weight under late sown condition

Treatments	Length of ear		Spikelet/ear		Grains/ ear		Weight of ear (g)		Grain weight/ear (g)		Test weight (g)	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Date of sowing												
15th December	9.83	10.29	20.89	21.79	57.04	56.06	3.01	3.26	2.43	2.63	40.98	41.48
25th December	9.66	9.90	20.51	20.58	55.99	52.90	2.90	2.94	2.38	2.37	40.16	40.24
05th January	9.42	9.50	20.01	19.56	54.65	50.28	2.88	2.81	2.33	2.25	39.18	38.76
S.E. (d)	0.023	0.072	0.049	0.203	0.133	0716	0.021	0.052	0.016	0.058	0.264	0.324
C.D. at 5%	0.063	0.200	0.134	0.562	0.366	1.976	0.058	0.144	0.043	0.159	0.729	0.895
Varieties												
Mandakini (K-9351)	8.97	9.07	19.05	19.40	52.01	49.87	2.74	2.80	2.21	2.26	37.78	37.88
Naina (K-9533)	9.64	10.08	20.48	20.35	55.93	52.33	2.95	2.92	2.37	2.35	40.59	40.87
Unnat Halna (K-9423)	10.51	10.55	22.32	22.45	60.93	57.73	3.22	3.34	2.59	2.70	42.86	42.45
Halna (K-7903)	9.43	9.88	20.04	20.37	54.45	52.38	2.89	2.93	2.325	2.36	39.78	39.43
S.E. (d)	0.121	0.120	0.256	0.366	0.700	1.232	0.105	0.095	0.085	0.105	0.759	0.550
C.D. at 5%	0.250	0.252	0.539	0.769	1.471	2.588	0.221	0.200	0.179	0.220	1.596	1.157

Table -3: Effect of Treatments on biological yield (q/ha), grain yield (q/ha), straw yield (q/ha), harvest index (%) and economics under late sown condition

Treatments	Biological yield		Grain yield		Straw yield		Harvest index		Gross income		Net income		B:C ratio	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Date of sowing														
15th December	113.34	104.08	49.23	45.75	64.11	58.33	43.45	44.00	82545	95712	50588	60862	1.62	1.75
25th December	95.54	96.89	42.31	42.84	53.23	54.05	43.98	44.36	69831	89472	37874	54621	1.19	1.57
05th January	82.96	90.50	36.61	40.38	46.67	50.12	43.92	44.52	61095	81553	29151	46725	0.92	1.34
S.E. (d)	2.138	1.586	1.535	0.767	0.964	0.732	0.237	0.353	1925.80	309.149	1919.38	289.18	0.043	0.031
C.D. at 5%	5.849	4.379	4.239	2.117	2.662	2.032	N.S.	N.S.	5315.91	853.498	5299.01	798.37	0.119	0.086
Varieties														
Mandakini (K-9351)	91.66	90.35	39.82	40.20	51.85	50.15	42.92	44.47	66793	81355	34830	46504	1.09	1.33
Naina (K-9533)	98.59	99.37	41.86	42.13	56.11	57.24	42.58	42.41	70688	90936	38730	56086	1.21	1.61
UnnatHalna (K9423)	106.59	107.32	47.98	47.98	59.73	59.24	44.30	44.84	78183	96843	46226	62022	1.50	1.78
Halna (K-7903)	92.31	91.52	41.72	41.58	50.59	49.94	45.32	45.45	68964	86516	37029	51665	1.16	1.48
S.E. (d)	2.783	2.783	1.868	1.283	1.697	1.217	0.801	0.618	3091.50	592.915	3094.62	496.55	0.084	0.059
C.D. at 5%	5.849	5.848	3.926	2.697	3.566	2.557	1.683	1.298	6496.83	1245.90	6502.79	1043.42	0.176	0.125

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bound to increase except harvest index. The most probable reason for this phenomenon may be longer plants and increased dry matter more vegetative yields i.e. biomass, grain and straw yield and thereafter economics. The results were supported by Dhiman (2012).

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