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Effect of varieties (*Triticum aestivum* L.) under extended sowing times on yield, protein content, nutrient uptake and soil properties of wheat

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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 and its effect on uptake of nutrient and available nutrient status of soil. 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 significantly highest values of grain yield (39.90 q ha^{-1}), straw yield (61.58 q ha^{-1}) and protein content (11.30 per cent) were recorded in sowing time at 47th MW (19th-25th Nov). Also variety NIAW-1994 recorded significantly maximum grain yield, straw yield and protein content. Significantly more uptake of nutrient (NPK) by wheat was recorded when crop was sown in 47th MW and in variety NIAW-1994. Maximum organic carbon and available nutrient in soil (NPK) after harvest of wheat was recorded when crop was sown in 47th MW and in variety NIAW-1994.

Keywords: Sowing time, varieties, yield, protein and nutrient content

Introduction
Wheat (*Triticum aestivum* L.) belongs to family "Graminae" 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. 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) [16]. 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) [18]. Timely sown crop also effect on nutrient uptake by crop and soil properties after harvest. Hence the investigation was carried to during PG research work to access the different varieties of wheat under extended sowing time on yield, uptake and soil properties.

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

The grain yield of wheat was influenced significantly due to extended sowing times. The grain yield was maximum (39.90 q ha^{-1}) at 47th MW (D_2) which was significantly superior over other sowing times. Sowing time 47th MW was favorable to high grain production because the post anthesis period coincided with relatively low temperature. This result was similer with result of Kumar and Kumar (1997) [3], Sardana *et al*. (2003) [13], Shirpurkar *et al*. (2008) [14] and Mukherjee (2012) [6]. The straw yield was maximum (61.58 q ha^{-1}) at 47th MW which was significantly superior over rest of sowing times. The similar findings were also reported by Nainwal and Singh (2000) [7], Gill *et al*. (2013) [2] and Bachhao *et al*. (2018) [1]. Higher protein content was recorded in sowing time at 47th MW (D_2) which was statistically at par with 45th MW (D_1) but significantly superior over rest of sowing times. Similar results were reported by Mahajan and Nayeem (1990) [4], Kumar and Kumar (1997) [3] and Mittal *et al*. (1998) [5].

Sowing time at 47th MW (D_2) recorded significantly higher total nitrogen, phosphorus and potassium uptake by the wheat crop over rest of treatment, This result confirms the findings of Patil and Itnal (2002) [10] and Patel *et al*. (1999).

The effects of sowing times on soil reaction, EC, organic carbon and available nutrient like nitrogen, phosphorus and potassium were statistically non- significant. However maximum values were recorded in wheat sowing at 47th MW. Sowing at 45th MW, 47th MW and 49th MW shows positive response with respect to initial status of soil properties.

Effect of varieties

The grain yield was significantly higher in NIAW-1994 (37.48 q ha^{-1}) over rest of wheat varieties. 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) [17], Paikaray *et al*. (2005) [8] and Rasal and Gavhane (2005) [12]. The straw yield of NIAW-1994 and NIAW-301 were found to be at par with each other but significantly superior over rest of varieties. The difference in straw yield in wheat varieties might be due to inherent genetical potential of wheat varieties. The similar findings were also reported by Zende *et al*. (2005) [18]. The wheat varieties *viz.*, NIAW-1994 was recorded significantly maximum protein content (11.23). Similar results were reported by Pharande *et al.* (1988) [11] and Singh and Jain (2000) [15].

The total uptake of nitrogen, phosphorus and potassium by wheat plant was influenced significantly by wheat varieties. Significantly higher total nitrogen, phosphorus and potassium uptake was registered in variety NIAW-1994 than rest of wheat varieties. The higher nutrient uptake by the NIAW-1994 wheat variety might be because of higher nutrient content, more grain yield and straw yield than other varieties. These results support the findings made by Patil and Itnal (2002) [10].

The effects of varieties on soil reaction, EC, organic carbon and available nutrient like nitrogen, phosphorus and potassium were statistically non- significant**.** An organic carbon shows positive response with respect to initial status of V_1:NIAW-301 and V_4:NIAW-1994. Available NPK shows positive response with respect to initial status of all varieties except V_3: NIAW-34.

Effect of Interaction

Wheat variety NIAW-1994 was sown in 47th MW produces statistically higher grain yield (45.77 q ha^{-1}). Significantly higher uptake of nitrogen, phosphorus and potassium was registered in wheat sown at 47th MW with NIAW-1994 variety. Wheat variety NIAW-1994 (V_4) was sown in 47th MW produces statistically higher total nitrogen uptake, over rest of possible treatment combinations.

Conclusion

Sowing of wheat at 47th MW shows higher yield and uptake of nutrients as well as improves soil properties. Also variety NIAW-1994 was found better as compared to all other varieties under study

Table 1: Grain, straw yield and protein content of wheat as influenced by different treatments

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Protein content (%)
Sowing times			
D_1:45th MW	35.77	57.77	11.23
D_2: 47th MW	39.90	61.58	11.30
D_3: 49th MW	34.83	56.92	11.12
D_4: 51th MW	31.78	54.90	11.12
D_5: 1st MW	19.33	49.64	11.04
S.E(m)±	1.19	0.71	0.033
C.D.at 5%	3.90	2.32	0.11
Varieties			
V_1: NIAW-301	33.11	57.31	11.17
V_2: NIAW-917	30.80	55.24	11.15
V_3:NIAW-34	27.91	53.57	11.09
V_4:NIAW-1994	37.48	58.52	11.23
S.E(m)±	0.40	0.41	0.009
C.D.at 5%	1.16	1.21	0.02
Interaction (Sowing times × Varieties)			
S.E(m)±	0.90	0.93	0.02
C.D.at 5%	2.60	N.S.	N.S.
General mean	32.32	56.16	11.16

Table 2: 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	35.77	39.90	34.83	31.78	19.33	
S.Em±	0.90					
C. D. at 5%	2.60					

Table 3: Total N, P and K uptake by grain and straw of wheat as influenced by different treatments.

Treatment	Nutrient uptake by grain(kg ha^{-1})			Nutrient uptake by straw(kg ha^{-1})			Total nutrient uptake by crop (kg ha^{-1})		
	N	P	K	N	P	K	N	P	K
Sowing times									
D_1:45th MW	68.95	15.32	18.60	32.59	11.97	68.55	101.62	27.22	87.15
D_2: 47th MW	77.46	17.22	20.58	34.99	13.24	74.22	112.36	30.46	94.82
D_3: 49th MW	66.50	14.92	17.87	32.39	11.79	69.71	98.89	26.67	88.36
D_4: 51th MW	60.66	13.61	16.20	30.79	11.30	68.05	91.50	24.90	84.25
D_5: 1st MW	36.64	8.03	9.88	27.68	10.26	59.45	64.33	18.29	69.29
S.E(m)±	2.17	0.55	0.69	0.47	0.19	1.44	2.30	0.60	1.83
C.D.at 5%	7.09	1.80	2.25	1.53	0.64	4.71	7.53	1.98	5.98
Varieties									
V_1: NIAW-301	63.57	14.12	17.08	32.23	11.84	69.06	95.82	25.91	86.10
V_2: NIAW-917	59.08	13.13	15.80	31.03	11.35	66.32	90.12	24.48	82.79
V_3:NIAW-34	53.19	11.84	14.23	30.23	11.05	64.02	83.40	22.85	78.25
V_4:NIAW-1994	72.31	16.18	19.39	33.26	12.61	72.58	105.61	28.79	91.95
S.E(m)±	0.80	0.20	0.22	0.24	0.17	1.09	0.86	0.33	1.20
C.D.at 5%	2.32	0.60	0.63	0.71	0.50	3.17	2.48	0.95	3.48
Interaction (Sowing times × Varieties)									
S.E(m)±	1.80	0.46	0.49	0.55	0.39	2.4	1.92	0.73	2.70
C.D.at 5%	5.19	1.34	1.42	N.S.	N.S.	N.S.	5.55	N.S.	N.S.
General mean	62.04	13.82	16.62	31.69	11.71	68	93.74	25.51	84.77

Table 4: Soil pH, EC, organic carbon and available nutrient in the soil after harvest of wheat as influenced by different treatments

Treatment	pH	EC (dSm^{-1})	Organic Carbon (%)	Available nutrient		
				N	P	K
Sowing times						
D_1:45th MW	6.97	0.10	0.53	142.83	26.5	164.38
D_2: 47th MW	7.13	0.12	0.55	145.82	27.29	166.01
D_3: 49th MW	7.08	0.09	0.51	139.08	25.2	151.25
D_4: 51th MW	7.03	0.09	0.49	140.88	21.5	160.09
D_5: 1st MW	7.05	0.08	0.48	135.04	22.3	159.93
S.E(m)±	0.03	0.005	0.01	1.19	0.64	2.02
C.D.at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Varieties						
V_1: NIAW-301	7.08	0.11	0.51	143.34	27.11	161.26
V_2: NIAW-917	6.99	0.09	0.50	140.14	24.5	160.33
V_3:NIAW-34	6.99	0.07	0.49	134.67	21.6	158.88
V_4:NIAW-1994	7.15	0.11	0.54	146.56	27.26	166.22
S.E(m)±	0.04	0.005	0.01	1.22	0.62	1.84
C.D.at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Interaction (Sowing times × Varieties)						
S.Em±	0.10	0.01	0.03	2.41	1.26	3.86
C.D.at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
General mean	7.7	0.10	0.51	140.93	26.92	161.33
Initial status	7.6	0.09	0.51	137.2	24.5	159

Table 5. Interaction effect of total nitrogen uptake (kg ha^{-1}) by wheat plant as influenced by sowing times and 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	100.55	114.56	103.62	96.29	64.09	95.82
V_2: NIAW-917	95.73	110.44	95.28	86.73	62.42	90.12
V_3:NIAW-34	90.49	99.34	87.44	81.36	58.38	83.40
V_4:NIAW-1994	119.70	125.10	109.21	101.63	72.43	105.61
Mean (Sowing time)	101.62	112.36	98.89	91.50	64.33	
S.E(m)±	1.92					
C.D. at 5%	5.55					

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