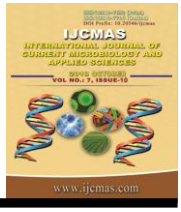
Int.J.Curr.Microbiol.App.Sci (2018) *7*(10): 1555-1561

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 10 (2018)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2018.710.174

Response of Wheat Varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to Sowing Time

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Keywords

Wheat, Genotype, Maturity, GDW 1255, Sowing, Durum and soil fertility

Article Info

Accepted:
12 September 2018
Available Online:
10 October 2018

A B S T R A C T

Among various production factors for wheat crop, time of sowing and wheat varieties are crucial ones influencing productivity. Onset of various phenophases of wheat crop is greatly related with the prevailing temperature at that time. Any deviation from optimum temperature for onset of phenophase may drastically reduce the crop productivity. Similarly wheat varieties play vital role under different temperature situation. Hence, considering these two aspects a field experiment was conducted on sandy loam soil at Centre of Excellence for Research on Wheat, Sardarkrushinagar Dantiwada Agricultural University, Vijapur to study the "Response of wheat varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to sowing time" in North Gujarat conditions" during *rabi* season of the year 2012-13. The experiment comprising of twelve treatment combinations was laid out in Split Plot Design with four replications. The treatment consisted of three sowing times *i.e.*, 15th November (Timely), 1st December (Late) and 15th December (Very late) and four wheat varieties (*viz.*, GW 11, GW 173, GW 322 and GDW 1255 (d)). The results of experiment revealed that the plant population at initial and harvest, harvest index were remained unaffected due to different sowing times. Significantly higher Plant height (80.2 cm), number of spikes/m^2 (328.1), length of spike (8.7 cm) number of grains per spike (57.5), 50% heading (65.2), Test weight (52.7), protein content (14.81%) grain (4716 kg ha^{-1}) and straw (7068 kg ha^{-1}) yield was found when crop sown on 15th November. The result of mean data of varieties indicated that the different growth parameters viz., plant height, days to 50 per cent heading, days to physiological maturity were significantly influenced and maximum values of these parameters were recorded by wheat variety GW 322. However, plant population at initial and harvest, number of spikes per meter^{-2} and harvest index were remained unaffected due to different varieties. Significantly higher values of yield attributes *viz.*, plant height (85.1cm), length of spike (9.2cm) number of grains per spike (52.8) and 50% heading (62.7) were observed in variety GW 322 while, test weight (54.2gm) and protein content (14.9%) was recorded significantly higher by variety GW 1255. The wheat variety GW 322 produced significantly higher grain yield 4408 kg ha^{-1} and straw yield 6612 kg ha^{-1}. The increase was 0.4, 10.2 and 11.9 per cent in grain yield and 0.4, 10.3 and 11.9 per cent in straw yield as compared to GW 11, GW 173 and GDW 1255, respectively.

Introduction

Wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.] is the most important staple food crop of the world and emerged as the backbone of India's food security. It is grown all over the world for its wider adaptability and high nutritive value. It is an important winter cereal contributing about 38% of the total food grain production in India. Wheat straw is an important source of fodder for a large animal population in India. In India, wheat is the second most important cereal crop after rice covering an area of 30.79 million hectares. Total annual production of wheat in India is 98.51 million tonnes with the productivity of 3.20 tonnes per hectare during 2017-18 (Anon. 2017-18). India is the second largest wheat producer (approximately 12 per cent world's wheat production) and consumer after China. In Gujarat, wheat is an important *rabi* crop and is grown almost throughout the state with 1.05 million hectares area under cultivation, total production of 3.05 million tonnes and an average yield of 2.89 tonnes per hectare during 2017-18 (Anon. 2017-18).

There are many factors, which are responsible for low average yield of wheat in this tract. Therefore, some efforts have been made to increase the yield by introduction of high yielding varieties, balanced fertilizer application & efficient use of irrigation facilities. But, still there are certain factors on which attention have not been given to increase the per hectare yield of wheat. One of such environmental factor is date of sowing. This factor affects the yield of wheat crop considerably.

Recently developed new varieties of wheat have potential to replace the old established varieties of the command area. Sowing time significantly influenced the growth, yield attributes, grain and straw yields. There are still many factors, which are responsible for low average yield of wheat in this tract. One of such environmental factors is untimely planting and it affects yield of wheat crop considerably (Saini *et al.,* 1988). Another important aspect is lack of improved varieties, which are having short maturity and suitable under late sown condition due to relatively shorter growing period available to crop. Moreover, varieties also vary both in yield and nutrient uptake under late sown condition (Singh *et al.,* 1997). Wheat varieties preferably photo and thermo insensitive nature generally suit to a wider range of sowing times in irrigated condition as they could maintain a good level of seed yield even in late sown condition. New varieties of wheat have been developed in the recent pasts which have higher yield potential even under delayed sowing with higher degree of tolerance to high temperature as well as diseases and insect pest resistance to check varieties. Sowing time significantly influences the growth, yield attributes, grain and straw yield.

Keeping in view the aforesaid facts, the present study is being undertaken to evaluate the performance and adaptability of newly developed varieties of wheat to a wider range of sowing dates in irrigated conditions under agro-ecosystem of Northern part of Gujarat.

Materials and Methods

A field experiment was conducted on sandy loam soil at Centre of Excellence for Research on Wheat, Sardarkrushinagar Dantiwada Agricultural University, Vijapur to study the "Response of wheat varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to sowing time" in North Gujarat conditions" during *rabi* season of the year 2012-13. The experiment comprising of twelve treatment combinations was laid out in Split Plot Design with four replications. The treatment consisted of three sowing times *i.e.,* 15th November (Timely), 1st December (Late) and 15th

December (Very late) and four wheat varieties (*viz.*, GW 11, GW 173, GW 322 and GDW 1255 (d)). The soil of experimental plot was loamy sand in texture. The soil was low in organic carbon (0.39%) available nitrogen (183 kg ha^{-1}) and medium in available phosphorous (49.32 kg ha^{-1}) and potash (298.78 kg ha^{-1}). The wheat varieties were sown with seed rate of 100 kg ha^{-1}, with spacing of 20.0 cm in between two rows. The economics was workout on current market price basis. Nitrogen was given as per recommended dose in the form of urea in which half dose of nitrogen applied as basal dose at the time of sowing and other half dose in two equal split. The full dose of phosphorus from SSP and potash from sulphate of potash was given as basal at the time of sowing. The values off "F" was worked out and compared with the values of table F at 5 per cent level of significance. The value of S.Em.± C.D. and C.V. per cent were also calculated (Cochran and cox, 1967).

Results and Discussion

Effect of date of sowing

The data presented in Table 1 and 2 showed that, among the date of sowing, date of sowing 15th November (Timely) recorded significantly the highest grain yield (4716 kg ha^{-1}). The same trend was found in straw yield, were it was recorded significantly the highest in S_1 (15th November (Timely)). Increase in grain yield kg ha^{-1} was 8.8 and 26.6 per cent as well as straw kg ha^{-1} 8.7 and 26.5 per cent higher as compared to late and very late (1st December and 15th December) sowing times, respectively. The higher grain and straw yield was observed on date of sowing 15th November (Timely), which might be due to the fact that timely (15th November) sowing of wheat mitigated the heat stress and simultaneously, the wheat crop had enjoyed better and congenial weather parameters with better development of growth and yield attributes which in turn resulted in higher yield. The findings are in conformity with those reported by Kumar *et al.*, (2004), Zende *et al.*, (2005), Shirpurkar *et al.*, (2008), Man, M.K. (2010), Jhanji, S. and Gill (2011), Jat Lokesh kumar *et al.*, (2013) and Md. Parwaize Alam *et al.*,(2013).

The result showed that the date of sowing S_1 (15th November (Timely)) recorded significantly the higher plant height (80.2 cm), Earhead/m^2 (328.1), length of spike (8.7 cm), days required to 50 % heading (65.2 days), grains/earhead (57.5) and test weight (52.7 gm). This was due to the fact that timely sowing condition of wheat provided better adoptability of weather parameters like, lower gape between minimum and maximum temperature, relative humidity, lower evapo-transpiration leading to better availability of soil moisture and nutrients, which in turn favoured to profuse growth in terms of more taller plant and late or very late sowing conditions restricted the growth in terms of shorter plants. The results are in agreement with those reported by Tyagi *et al.*, (2003), Zende *et al.*, (2005), Man (2010), Jhanji and Gill (2011) and Jat Lokesh Kumar *et al.*, (2013).

While protein content (14.81%) was found significantly higher in the date of sowing 15th December (Very late). This was might be due to very late (15th December) sowing or increase in temperature which favoured synthesis of amino acids but simultaneously, due to rise in temperature the grain development was retarded or grains of the wheat were shriveled resulting higher protein content in lower dry matter of the grains.

Effect of varieties

The data presented in Table 2 showed that, effect of varieties on grain and straw yield

found significant. The grain yield (4716 kg ha^{-1}) found significantly higher in variety V_3 (GW 322), however it was at par with variety V_1 (GW 11). The same trend was found in straw yield, were it was recorded significantly the higher in variety V_3 (GW 322), while it was at par with variety V_1 (GW 11). The increase in yield was 0.4, 10.2 and 11.9 per cent in grain yield and 0.4, 10.3 and 11.9 per cent in straw yield as compared to GW 11, GW 173 and GDW 1255.

The higher grain and straw yield was observed with variety V_3 (GW 322) which might be due to fact that in general, the aestivum wheat varieties (GW 322 and GW 11) have higher capacity of uptake of nitrogen, phosphorus, potash and other macro and micro nutrients and also have more consumption and utilization power leading to higher dry matter accumulation and their translocation in different growth and yield attributes resulting higher grain and straw yield compared to durum wheat GDW 1255. The findings are in close agreement with those reported by Mishra *et al.*, (2000), Jadhav and Karanjikar (2001), Rajput (2001), Tyagi *et al.*, (2003), Patel (2005), Verma *et al.*, (2005) Shripurkar *et al.*, (2008) and Man, M.K. (2010). The result showed that the variety V_3 (GW 322) recorded significantly the higher plant height (85.1 cm), length of spike (9.2 cm), days required to 50 % heading (62.7 days), grains/earhead (52.8) and protein content (14.81%), While test weight (52.7 gm) was found significantly higher in variety GDW 1255 (d), This was because of fact that the variety GW 322 have unique genetic makeup with more utilization of power of fertilizers and other nutrients with late maturity characteristics leading to higher dry matter accumulation and translocation in plant parts in terms of length of spike and number of grains per spike resulting obtained the higher values than other varieties.

Table.1 Growth and yield parameters of wheat genotypes at different date of sowing under irrigated conditions

Treatments	Plant Height (cm)	Ear head/m^2	Length of spike (cm)	Days to 50 per cent heading	Grains/ Ear head	Test weight (g)
Date of sowing:						
S_1: 15th November (Timely)	80.2	328.1	8.7	65.2	57.5	52.7
S_2: 1st December (Late)	74.8	298.5	8..6	60.0	50.2	45.0
S_3: 15th December (Very Late)	73.8	233.3	7.6	55.0	43.1	40.6
S. Em.±	1.47	9.85	0.12	0.66	1.38	0.73
LSD (P=0.05)	5.09	34.07	0.43	2.28	4.76	2.53
CV (%)	7.72	13.74	6.01	4.39	10.95	6.34
Varieties :						
V_1: GW 11	81.6	290.4	8.6	58.0	51.9	49.6
V_2: GW 173	67.7	298.0	7.5	58.7	50.4	42.7
V_3: GW 322	85.1	284.9	9.2	62.7	52.8	38.0
V_4:GDW 1255 (d)	70.8	273.2	7.9	61.0	45.9	54.2
S. Em.±	1.17	10.13	0.13	0.95	1.21	1.02
LSD (P=0.05)	3.40	NS	0.38	2.76	3.50	2.96
CV (%)	5.33	12.25	5.52	5.47	8.32	7.66
S X V	NS	NS	S	NS	S	S

Table.2 Yield, quality and BC ratio of wheat genotypes at different date of sowing under irrigated conditions

Treatments	Protein content (%)	Grain Yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})	Harvest index (%)	BCR
Date of sowing:					
S_1: 15th November (Timely)	13.19	4716	7068	40.00	2.59
S_2: 1st December (Late)	13.50	4302	6453	40.12	2.38
S_3: 15th December (Very Late)	14.81	3462	5193	39.99	1.98
S.Em.±	0.19	105.09	163.91	0.076	-
LSD (P=0.05)	0.65	363.70	567.22	NS	-
CV (%)	5.42	10.11	10.51	0.75	-
Varieties :					
V_1: GW 11	13.6	4391	6583	39.99	2.34
V_2: GW 173	13.9	3958	5933	40.18	2.11
V_3: GW 322	12.9	4408	6612	40.00	2.35
V_4:GDW 1255 (d)	14.9	3882	5824	39.99	2.34
S. Em.±	0.19	85.16	125.30	0.092	-
LSD (P=0.05)	0.56	247.12	363.61	NS	-
CV (%)	4.87	7.09	6.96	0.79	-
S X V	NS	S	S	NS	-

The findings are in agreement with Bahera (1994), Kumar *et al.*, (1994), Tyagi *et al.*, (2003), Patel (2005) and Verma *et al.*, (2005). However, was not found significant.

Interaction effect of sowing times and varieties (S x V)

Interaction effect between sowing times and wheat varieties (S x V) found significant in respect of length of spike (cm), number of grains per spike, 1000-grain weight, grain and straw yield (kg ha^{-1} as shown in Table 1a & 1b.

This was because of better and congenial weather parameters enjoyed by wheat varieties up to 1st December sowing *i.e.* optimum and suitable cold spell which favoured and enhanced the values of growth and yield attributes which reflected on grain and straw yield. The findings are in closed agreement with findings of Jadhav and Karanjikar (2001), Tyagi *et al.*, (2003) Shirpurkar *et al.*, (2008), Tahir Muhammad *et al.*, (2009) and Man, M.K. (2010).

Economics of different treatments

Economics play important role in deciding the adoption of particular treatment by the farmers. Therefore, the gross realization, net realization and benefit cost ratio (B.C.R.) were calculated for date of sowing and varieties.

Among date of sowing time maximum gross (`92216 ha$^{-1}$) and net realization (`56656 ha^{-1}) with maximum BCR value of 2.59 were obtained under S_1 (15th November (Timely)) sowing date.

Among varieties maximum gross 83752 ha^{-1}) and net realization (`48192 ha^{-1}) with

maximum BCR value of 2.35 were obtained under variety V_3 (GW 322).

On the basis of the results, it can be concluded that for securing higher yield and net return, wheat variety GW 322 should be sown for timely sowing (15th November) and GW 11 should be sown for late sowing (1st December) on sandy loam soil of North Gujarat conditions.

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How to cite this article:

Patel, M.D., M.S. Dabhi, A.K. Patel, H.A. Desai and Chatra Ram. 2018. Response of Wheat Varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to Sowing Time. *Int.J.Curr.Microbiol.App.Sci.* 7(10): 1555-1561. doi: https://doi.org/10.20546/ijcmas.2018.710.174