

Original Research Article

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Identification of Suitable Date of Sowing and Variety of Wheat (*Triticum aestivum* L.) for South Saurashtra, Gujarat under Changing Climatic Conditions

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ABSTRACT

Keywords

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A field experiment was conducted during *rabi* 2015-16 at Instructional Farm, Department of Agronomy, College of Agriculture JAU, Junagadh to evaluate identification of suitable date of sowing and variety of wheat (*Triticum aestivum* L.) for South Saurashtra, Gujarat under changing climatic conditions. The experiment consisting 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 germination percentage, plant population per square meter, plant height, dry matter accumulation, root dry weight, root length, root volume, crop growth rate from 30 to 60 DAS, maximum number of tillers/plant, effective tillers/meter, total tillers/meter, length of spike, number of grains/spike, weight of spike, test weight, grain yield, straw yield and biological yield was recorded with sowing of GW 366 on 15th November. Protein content in grain, and nitrogen, phosphorus and potassium content of grain and straw as well as their uptake by grain and straw was significantly higher with sowing of GW 366 on 15th November. Maximum net returns was found with sowing of GW 366 on 15th November.

Introduction

Wheat is a major staple crop of India after rice. In India wheat was grown on 30.23 Mha area with total production of 93.50 million tonnes during 2015-16 (Anonymous). There is increasing concern of wheat production getting affected by global warming in India (Valizadeh *et al.*, 2014). Temperature is one of the major factors which play vital role in the reduction of growth and yield parameters of wheat crop. The physiological functions and

thereby growth stages are severely affected due to high temperature which also decides the duration of life cycle of wheat plant. Rawson (1986) indicated that rapid phenological development, poor biomass production and sterility were major factors leading to poor yields in wheat grown under high temperature regimes throughout the crop growth period. There is need to quantify the yield reduction in wheat due to high temperature which can be simulated by different dates of sowing under field

conditions. Choice of planting date is also a key factor and is studied to assess its impact on yield of many crops, especially wheat and maize (Turner, 2004). Hence, the current investigation was undertaken with the objectives of quantifying wheat yield reduction due to high temperatures and identifying suitable wheat variety for high yield under heat stress.

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 consisting of four dates of sowing in main plots *viz.*, 05th November (S₁), 15th November (S₂), 25th November (S₃), and 05th December (S₄) and three varieties in sub plots i.e. GW 322 (V₁), GW 366 (V₂) and GW 173(V₃) was carried out 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⁻¹. The soil was medium in available nitrogen (241.0 kg ha⁻¹) and high in available phosphorus (25.5 kg ha⁻¹), and available potassium (259.0 kg ha⁻¹). The crop was sown in rows 22.5 cm apart using 120 kg/ha seed rate. The recommended dose of NPK was 120:60:60 kg/ha. Half dose of nitrogen and full dose phosphorus and potassium was applied as basal while remaining half dose of nitrogen was given in two equal splits 25 and 45 day after sowing. N was applied through urea and DAP, P through DAP and K as MOP. The crops under S₁, S₂, S₃, and S₄ were harvested on 16th February, 23rd February, 25th February, and 27th February, 2016, respectively. The total numbers of irrigations applied were 9, 8, 8, and 6 under S₁, S₂, S₃, and S₄, respectively. Weeds were controlled using pre-emergence

application of pendimethalin followed by one hand weeding and interculturing 30 days after sowing. Available N was estimated following Kjeldahl method, available P by Olsen method, and available K by flame photometric method.

Results and Discussion

Effect on growth attributes

Significantly maximum number of germination percentage, plant population per square meter, plant height, dry matter accumulation, root dry weight, root length and root volume, crop growth rate from 30 to 60 DAS was recorded with sowing of GW 366 on 15th November. The low germination percentage in case of 05th November and 05th December sowing was due to unfavorable temperature regimes which resulted into less than optimum plant population. The crop sown on 05th December was found to have significantly lesser number of tillers compared to crop sown on 15th November. Maximum plant height, dry matter accumulation, root dry weight, root length and root volume was recorded in GW 366 owing to less affected by temperature fluctuation. These findings supported the results of Mishra *et al.*, (2003), Sanghera and Thind (2014), and Singh and Dwivedi (2015).

Effect on yield attributes and yield

Significantly, maximum number of effective tillers/plant, effective tillers/meter, total tillers/meter, length of spike, number of grains/spike, weight of spike, test weight, grain yield, straw yield, biological yield and harvest index was recorded with sowing of GW 366 on 15th November. The crop sown on 15th November produced significantly more number of effective tillers/plant, effective tillers/meter and total tillers/meter, while minimum number of effective tillers/plant,

effective tillers/meter and total tillers/meter was obtained was on 05th December due to less germination counted per meter square. That is because of temperature was not according to the germination and tillering requirement, which results in less number of total tillers/m². High temperature reduced the vegetative periods, duration of grain filling and grain development period, thus reduced length of spike, number of grains/spike, weight of spike, grain size, test weight, grain yield, straw yield, which ultimately resulted into lower grain yield and straw 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. Maximum grain and straw yield was recorded in GW 366, owing to stress tolerance, and minimum grain and straw yield was recorded in GW 322 and GW 173 owing heat shock. Dhaka *et al.*, (2006), Singh *et al.*, (2011) and Jat *et al.*, (2013) also reported similar findings.

Effect on total nutrient uptake

Protein yield and nitrogen, phosphorus and potassium content of grain and straw as well

as their uptake by grain and straw was significantly higher with sowing of GW 366 on 15th November. Delayed sowing leads to heat stress at grain filling stage, which results in forced maturity and shriveled grains with poor quality and low protein content, which is correlated with low nitrogen content in such grains. These results support findings of Kamani and Singh (2013). In general, the significantly higher uptake of N, P, and K by grain and straw as well as their total uptake is due to higher yield and N, P, and K content in grain and straw with sowing of GW 366 on 15th November. The present findings are in close agreement with the results found by Dhaka *et al.*, (2006).

Effect on available nutrients in soil after harvest

The N, P₂O₅ and K₂O content in soil after harvest was significantly affected by different dates of sowing. Significantly, maximum available N, P₂O₅ and K₂O in soil after harvest of wheat was observed with sowing on 05th December. 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 (Deshmukh *et al.*, 2015 and Mumtaz *et al.*, 2015).

Table.4

Treatments	Cost of cultivation (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B: C ratio
Dates of sowing			
S ₁	37245	43085	2.2
S ₂	36445	58509	2.6
S ₃	36445	51959	2.4
S ₄	34445	35747	2.0
Varieties			
V ₁	36245	49023	2.3
V ₂	36245	51951	2.4
V ₃	36245	40973	2.1

Table.1

Treatments	Germination Percentage	Initial plant population per square meter (10 DAS)	Plant height (cm) at harvest	Dry matter accumulation/plant (g) at harvest	CGR from 30 to 60 DAS (g)	CGR from 60 DAS to harvest (g)	Root dry weight at harvest (g/plant)	Average root length at harvest (cm)	Root volume/plant at harvest (ml)
Dates of sowing									
S ₁	90	182	94.6	20.0	57.59	29.29	13.81	13.86	23.31
S ₂	96	186	101.6	21.9	63.01	40.22	14.84	14.42	24.44
S ₃	92	183	95.1	21.0	60.18	49.53	14.10	13.95	23.99
S ₄	88	175	77.7	18.7	54.17	65.78	12.74	12.43	20.89
S.Em±	1.6	1.87	4.02	0.26	1.48	2.26	0.20	0.32	0.58
C.D. at 5%	5.8	6.47	13.93	0.89	5.13	7.84	0.71	1.09	2.01
C.V.%	2.8	3.08	13.16	3.78	7.58	14.70	4.42	6.94	7.53
Varieties									
V ₁	91	182	94.0	20.4	59.57	45.05	13.63	13.73	23.13
V ₂	92	181	96.4	20.8	60.80	49.62	14.78	14.23	23.61
V ₃	90	181	85.0	20.0	55.85	43.94	12.21	13.03	22.74
S.Em±	0.90	1.16	3.10	0.06	0.65	1.31	0.15	0.14	0.09
C.D. at 5%	NS	NS	9.29	0.19	1.95	3.93	0.46	0.42	0.28
C.V.%	1.69	2.21	11.70	1.07	3.83	9.82	3.83	3.51	1.38

Table.2

Treatments	Numberof effective tillers/plant	Number of effective tillers/ meter	Number of total tillers/met er	Length of spike (cm)	Grains/ spike	Weight of spike (g)	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Biologica l yield (kg/ha)	Harvest index (%)
Dates of sowing											
S ₁	3.00	81.97	96.63	7.35	35.30	5.89	41.69	4238	6261	10498	40.32
S ₂	3.67	93.29	102.56	8.54	43.92	7.18	51.32	5070	6917	11987	42.27
S ₃	3.29	88.03	97.90	7.38	39.26	6.51	46.43	4704	6570	11287	41.67
S ₄	1.93	71.25	80.36	6.10	28.12	5.13	35.36	3733	5464	9076	40.47
S.Em±	0.13	2.67	1.61	0.34	1.39	0.20	1.46	232.3	126.8	374.7	1.2
C.D. at 5%	0.46	9.25	5.56	1.18	4.80	0.68	5.05	803.9	439.0	1296.8	NS
C.V.%	13.46	9.59	5.11	14.21	11.36	9.53	10.03	15.7	6.0	10.5	8.7
Varieties											
V ₁	2.88	83.59	95.89	7.22	36.87	6.10	44.06	4538	6330	10877	41.75
V ₂	3.47	88.62	98.83	8.04	40.45	7.06	46.75	4696	6530	11269	41.79
V ₃	2.47	78.71	88.37	6.44	32.68	5.37	40.29	4070	6049	9990	40.01
S.Em±	0.10	1.18	1.15	0.23	0.56	0.14	0.029	46.5	29.2	94.9	0.5
C.D. at5%	0.31	3.54	3.43	0.70	1.69	0.43	0.88	139.4	87.5	284.4	1.4
C.V.%	11.97	4.90	4.21	11.12	5.32	8.07	2.32	3.6	1.6	3.1	3.9

Table.3

Treatments	Protein content of grain (%)	Total N uptake (kg/ha)	Total P uptake by (kg/ha)	Total K uptake (kg/ha)
Dates of sowing				
S ₁	11.25	110.56	17.68	106.82
S ₂	11.55	134.72	22.14	133.72
S ₃	10.39	118.26	19.03	116.28
S ₄	9.92	75.09	12.68	74.35
S.Em±	0.27	3.87	0.66	3.31
C.D. at 5%	0.93	13.38	2.27	11.47
C.V.%	7.37	10.58	10.87	9.22
Varieties				
V ₁	11.01	111.23	18.36	109.63
V ₂	11.32	120.63	20.58	118.56
V ₃	10.45	97.11	15.45	95.19
S.Em±	0.14	1.48	0.38	1.39
C.D. at 5%	0.41	4.43	1.15	4.18
C.V.%	4.37	4.67	7.32	4.48

Economics

Maximum net return and B:C ratio was found with sowing of GW 366 on 15th November. The significantly higher yield with no substantial difference in cost of cultivation with sowing on 15th November resulted into higher net return and B:C ratio for GW 366 sown on 15th November. While least net returns and B:C ratio was obtained with GW 173 on 05th December sowing, due to less yield. Ouda *et al.*, (2005) reported that delay in sowing resulted in reduction of grain yield because of exposure of crop to high temperature which reduces length of growing duration

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