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Performance of different varieties under extended sowing times on growth, yield and economics of wheat (*Triticum aestivum* L.)

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Abstract
An experiment entitled, "Performance of wheat varieties under extended sowing times" was conducted on medium black soil during Rabi, 2016-17 at Kolhapur to find out suitable sowing time and varieties of wheat under extended sowing times. The experiment was laid out in split plot design viz. five sowing times viz. 45thMW, 47th MW, 49th MW, 51th MW and 1st MW as main plot treatment and four varieties viz. NIAW-301(Trimbak), NIAW-917 (Tapovan), NIAW-34 (Niphad -34) and NIAW-1994 (Phule Samadhan) as sub plot treatments with three replications. The growth and development of wheat measured in terms of plant height, number of leaves, total number of tillers m2, leaf area and total dry matter per plant was recorded higher when sowing was done at 47th MW (19th- 25th Nov.). The yield contributing character such as length of spike, number of spikelets spike-1 was higher when crop sown at 47th MW (19th-25th Nov.). The significantly superior grain yield (39.90 q ha-1) and Straw yield (61.58 q ha-1) was recorded when wheat crop sown at 47th MW (19th-25th Nov). All the growth attributing characters and yield attributing characteristics influence significantly due to different varieties, and higher values are recorded in wheat varieties NIAW-1994. The significantly highest values of grain yield (37.48 q ha-1), straw yield (58.52 q ha-1) as well as harvest index (38.48 percent) were recorded by variety NIAW-1994 as compared to other varieties.

Keywords: Sowing times, varieties, growth, yield and economics

Introduction
Wheat (*Triticum aestivum* L.) belongs to family "Gramineae" and genus "*Triticum*". It is the World's most important widely cultivated food crop. It is basically a long day crop and primarily grown in temperate region and also at higher altitude under tropical climatic areas in winter season. It requires relatively low temperature for satisfactory growth and development. Among the food crops, wheat is one of the most abundant sources of energy and proteins for the world population and its increased production is essential for food security. Wheat is the most important staple food crop of India. Beside staple food for human beings, wheat straw is a good source of feed for a large population of cattle in our country and also used for manufacturing of straw boards, papers and other pulp products. The sowing time plays an important role among various agronomic factors, which influencing the quality and yield of wheat. Its time of sowing is one of the most important factors that govern the crop phenological development and efficient conversion of biomass into economic yield. Normal sowing has longer growth during which consequently provides an opportunity to accumulate more biomass as compared to late sowing, hence manifested in higher grain and biological yields (Singh and Pal 2003) [11]. However, the higher protein yield, grain protein content, dry gluten content, beta carotene content and sedimentation index in late sown wheat have been reported by (Zende *et al*. 2005) [14].

Material and Methods
The field experiment was conducted during the *rabi* season of the year 2016-17 on medium black soil at post graduate research farm, R.C.S.M. college of Agriculture, Kolhapur which is situated between 16°42' North latitude and 74°14' East longitude. Chemical composition indicated that the soil was low in available nitrogen (137.2 kg ha^{-1}), moderately high in available phosphorus (24.5 kg ha^{-1}) and medium in available potassium (159 kg ha^{-1}). The soil was alkaline in reaction (pH-7.7). The ecologically this area comes under sub mountain zone with average annual rainfall is 1057 mm.

The experiment was conducted in split plot design with five sowing times as a main plot treatment and four varieties as sub plot treatments with three replication. The treatment details are A) Main Plot treatments: Meteorological weeks (Sowing Times) D_1: 45th MW (5th Nov. to 11th Nov.), D_2: 47th MW (19th Nov.to 25th Nov.), D_3: 49th MW (3rd Dec. to 9th Dec.), D_4: 51th MW (17th Dec. to 23th Dec.) and D_5: 1st MW (1st Jan. to 7th MW) and B) Sub. Plot treatment: Wheat varieties. V_1: NIAW-301, V_2: NIAW-917, V_3: NIAW-34 and V_4: NIAW-1994. Sowing was carried out by drilling with spacing of 22.5 cm. The seeds were covered immediately after sowing. The sowing was carried out at five different times as per treatment. Recommended dose of fertilizer i.e. 120: 60: 40 kg. N, P_2O_5, and K_2O per hectare was given. However N applied in two splits doses. Five plants from each net plot were randomly selected and labeled for taking biometric observations. The same five plants were harvested separately for post-harvest studies.

Results and Discussion

Effect of sowing times

Among all the sowing times, sowing at 47th MW (24th November 2016) recorded higher plant height (78.19 cm), total number of tillers metre^{-2} row length (123.58), number of leaves plant^{-1}(14.38), leaf area plant^{-1} (0.60 dm^2) and total dry matter accumulation plant^{-1} (17.12 g)at harvest which is at par with sowing at 45th MW as compared to rest of treatment. The higher the growth attributes in timely sown wheat was might be due to the optimum temperature in during initial stage of crop. Similar results were observed by Patil *et al*. (2000), Kaur and Hundal (2007) [4]. These results indicate that sowing of wheat crop in 47th MW (D_2) was most suitable for better growth. This might be associated with the wheat sown in 47th MW (D_2) was exposed low temperature, more dew formation, higher coldness and resulted to the attained higher growth characters. The result are also in conformity with Bishnoi *et al.* (1995) [1]. The lowest values for all these characters were recorded by 1st MW (1st -7th Jan.) sowing time. Yield attributing characters *viz*., length of spike (8.08 cm), number of spikelets spike^{-1}(12.64), number of grains spike^{-1}(38.19), weight of grains plant^{-1} (1.31 g) and thousand grain weight (34.42 g) were found higher in 47th MW (24thNovember 2016). This might be due to higher growth reflects in yield attributing characters. Maximum grain yield (39.90 q ha^{-1}), straw yield (61.58 q ha^{-1}) and harvest index (39.23%) was recorded at 47th MW (24th November 2016) over rest of sowing times. This may be due to higher yield contributing characters. Similar results were obtained by Shirpurkar *et al*. (2008) [9] and Mukherjee (2012) [5].

Effect of varieties

The higher plant height (77.52 cm), number of tiller (123.33) row length metre^{-2}, number of leaves plant^{-1} (14.99), leaf area plant^{-1} (0.58 dm^2) and dry matter plant^{-1} (17.49 g) was recorded in NIAW-1994 as compared to rest of varieties. Similar results were observed by Negi *et al*. (2003) [6] and Chopade *et al.* (2015) [2]. This might be due to more genetic potential to enhance the growth during growth period in NIAW-1994 variety of wheat than the rest of the varieties. The increased growth habit is genetically governed phenomenon, harmonal balance, nutrient absorption capacity and conversion of radiant energy to chemical energy in presence of chlorophyll. The variety NIAW-34 recorded significantly lower growth attributes than remaining varieties. Variety NIAW-1994 recorded significantly higher yield contributing characters *viz*., length of spike (7.11 cm), number of spikelets spike^{-1} (12.13), number of grains spike^{-1} (36.40), weight of grains spike^{-1} (1.11 g) and test weight (30.53g) as compared to rest of varieties. Similarly wheat variety NIAW-1994 recorded significantly higher grain yield (37.48 q ha^{-1}) and straw yield (58.52 q ha^{-1}). The difference in grain yield in wheat varieties might be due to inherent genetical potential of wheat varieties. These results confirm the findings reported by Singh and Dhaliwal (2000) [10] and Paikaray *et al.* (2005) [7]. Highest harvest index was also recorded in NIAW-1994 (38.48 percent).

Effect on Interaction

Interaction effect of dry matter accumulation, length of spike, number of spikelets spike^{-1}, number of grains spike^{-1}, weight of grains spike^{-1}, weight of grains plant^{-1} and grain yield was found significant due to effect of sowing time and varieties. The values of all these were higher when wheat crop was sown during 47th MW with variety NIAW-1994.

Table 1: Effect of sowing times and varieties on growth and yield contributing characters of wheat at harvest

Treatment	Plant height (cm)	No. of tillers m^2	No. of leaves plant^{-1}	Leaf area plant^{-1}	Dry matter plant^{-1}	Length of spike	No. of spikelets spike^{-1}	No. of grains spike^{-1}	Wt. of grains plant^1 (g)	1000 grain wt. (g)
Sowing times										
D_1:45th MW	77.62	121.58	13.55	0.59	16.94	7.43	11.90	36.12	1.21	33.73
D_2:47th MW	78.19	123.58	14.38	0.60	17.12	8.08	12.64	38.19	1.31	34.42
D_3:49th MW	77.23	121.25	13.40	0.53	16.69	6.63	11.76	35.44	1.11	31.33
D_4:51th MW	76.85	119.00	13.10	0.52	16.24	6.16	10.98	33.42	0.98	29.46
D_5:1st MW	72.08	117.50	12.90	0.50	15.29	6.09	10.61	31.92	0.64	20.23
SEm±	0.40	0.62	0.16	0.005	0.02	0.08	0.12	0.92	0.04	0.59
C.D. at 5%	1.33	2.02	0.49	0.019	0.06	0.28	0.40	3.00	0.15	1.95
Varieties										
V_1:NIAW-301	76.74	121.40	13.86	0.55	16.32	7.00	11.75	35.91	1.09	30.53
V_2: NIAW-917	76.08	119.60	10.23	0.53	16.15	6.81	10.39	34.19	1.00	29.37
V_3: NIAW-34	75.23	118.00	10.08	0.52	15.86	6.58	10.09	33.56	0.97	28.91
V_4: NIAW-1994	77.52	123.33	14.99	0.58	17.49	7.11	12.13	36.40	1.11	30.53
SEm±	0.12	0.12	0.52	0.003	0.02	0.02	0.09	0.18	0.03	0.45
C.D. at 5%	0.36	0.36	1.58	0.010	0.06	0.08	0.28	0.54	0.011	1.31
Interaction										
SEm±	0.28	0.27	0.30	0.008	0.05	0.06	0.21	0.42	0.08	1.02
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	0.14	0.17	0.63	1.21	0.24	N.S.
General mean	76.40	120.58	13.30	0.55	16.46	6.88	11.59	34.85	1.03	29.83

Table 2: Effect of sowing times and varieties on yield and economics of wheat

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Gross monetary returns (Rs.ha^{-1})	Net monetary returns (Rs.ha^{-1})	B:C ratio
Sowing times						
D_1:45th MW	35.77	57.77	38.24	68285.46	28657.46	1.72
D_2:47th MW	39.90	61.58	39.23	75987.71	36359.71	1.91
D_3:49th MW	34.83	56.92	37.96	66726.33	27098.33	1.68
D_4:51th MW	31.78	54.90	36.36	61110.75	23249.75	1.61
D_5:1st MW	19.33	49.64	27.91	38797.50	3365.5	1.09
SEm±	1.19	0.71	0.81	2129.50		
C.D. at 5%	3.90	2.32	2.64	6944.71		
Varieties						
V_1:NIAW-301	33.11	57.31	36.14	63669.23	24908.23	1.64
V_2: NIAW-917	30.80	55.24	35.16	59417.40	20767.4	1.53
V_3: NIAW-34	27.91	53.57	33.79	54202.93	15552.93	1.40
V_4: NIAW-1994	37.48	58.52	38.48	71436.63	32444.63	1.83
SEm±	0.40	0.41	0.22	725.70		
C.D. at 5%	1.16	1.21	0.63	2095.99		
Interaction						
SEm±	0.90	0.93	0.49	1622.73		
C.D. at 5%	2.60	N.S.	N.S.	4686.78		
General mean	32.32	56.16	35.89	62181.55	31151	1.83

Table 3: Interaction effect of sowing time on grain yield of wheat varieties

Sowing times Varieties	45th MW (D_1)	47th MW (D_2)	49th MW (D_3)	51th MW (D_4)	1st MW (D_5)	Mean (Varieties)
V_1: NIAW-301	35.00	41.15	36.52	33.48	19.39	33.11
V_2: NIAW-917	33.13	38.70	33.44	30.14	18.58	30.80
V_3: NIAW-34	31.30	34.00	29.79	27.54	16.94	27.91
V_4: NIAW-1994	43.63	45.77	39.57	35.98	22.43	37.48
Mean (Sowing time)	35.77	39.90	34.83	31.78	19.33	
S.Em±	0.90					
C. D. at 5%	2.60					

Economics

The gross monetary returns (75987.71 Rs. ha^{-1}), net monetary returns (36359.71 Rs. ha^{-1}) and B: C ratio (1.91) were found maximum when wheat crop was sown at 47th MW (24th November 2016). This might be due to favourable growth environment, higher growth, higher grain and straw yield which reflects increase in gross and net monetary returns and B: C ratio. Similar results were obtained by Singh and Uttam (1994) [12] and Dixit and Gupta (2004) [3]. The gross monetary returns (71436.63 Rs. ha^{-1}), net monetary returns (32444.63 Rs.ha^{-1}) and B: C ratio (1.83) were found maximum in NIAW-1994 variety than rest of the varieties. Similar results were obtained by Yadav *et al*. (2008) [13] Data presented in table 1-3.

Conclusion

For better growth, yield and economics of wheat, the crop can be sown in 47th MW. Also variety NIAW-1994 was found better as compared to all other varieties under study

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