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Influence of Dates of Sowing on Phenology and Yield Associated Traits in *Rabi* Sorghum Genotypes

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ABSTRACT

Field experiment was conducted to study the influence of dates of sowing on yield and productivity traits in four rabi sorghum genotypes during 2016-17 at Main Agricultural Research Station (MARS), Dharwad. The phenological results indicated that, the number of days to 50 per cent flowering and complete flowering increased in S_6 condition (79.30 and 85.74 days respectively). Genotype BJV-44 recorded significantly maximum number of days to 50 per cent flowering and complete flowering (76.06 and 84.89 days respectively). Further, panicle length was significantly higher under S_6 condition (20.07 cm) followed by S_5 (19.67 cm). Under S_6 condition, reproductive phase coincided with higher temperature (>36^{0}C) resulting in reduced seed number per panicle (1007) while, maximum seeds per panicle was recorded under S_3 (1311). Genotype MS 104-B recorded maximum panicle length (21.59 cm) while, genotype BJV-44 recorded significantly higher seed number (1266) compared to other genotypes. The yield and yield associated traits were decreased with delayed dates of sowing. Seed setting percent was significantly higher under S_3 (78.95 %), while seed weight was recorded higher in S_4 (59.63 g). Among the genotypes, BJV-44 recorded maximum seed weight and seed setting per cent (58.22 g and 79.13 %). The influence of dates of sowing resulted in reduced test weight and yield kg per ha under S_6 condition (41.12 g and 841 kg ha^{-1}). Maximum test weight and seed yield was recorded under S_3 (44.69 g and 1378 kg ha^{-1}). Among the genotypes, BJV-44 recorded significantly higher test weight (44.24 g) and seed yield (1317 kg ha^{-1}) followed by genotype M 35-1 (1139 kg ha^{-1}). The experiment inferred that, genotype BJV-44 was found to be thermo-insensitive and higher reproductive efficiency compared to other genotypes. Thus, it may provide better source for breeding/developing heat tolerant genotypes in rabi sorghum.

Key words: *Panicle length, Seed setting, Seed weight, Test weight, Yield*

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] commonly known as **'*Jowar*'** is the fifth important cereal crop in the world next to wheat, rice, maize and barley. It is a staple food crop for more than 300 million people living in Asia and Africa. It is a valuable food crop in developed countries. India has the largest share (32.5%) in the world sorghum area and ranks second in production after USA.

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It is reported that, initiation of panicle is influenced by relative length of the day. The more day length tends to accumulate more heat units. This maximum utilization of heat units delays the initiation of panicle in sorghum genotypes. Mirza *et al.*[8], reported that, low temperatures not only affect normal heading but also panicle exsertion and prevent the normal elongation of internodes of rice. It is reported that, in mid winters (Oct-Dec), when the day temperature rises $>20^0$C and night temperature falls below$<10^0$C, leads to accumulation of plant pigments such as anthocyanin in vacuole[5]. This warm temperature prolongs the vegetative phase, extending the period of anthesis in sorghum genotypes. The effect of stress due to environmental factors on final yield may depend upon the growth stage in which it occurs and the genotype[3]. Shankarapndian *et al.*[11], showed that the reduction in grain yield was more, when stress occurred at reproductive stage and least in vegetative stage. Several studies confirmed that moisture stress at terminal stage drastically reduce the yield[7,10]. The reduction in yield is mainly attributed to reduction in its components. Number of seeds per panicle as well as yield per plant were reduced when planting was delayed indicating that even potential and high yielding genotypes are drastically affected under stress. Low yield was recorded in plants which were sown at 6thdate of sowing. In 3rddate of sowing number of seeds per panicle was maximum indicating suitability of this environment for the full expression of this trait. For grain yield per hectare the plants sown at, 3rddate of sowing recorded highest yield indicating that this period is optimum for sowing to achieve highest productivity.

MATERIAL AND METHODS

The field experiment was conducted during *rabi*2016-17at Main Agricultural Research Station (MARS), UAS, Dharwad, which is situated at $15^0$26' N latitude and $75^0$01'E longitude with an altitude of 678 above mean sea level. The experimental site consisted of medium deep black soil. The sowing dates were represented in Standard Meteorological Week (SMW). The six dates of sowing was undertaken to create a different temperature regimes(S_1-Sowing on 10th of September (37th SMW), S_2-Sowing on 20thof September (38th SMW), S_3- Sowing on 30thof September (39th SMW), S_4- Sowing on 10th of October (41st SMW), S_5-Sowing on 20th of October (42nd SMW), S_6-Sowing on 30thof October (44th SMW).The crop was raised with a spacing of 45 x 15 cm, fertilized with 80:40:40 N:P_2O_5:K_2O kg ha^{-1}. The T_{max} and T_{min} along with rainfall and humidity was recorded from the meteorological station UAS, Dharwad. The observation on days to 50 % flowering, days to complete flowering, panicle length and seeds per panicle, seed weight per ear head, seed setting per cent, test weight (g) and seed yield (kg ha^{-1}) were recorded at respective stage and at harvest.

RESULTS AND DISCUSSION

The experiment results indicated that, the number of days to 50 per cent flowering and complete flowering was delayed in S_6 condition (79.30 and 85.74 days, respectively). Among the genotypes, BJV-44 recorded maximum days for 50 per cent flowering and complete flowering (76.06 and 84.89 days, respectively). Further, panicle length and seeds per panicle differed significantly with dates of sowing and genotypes (Table 1). As the sowing dates were delayed the length of the panicle increased under S_6 condition (20.07 cm). Among the genotypes MS-104 B recorded significantly higher panicle length (21.59 cm) followed by BJV-44 (19.92 cm). The length of the reproductive phase is highly dependent on maximum and minimum temperatures. Usually cooler temperature favour more vegetative phase compared to temperatures above 34^0C.In the present study, flowering period extended with delayed sowing. S_6 condition recorded maximum number of days from 50 per cent flowering to complete flowering (79.33 and 85.74 days respectively). These results are in confirmative with the findings of Karhale *et al.*[4], who reported that, crop sown under 24th standard

meteorological week recorded maximum days for complete flowering as the longest photoperiod coincided with the reproductive phase. Further, the initiation of flowering is reported to be highly associated with the minimal required dry mater accumulation. The improved sorghum varieties, BJV-44 recorded maximum days for phenological stages compared to other genotypes. However, the seeds per panicle decreased with delayed sowing. This indicates that, under delayed sowing crop experiences heat stress during the reproductive phase that coincides with the high temperature.. Under S_3 condition, significantly more number of seeds was recorded (1311) followed by S_2 and S_4 (1213 and 1208 respectively) were found on par with each other. Significantly less number of seeds per panicle was recorded under S_6 (1007). Genotype BJV-44 and M 35-1 considered to be thermo-insensitive genotypes recorded more number of seeds per panicle (1266 and 1198 respectively) compared to other genotypes. Among the interaction levels, genotype BJV-44 under S_3 condition recorded significantly more number of seeds per panicle (1403).

The yield and yield associated characters such as seed weight per panicle, seed setting per cent, test weight and seed yield kg per ha differed significantly with respect to dates of sowing and genotypes (Table 2). Maximum seed weight per ear head was recorded under S_4 (59.63 g) followed by S_3 (54.92 g). However, seed setting per cent was maximum under S_3 (78.95 %) followed by S_2 and S_5 condition (77.02 and 76.40 % respectively). Less number of seeds per ear head in late sowing was due to less production of photosynthates. Differences in number of seeds per spike among varieties might be attributed to their genetic variability. These results are in line with those reported by Haider[2]. The early sowing resulted in better development of the grains due to longer growing period. These findings are strongly supported by those of Spink *et al*.[13], and Shahzad *et al.*[12], who had also reported decreased 1000 grain weight with delay in sowing. Differences in 1000 grain weight among varieties might be attributed to their genetic diversity. Genotypes MS 104-B being sensitive to heat stress was most affected compared to other genotypes. Among the interaction levels significantly higher seed weight per panicle and seed set per cent was recorded in BJV-44 (69.80 g and 81.13 % respectively) under S_3 condition. These results are in line with Mukri *et al.*[9], who reported that the seed setting per cent was more than 65 per cent as long as minimum temperature was higher than 13^0C irrespective of sowing dates. Whereas, seed set per cent was drastically reduced when temperature dropped down to below 10^0C. However, the genotypes exhibited differential response to the minimum temperature prevailed during flowering. While the decrease in seed set per cent to a considerable extent during late sown condition was due to the increase in temperature above 32^0C during the seed filling stage. Increases in temperature from 32/22 to 36/26.8 ^{0}C decreased number of filled sites and per cent seed set by 14 and 30 per cent as reported by Varaprasad *et al.*[14]. It has been reported that, plant density and planting date with their mutual effect has a significant impact on weight of 1000 grains. In the present study test weight reduced significantly under S_6 (41.12 g).However, maximum test weight was recorded under S_3 condition (44.69 g) followed by S_2 (43.87 g). These traits finally influenced on seed yield wherein maximum seed yield was recorded under S_3 (1378 kg ha^{-1}) followed by S_4 (1212 kg ha^{-1}). Significantly less seed yield was recorded under delayed sowing S_6 (841 kg ha^{-1}). Among the genotypes

BJV-44 recorded maximum seed yield under S_3 condition (1508 kg ha^{-1}). The significant increase in seed production is ascribed to favourable temperatures at different growth stages, which may increase photosynthetic rate, these assimilates will be supplied for increased seed growth in early sown crops than in late sown crop[1]. And[6]. Sowing date can affect development and maturity of sorghum in semi- arid region,

where high temperature and drought stress are common during development and maturity. Early sowing resulted in higher grain yield by producing early ground cover to make better use of precipitation and soil moisture also increased the probability of favourable consequences relative to grain yield and yield components. In the present investigation, the genotype BJV-44 sown during 30th September (39th SMW) recorded higher seed yield as compared to other genotypes and sowing dates.

Table 1: Effect of sowing dates on days to 50 % flowering, days to complete flowering, panicle length and seeds per panicle in sorghum genotypes

	Days to 50 % flowering	Days to complete flowering	Panicle length (cm)	Seeds per panicle
Dates of sowing (S)				
S_1(37th SMW)	70.60	80.36	18.82	1162
S_2(38th SMW)	72.30	79.65	18.68	1213
S_3(39th SMW)	68.30	79.07	19.55	1311
S_4(41st SMW)	67.30	78.16	17.83	1208
S_5(42nd SMW)	77.80	84.11	19.67	1114
S_6(44th SMW)	79.30	85.74	20.07	1007
S. Em. ±	**0.45**	**0.86**	**0.37**	**45.50**
LSD @ 5%	**1.49**	**2.70**	**1.18**	**143.4**
Varieties (V)				
M 35-1 (V_1)	73.00	82.16	17.18	1196
MS-104 B (V_2)	71.00	79.59	21.59	1098
RS-585 (V_3)	70.28	78.09	17.72	1118
BJV-44 (V_4)	76.06	84.89	19.92	1266
S. Em. ±	**0.25**	**0.41**	**0.30**	**23.97**
LSD @ 5%	**0.70**	**1.19**	**0.87**	**68.75**
Interaction (S x V)				
S_1V_1	71.33	82.00	17.07	1186
S_1V_2	69.00	78.00	21.47	1070
S_1V_3	68.33	77.11	18.00	1154
S_1V_4	73.67	85.78	18.73	1239
S_2V_1	73.33	81.62	17.13	1205
S_2V_2	70.00	77.67	21.60	1173
S_2V_3	69.33	75.45	17.07	1197
S_2V_4	76.33	85.00	18.93	1275
S_3V_1	69.33	79.88	16.60	1314
S_3V_2	67.67	76.51	21.87	1258
S_3V_3	64.33	75.00	17.67	1270
S_3V_4	72.00	84.55	22.07	1403
S_4V_1	65.67	78.67	16.40	1172
S_4V_2	65.00	76.33	20.20	1084
S_4V_3	65.33	74.00	15.60	1218
S_4V_4	69.33	83.32	19.13	1359
S_5V_1	77.00	84.00	17.67	1293
S_5V_2	76.33	83.67	22.47	1100
S_5V_3	76.33	83.33	18.40	995.0
S_5V_4	81.67	85.44	20.13	1069
S_6V_1	79.67	86.77	18.20	1005
S_6V_2	77.00	84.33	21.93	902.0
S_6V_3	77.33	83.66	19.60	874.0
S_6V_4	83.33	88.19	20.53	1248
S. Em. ±	**0.60**	**1.01**	**0.74**	**58.71**
LSD @ 5%	**1.73**	**2.90**	**NS**	**168.4**

Table 2: Effect of sowing dates on seed weight per ear head, seed setting percentage, test weight(g) and seed yield (kg ha^{-1})in sorghum genotypes

	seed weight per ear head	Seed setting percentage	Test weight (g)	Seed yield (kg ha^{-1})
Dates of sowing (S)				
S_1(37th SMW)	53.48	76.40	43.30	1160
S_2(38th SMW)	47.31	77.02	43.87	1095
S_3(39th SMW)	54.92	78.95	44.69	1378
S_4(41st SMW)	59.63	76.13	42.83	1212
S_5(42nd SMW)	47.42	75.45	42.39	1063
S_6(44th SMW)	43.43	69.67	41.12	841.0
S. Em. ±	**2.38**	**1.66**	**1.27**	**50.29**
LSD @ 5%	**7.50**	**5.23**	**0.38**	**158.4**
Varieties (V)				
M 35-1 (V_1)	53.48	77.65	42.52	1139
MS-104 B (V_2)	43.43	71.20	42.82	997.1
RS-585 (V_3)	51.08	74.43	42.55	1044
BJV-44 (V_4)	58.22	79.13	44.24	1317
S. Em. ±	**1.84**	**0.78**	**0.38**	**30.16**
LSD @ 5%	**5.81**	**2.23**	**1.08**	**86.50**
Interaction (S x V)				
S_1V_1	54.03	75.87	41.85	1060
S_1V_2	37.87	75.13	44.27	1029
S_1V_3	49.90	75.47	43.74	1043
S_1V_4	57.20	79.13	43.33	1329
S_2V_1	54.47	78.47	44.92	1188
S_2V_2	50.93	74.00	43.17	1026
S_2V_3	53.00	77.47	42.94	1119
S_2V_4	58.70	78.13	44.47	1306
S_3V_1	57.80	79.40	44.92	1358
S_3V_2	53.53	76.20	45.18	1355
S_3V_3	57.40	79.07	44.20	1292
S_3V_4	69.80	81.13	44.47	1508
S_4V_1	54.93	78.27	40.30	1163
S_4V_2	51.20	70.40	42.77	1076
S_4V_3	53.93	77.13	41.24	1293
S_4V_4	60.93	78.73	46.99	1317
S_5V_1	50.33	70.47	42.48	1206
S_5V_2	36.43	69.53	42.19	861.5
S_5V_3	48.47	64.90	42.11	855.7
S_5V_4	52.67	72.93	42.80	1327
S_6V_1	49.33	77.33	40.64	1042
S_6V_2	30.60	59.27	39.36	630.7
S_6V_3	43.80	63.73	41.10	652.8
S_6V_4	50.00	78.33	43.37	1117
S. Em. ±	**2.91**	**2.18**	**0.92**	**73.87**
LSD @ 5%	**8.35**	**6.26**	**2.64**	**211.9**

(SMW – Standard Meteorological Week)

REFERENCES

1. Aslani, F. and Mehrvar, M. R., Responses of wheat genotypes as affected by different sowing dates. *Asian J. Agric. Sci.*,**4(1):** 72-74 (2012).
2. Haider, R. S., Growth and yield response of three wheat varieties to N alone and in combination with P and P + K under late sown conditions. *M.Sc. Agri Thesis*, Univ. Agri., Fasilabad, Pakistan. (2004).
3. Jones, O. R. and Johnson, G. L., Row width and plant density effects on Texas high plains sorghum. *J. Agric.*, **4:** 613–619 (1991).
4. Karhale, M. B., Jaybhaye, P.R., Asewar, B.V. and Shinde, P.B., Effect of different sowing dates on growth and yield of *kharif* sorghum hybrids. *IOSR J. Agric. Vet. Sci.*, **7(12):** 5-8 (2014).

5. Kumar, S., Mallikarjuna, J., Thakur, P., Kaistha, S., Sharma, K. D. and Upadhyaya, H. D., Growth and metabolic responses of contrasting chickpea (*Cicer arietinum* L.)genotypes to chilling stress at reproductive phase. *Acta Physiol. Plantarum*, **33(3):** 779-787 (2011)
6. Lauer, J. G. and Partridge, J. R., Planting date and nitrogen rate effects on spring malting barley. *J. Agron.,* 82: 1083-1088 (1990).
7. Ludlow, M. M., Santamaraia, J. M. and Fukai, K., Contribution of osmotic adjustment to grain yield in sorghum under water limited condition II. Water stress after anthesis. *Aus. J.Agric. Res.*, **41:** 67-68 (1990).
8. Mirza, H., Kamrun, N. and Masayuki, F., Extreme temperature responses, oxidative stress and antioxidant defense in plants. pp. 12-15 (2013).
9. Mukri, G., Biradar, B.D., Uppar, D.S. and Salimath, P.M., Influence of different temperature regimes on seed setting behaviour and productivity traits in *rabi* sorghum. *Elec. J. Plant Br.*, **1(4):** 1042-1048 (2010).
10. Rao, C. L. N., Effect of stress during grain filling on growth, yield and yield components of glossy and non glossy lines of grain sorghum. *J. Res.*, **2(4):** 38-44 (1997).
11. Shankarapandian, R., Krishnadas, D., Muppidathi, N. and Chidambaram, Variability studies in grain sorghum for certain physiological characters under water stress condition. *Crop Imp.*, **20:** 45 -50 (1993).
12. Shahzad, K., Bakht, J., Shah, W. A., Shafi, M. and Jabeen,N., Yield and yield components of various wheat cultivars as affected by different sowing dates. *Plant Sci*., **1:** 52-525 (2002).
13. Spink, J. H., Semere, T., Sparkes, D. L., Whaley, J. M., Foulkers, M. J., Clare, R. W. and Scott, R. K., Effect of sowing date on plant density of winter wheat. *Annl. Appl. Biol.*, **137:** 179-188 (2000).
14. Varaprasad, P.V., Kenneth, J. B. and Hartwell, A. L., Adverse high temperature effects on pollen viability,seed-set, seed yield and harvest index of grain-sorghum [*Sorghum bicolor* (L.) Moench]. *Agric. Forest Meteorol.*, **139:** 237–251 (2005).