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Sowing Dates and Varieties of Wheat can Affect Yield, Nutrient Content in Grain, Straw and Soil after Crop Harvest

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study aimed to determine the Sowing dates and varieties of wheat can affect yield, nutrient content in grain, straw and soil after crop harvest. A field experiment was conducted during *Rabi season (*2015-16) at Instructional Farm, Department of Agronomy, College of Agriculture JAU, Junagadh to evaluate the identification of the suitable date of sowing and variety of wheat (*Triticum aestivum L.*) for South Saurashtra, Gujarat under changing climatic conditions. The experiment consisted of 12 treatment combinations of four dates of sowing in main plots (05th November, 15th November, 25th November and 05th December) and three varieties in sub plots (GW 322, GW 366 and GW 173) was carried out in split-plot design with three replications. Significantly maximum grain yield, N, P and K in grain and straw was recorded with sowing on 15th November and with the sowing of GW 366. Higher available N, P_2O_5 and K_2O in the soil after harvest was found on 05th December and GW 173.

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1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is the world's leading cereal crop in terms of area harvested. Wheat is a thermo-sensitive and long-day plant. Mexican dwarf wheat (*Triticum aestivum* L.), presently grown in India, also known as common bread wheat and belongs to dinkale series (hexaploid 2n=4x=42), was evolved by Dr. N. E. Borlaug at CIMMYT, Mexico. Wheat is most successfully grown between 30º and 60º N and between 27º and 40º S latitudes. It has highest protein among all cereals, ranging from 10 to 12%, known as gluten and is important for bakery purpose. Wheat also has a high amount of niacin and thiamine amino acids.

In the world, wheat is grown a 220.4 million ha area, with 729.0 million tonnes and productivity of 3.30 tonnes/ha (FAO, 2014). In India wheat has an area of 30.4 million ha and production of 95.85 million tonnes and productivity of 3145 kg/ha. The low productivity of wheat in Gujarat is mainly owing to factors like low soil fertility, moisture stress due to low water-holding capacity of the soil, lack of required soil depth, imbalanced use of fertilizers, no or very low use of organic manures, non-availability of quality seed of locally recommended varieties *etc*. Besides the at the above factors, non availability of optimum temperature regimes during plant growth and development of wheat, particularly in Saurashtra, is another major factor for low yield of wheat in Gujarat.

Weather is one of the key critical factors influencing agricultural production and productivity. Studies indicate that weather during cropping season strongly affected crop growth for only one-third of productivity. The predominant influence of weather is operative even before the crop is sown as the moisture availability and the thermal regime of the seed zone determine the date of sowing and the appropriate genotype to be buried despite the cultivation of wide high-yielding varieties, improved cultural practices and plant protection measures, favorable weather is a must for a good harvest [1].

Among the climatic factors, temperature plays a crucial role in determining sowing time and consequently the duration of different phenophases. Thus, the crop productivity of wheat in almost all wheat growing regions starts starting from germination to maturity [2]. The physiological functions and growth stages are severely affected by temperature which decides the duration of the life cycle of the wheat plant. Under late sown conditions, the wheat crop forcefully completes its life cycle before the stipulated time available for maturity [3].

Therefore, it is important to identify suitable coping strategies to reduce the adverse effects of climate change related to increased in temperature on wheat. The date of sowing is one such adaptation strategy that can help to reduce temperature-related adverse affects on growth and development of plants. Even though the optimum date of sowing of wheat in south Saurashtra is 15th November, there is a need to revalidate the same in light of increased in temperature and decreased in number of cold says over the years in Saurashtra [4]. It may require to delay wheat sowing beyond 15th November by few days to escape the effects of increased temperatures on plants. However, to be cautious, more delay may affect wheat performance again by reducing the tillering period and hot weather during critical period of grain filling leading to forced maturity [5].

Further, selection of varieties tolerant to heat stress is another major adaptation strategy to reduce the adverse effects of high temperature on wheat crop. A simulation study found that the projected increase in temperature reduced wheat cultivars GW 322 and GW 496 by 38 to 43 % at Anand [6].

2. MATERIALS AND METHODS

A field experiment was conducted during *Rabi* 2015-16 at Instructional Farm, Department of Agronomy, College of Agriculture JAU, Junagadh to quantify the wheat yield losses and identify the suitable wheat variety for high yield under heat stress for South Saurashtra, Gujarat. The experiment consisted of four dates of sowing in main plots viz., 05th November, 15th November, 25th November, and 05th December and three varieties in sub plots i.e. GW 322, GW 366 and GW 173 in split plot design with three replications. The soil of experimental plot was clayey in texture and slightly alkaline in reaction with pH 7.8 and EC of 0.35 dS/m. The soil was medium in available N (241.0 kg/ha) and high in available P_2O_5 (25.5 kg/ha), and available K_2O (259.0 kg/ha). The crop was sown in rows 22.5

cm apart using 120 kg/ha seed rate. The recommended dose of N, P and K was 120, 60 and 60 kg/ha. Half N and full dose P and K was applied as basal while remaining half dose of N was given in two equal splits 25 and 45 days after sowing. N was applied through urea and DAP, P through DAP and K as MOP. Available N, P and K were estimated by Kjeldahl method [7], Olsen's method [8], Flame photometric method [9], respectively. N in grain and straw was estimated following Kjeldahl method [9], P in grain and straw by Venedo-molybdous phosphoric acid yellow color method [9], and K in grain and straw by flame photometric method [9].

3. RESULTS AND DISCUSSION

3.1 Date of Sowing and Variety Effect on Yield

Significantly, maximum grain yield was recorded with the sowing of GW 366 on 15th November. The crop sown on 15th November produced a significantly higher yield parameter. High temperature reduced the vegetative periods, duration of grain filling and grain development period, thus reducing yield parameter, which ultimately resulted in lower grain yield of wheat as compared to sowing under favorable temperature regimes. Similarly, higher temperature at grain filling, as simulated on 05th December sowing, led to forced maturity, thereby, reducing the grain yield. Moreover, significantly lower plant population with sowing on 05th December also resulted into lower crop yield. Due to stress tolerance maximum grain yield was recorded in GW 366, and minimum grain grain and straw yield was recorded in GW 322 and GW 173 due to heat shock. [10], [11] and [12] also reported similar findings.

3.2 Date of Sowing and Variety Effect on N, P and K Content in Grain and Stover

Significantly maximum N content in grain and straw were recorded with sowing on 15th November and at par with 05th November and 25th November sowing. Whereas, significantly maximum N content in grain and straw were recorded in GW 366 and was at par with GW 322. Delayed sowing leads to heat stress at the grain filling stage resulting in forced maturity and shriveled grains with poor quality, which is correlated with low nitrogen content in such grains and straw. These results support findings of [13] and [14].

Significantly maximum P content in grain was recorded with sowing on 15th November and was statistically at par with 05th November sowing. Significantly maximum P content in grain was recorded in GW 366. The effect of different date of sowing and varieties on P content of grain and straw was found to be non-significant.

It was found that dates of sowing had significant effect on K content in grain and straw of wheat. Significantly maximum K content in grain and straw was recorded with sowing on 15th November, being at par with 05th November sowing. Maximum K content in grain was recorded in GW 366. Whereas, significantly maximum K content in straw was recorded in GW 366 which remained at par with GW 322. In general, the higher N, P and K content in grain and straw with sowing on 15th November could be due to favorable temperature conditions leading to better growth and development of plants. The present findings are in close agreement with the results found by [15].

3.3 Date of Sowing and Variety Effect on N, P and K in Soil after Harvest

It was indicated that different dates of sowing and varieties exerted a significant effect on available N, K_2O and P_2O_5 in soil after wheat harvest. Significantly maximum available N, K_2O and P_2O_5 in soil after harvest of wheat was observed with sowing on 05th December**.** Significantly maximum available N and K_2O in soil after harvest was recorded with GW 173. However, significantly maximum available P_2O_5 in soil after harvest was observed with GW 173, being at par with GW 322.

Whereas, significantly minimum available N, P_2O_5 and K_2O in soil after harvest of wheat was recorded on 15th November and GW 366. This could be attributed to low nutrient uptake by plants due to poor growth and development of plants and lower productivity due to unfavorable temperature conditions when sown on 05th December [14] and [15]. The higher N, P_2O_5 and K_2O content in soil after harvest with GW 173 could be attributed to lower productivity and consequent lower uptake as compared to GW 366. These results confirm the findings of [16], [17] and [18].

Table 1. Effect of dates of sowing and varieties on N, P and K content of grain and straw in wheat

Treatments	Grain yield (kg ha^{-1})	N content (%)		P content (%)		K content (%)	
		Grain	Straw	Grain	Straw	Grain	Straw
Dates of sowing							
05th November	4238	1.80	0.56	0.35	0.0444	0.46	1.63
15th November	5070	1.85	0.59	0.39	0.0470	0.50	1.68
25th November	4704	1.76	0.54	0.34	0.0465	0.43	1.58
05th December	3733	1.59	0.38	0.27	0.0416	0.32	1.41
S.Em±	232.3	0.04	0.02	0.01	0.00030	0.01	0.04
C.D. (0.05)	803.9	0.15	0.08	0.04	NS	0.04	0.15
Varieties							
GW 322	4538	1.76	0.53	0.34	0.0448	0.44	1.59
GW 366	4696	1.81	0.55	0.37	0.0480	0.46	1.60
GW 173	4070	1.67	0.48	0.31	0.0418	0.40	1.53
S.Em±	46.5	0.02	0.01	0.01	0.0023	0.01	0.02
C.D. at 5%	139.4	0.07	0.02	0.02	NS	0.01	0.06

Table 2. Effect of dates of sowing and varieties on available N, P_2O_5 and K_2O in soil after harvest of wheat

Treatments	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
Dates of sowing			
05th November	247.72	20.29	247.72
15th November	225.08	16.24	225.00
25th November	237.29	18.35	237.29
05th December	278.42	26.66	277.30
S.Em±	4.28	0.48	4.70
C.D. at 5%	14.81	1.67	16.27
Varieties			
GW 322	247.84	20.08	247.84
GW 366	237.91	19.63	237.31
GW 173	255.57	21.44	254.74
S.Em±	2.41	0.39	2.69
C.D. at 5%	7.24	1.17	8.08

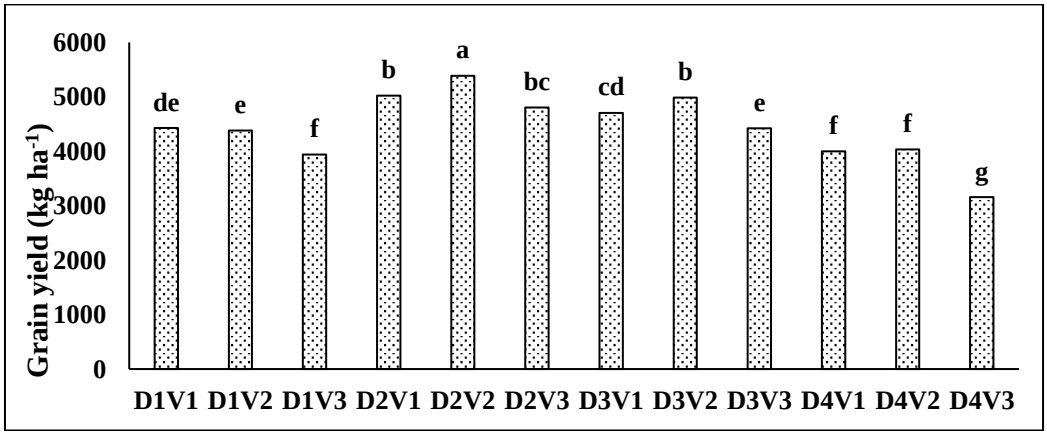

Fig. 1. Interaction effect of date of sowing and verities on grain yield of wheat

4. CONCLUSION

The above results conclude that soil 15th November significantly enhances the grain yield and nutrient content in grain and straw. Among varieties, GW 366 gave better grain yield and nutrient content in grain and straw. Under high-temperature conditions during sowing and early vegetative growth, as simulated by early sowing on 05th November, GW 322 gave significantly higher grain yield. Similarly, under high-temperature conditions during the reproductive stage, as simulated by late sowing on 05th December, GW 366 being at par with GW 322 gave statistically superior grain yield other GW 173.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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