Studies on canopy temperature of different Rabi Sorghum genotypes under dry land condition

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ABSTRACT

A field experiment has conducted during rabi season of 2010-11 to evaluate canopy temperature of different *rabi* sorghum genotypes under dry land condition at Parbhani. Among all the genotypes, Parbhani Moti showed better performance for grain and fodder yield. In case of meteorological aspects like canopy temperature and temperature differential (Tc-Ta), the genotype K-677 showed more canopy temperature throughout the growth period of the crop. The range of the canopy temperature and Tc-Ta throughout the growth period was from 29.0 to 34.0 °C and -8.6 to +4.5 °C, respectively. The K-677 genotype showed lowest grain yield as well as lowest soil moisture content and it showed that the canopy temperature was negatively correlated with yield of the crop. The genotypes K-219, K-369, K-217, K-252, K-606 and E-36-1 matured moderately early, showed moderate canopy temperature, moderate Tc-Ta and moderate grain and fodder yield, so that these genotypes possess characters attributing drought tolerance.

Keywords: *Rabi sorghum, Canopy temperature, Water stress, Tc-Ta.*

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is one of the most major food grains of the world. It is cultivated in tropical and subtropical climates, especially in semi-arid tropics. In addition, the fodder and straw is feed to millions of animal providing milk and meat for man. It is one of the most widely grown under dry-land for food grain in India. Moisture stress at any stage of the crop growth reduces yield considerably. There exist genotypic differences with regard to their response to moisture stress resulting in yield reduction. Hence, it is important to isolate genotypes which are affected to a lesser degree by moisture stress. Such genotypes could be directly recommended for cultivation under rainfed condition. Canopy temperature have been recognized as indicator of overall plant water status (Blum *et al.*,1982; Jackson and Pinter, 1981; Idso *et al.*, 1982), irrigation scheduling (Wanjura *et al.*,1995), cultivar comparison for water use (Pinter *et al.*, 1990; Hatfield *et al.*, 1987 Chantereau *et al.*, 2001; Morgan *et al.*,

2002; Kumar *et al.,* 2009). Considering these aspects in mind the present experiment was carried out using sorghum genotypes at Parbhani.

MATERIALS AND METHODS

The experiment was carried out during the rabi seasons (October - February) of 2010–2011 at the research farm of Department of Agricultural Meteorology, Marathwada Krishi Vidyapeeth (Latitude 19^0 08' N, Longitude 76^0 50' E and altitude 409 m amsl), Parbhani, India. The study site is situated in the subtropical climate zone with average annual rainfall is 957.6. The experiment was laid out in randomized block design with twenty genotypes with three replications. The treatment details were cv; K-219, K-369, K-217, K-252, K-225, K-352, K-241, K-279, K-648, K-282, K-606, K-677, RSG-04005, Phule Mauli, Akola Kranti, Parbhani Jyoti, Parbhani Moti, B-15, R-16, and E-36-1. Weather observations recorded at meteorological observatory during *rabi* season were used to study the effect of weather on crop growth. The canopy temperature was recorded at each phenophases of the crop growth between 13.30 and 14.30 hour by using Telatemp thermometer (Teletemp model (AG-42)).

RESULTS AND DISCUSSION

Canopy temperature and canopy temperature-air temperature differential

The result revealed that canopy temperature was influenced significantly on different genotypes (Table1). The mean canopy temperature throughout all growth stages in all genotypes was observed in between 30.2 °C (Physiological maturity) and 31.8 °C (dough stage). It is also observed that lowest canopy temperature in B-35 (25.8 °C) at panicle initiation and highest in K-217 (33.6 °C) at boot stage, it means that the variation in canopy temperature has influenced by the genotype as well as growth stage of *rabi* sorghum crop. The data revealed that the growth stage wise lowest canopy temperature was observed in B-35 (25.8 °C), K-219 (31.8 °C), K-369 (31.4 °C), K-369 (30.9 °C) and K-225 (27.3 °C) during the panicle initiation, boot stage, flowering stage, dough stage and physiological maturity respectively and the highest canopy temperature in K-225 (32.5 °C), K-217 (33.6 °C), K-677 (33.8 °C), K-677 (32.6 °C) and RSG-04005 (31.5 °C) at panicle initiation, boot stage, flowering stage, dough stage and physiological maturity respectively.

The similar results were obtained during observations of canopy temperature- air temperature differential (Table 1) and positive values of CT-AT deferential showed water stress and negative values shows availability of soil moisture to plant or crop. It was found that there was no moisture stress in all genotype at panicle initiation. It also revealed that there was observed slight moisture stress at boot stage in K-252, K-677, E-36-1 and Parbhani Moti and amongst stressed genotypes more stress was observed in E-36-1 and Parbhani Moti and lowest stress observed in Phule Mauli as compared to all genotypes. It also observed that the soil moister stress experienced in all genotype at flowering stage and it was observed highest in K-677 and lowest in K-219. At dough stage it was observed that the significantly highest soil moister stress in K-677 and at par with RSG-04005 and significantly lowest in K-252 and it was at par with K-369 and K-648. However, it was observed that the soil moister stress at physiological maturity in all genotype and significantly highest in K-677 and lowest in Phule Mauli.

Soil Moister Content (%)

The data regarding soil moisture of different genotype of *rabi* sorghum are presented in (Table 2). The differences in soil moisture of the genotype were significant at all crop growth stages. The mean soil moister was consistently decreasing from 45 DAS (initial growth stage) to at harvest (boot stage to physiological maturity stage) in all the genotypes, while at 15 DAS the soil moisture level was high due to received good quantum of rainfall (69.5 mm in 38 MW and 41.4 mm in 39 MW) and it was observed low at 30 DAS, it was due to a dry spell experienced during 40 and 41 MW. The genotype K-677 showed significantly lowest soil moisture content consistently throughout growth period except at 45 DAS in Akola Kranti and at 175 DAS in K-282. The genotype K-217 showed significantly highest soil moisture content consistently throughout the growth period except K-252 at 90 DAS and K-282 at 105 DAS.

Phonological parameter

Significant differences were observed in attaining the 50% flowering, physiological maturity, grain and fodder yields within the genotype of *rabi* sorghum (Table 2). Mean number of days required for 50 per cent flowering showed significant differences among the genotypes. General mean for 50 per cent flowering was observed 64.9 days. Genotypes K-219, K-352, K-241, and K-606 flowered significantly earlier (57 days) and later flowered than other genotypes Phule Mauli (72.3 days). The similar result were shown by Norem *et al.*, (1985), he found that the genotypic difference in days required for 50 per cent flowering in *rabi* sorghum genotypes. The days required for attaining the physiological maturity is given in (Table 2) and it showed that the mean number of days required for physiological maturity were 110.7 days with significant difference amongst the genotypes. The genotype K-352 and K-606 matured significantly earlier (105 days) and delay attained physical maturity by Parbhani Moti (122.3) than all other genotypes. The *rabi* sorghum crop grown on residual soil moisture which was stored by soil due to preseasonal rainfall and early maturity of the genotypes helpful to escape the crop from terminal moisture stress during physiological maturity stage. Similar results were reported by Kadam *et al*. (2002).

Grain and fodder yield

The data on mean grain yield in various genotypes are presented in (Table 2). The data indicated that significant differences were observed amongst genotypes in respect of mean grain and fodder yield. The data revealed that highest grain yield was observed in genotype Parbhani Moti (22.1 q ha^{-1}) and lowest in K-677 (17.7 q ha^{-1}). The genotype Parbhani Moti was significantly superior over all other genotypes except K-219, K-369, K-217, K-252, K-606, E-36-1 and Akola Kranti with which it was at par and similar results were reported by Kadam *et al.*, (2002). The data on fodder yield indicated that significant difference amongst all the genotypes in respect of mean fodder yield. The genotype Parbhani Moti showed similar results like grain yield and it was observed significantly (79.0 q ha^{-1}) superior over all other genotypes except K-369, K-217 and Parbhani Jyoti with which it was on par Kusalkar *et al*., (2003).

It can be concluded that drought tolerance, may be considered in future breeding programme of rabi sorghum to make improvement in grain yield. During the experimental season rainfall occurred at the early growth period of the crop, the considerable stress condition did not occurred in most of the genotypes. The major findings of this study are canopy temperature effects are important and there were

negative interactions between temperature and yield. However, these genotypes need further intensive screening for drought tolerance characters in concern to weather parameters.

Table 1

Canopy temperature (^{0}C) and CT-AT differential of sorghum genotypes at different growth stages

Genotype	P_2 Panicle initiation		P_3 Boot stage		P_4 Flowering		P_5 Dough stage		P_6 Physiological maturity	
	CT	CT-AT	CT	CT-AT	CT	CT-AT	CT	CT-AT	CT	CT-AT
K-219	31.2	-1.0	31.8	-0.7	31.6	0.1	31.6	4.0	31.2	3.4
K-369	29.4	-1.9	32.0	-1.3	31.4	0.5	30.9	2.7	31.0	3.3
K-217	31.0	-1.8	33.6	-0.03	33.1	1.2	32.2	3.9	29.4	1.7
K-252	31.7	-1.0	32.2	0.3	31.9	0.5	31.7	2.5	29.4	2.6
K-225	32.5	-0.7	32.4	-0.6	32.3	0.4	32.0	2.9	27.3	3.2
K-352	31.4	-0.7	32.0	-0.1	31.7	0.8	31.2	3.0	30.7	2.1
K-241	29.9	-3.2	33.1	-0.5	32.7	1.5	32.2	3.2	29.3	1.3
K-279	31.7	-3.6	33.0	-0.4	32.7	0.9	32.2	3.5	29.3	1.7
K-648	30.3	-2.5	32.1	-1.5	32.1	0.9	31.2	2.7	30.5	2.3
K-282	30.0	-2.4	33.1	-0.5	32.6	1.3	31.9	3.5	31.1	2.1
K-606	30.9	-1.8	31.9	-1.8	31.8	1.0	31.5	3.5	30.0	1.9
K-677	31.8	-0.4	34.1	0.1	33.8	2.8	32.6	4.5	31.0	3.7
RSG-04005	31.5	-1.5	32.9	0.2	33.0	1.4	32.3	4.4	31.5	2.4
E-36-1	31.0	-1.9	32.1	0.6	33.1	1.6	32.1	3.4	31.0	2.6
Akola Kranti	30.5	-2.0	33.4	-1.4	32.7	1.3	31.7	3.2	30.5	2.4
Parbhani Moti	30.3	-2.4	33.1	0.6	31.7	1.6	32.1	3.4	29.1	1.8
Parbhani Jyoti	30.0	-2.5	32.5	-1.5	32.2	0.9	31.5	3.6	29.5	1.3
Phule Mauli	28.9	-3.9	32.8	-2.0	32.5	1.7	31.8	4.2	29.8	1.1
B-35	25.8	-3.4	32.4	-1.6	33.3	1.7	31.8	4.1	31.4	3.2
R-16	29.9	-3.0	32.9	-1.0	32.2	0.7	31.6	3.0	31.0	3.0
Mean	30.5	-1.9	30.2	-0.7	30.5	1.1	31.8	3.4	30.2	2.3
P = 0.05	2.3	-3	0.2	1.1	2.3	1.1	0.7	0.7	0.2	0.6

CT - Canopy temperature, AT - Air temperature, CT-AT - Differential temperature between CT and AT

Table 2

Mean soil moisture content (%), phenological parameters and yield of sorghum genotypes.

Genotype	Days after sowing							Days to 50% flowering	Days to physiological maturity	Grain yield (q ha^{-1})	Fodder yield (q ha^{-1})
	15	30	45	60	75	90	105				
K-219	30.6	30.3	32.9	31.3	28.6	26.3	26.4	57.0	105.6	20.2	74.7
K-369	32.4	31.7	33.4	31.3	31.2	28.4	26.6	60.0	108.0	21.1	75.5
K-217	35.4	33.0	33.5	32.7	32.1	28.6	26.9	57.1	105.3	21.7	76.1
K-252	33.3	32.6	33.0	32.3	29.4	29.0	25.8	58.3	107.0	21.4	72.0
K-225	31.2	30.5	33.5	31.2	28.0	27.4	27.8	59.3	107.3	18.6	76.3
K-352	31.6	30.3	33.4	31.2	28.1	27.0	26.2	57.0	105.0	18.6	72.8
K-241	31.8	27.8	32.4	28.5	27.3	26.5	25.9	57.0	105.3	19.7	74.3
K-279	32.8	28.4	31.6	28.6	26.3	27.8	26.3	58.0	107.0	18.8	76.5
K-648	31.8	27.7	31.0	28.3	26.9	28.6	27.1	60.0	108.0	19.8	74.8
K-282	32.7	27.3	29.0	28.0	25.5	27.2	28.0	60.0	108.0	18.9	76.6
K-606	31.8	28.4	31.3	28.2	26.3	27.8	26.7	57.0	105.0	20.4	73.5
K-677	30.0	27.0	28.0	27.2	26.4	26.0	25.0	60.0	124.0	17.7	77.3
RSG-04005	32.5	30.8	31.8	30.3	29.6	28.1	25.8	58.0	107.0	19.4	78.3
E-36-1	31.3	31.0	30.6	31.3	29.8	27.5	26.9	57.3	106.0	20.0	72.1
Akola Kranti	31.3	27.2	27.2	27.9	27.7	26.8	26.0	70.0	119.3	20.6	73.3
Parbhani Moti	31.3	27.2	28.6	28.2	26.6	27.8	27.8	60.0	122.3	22.1	79.0
Parbhani Jyoti	32.6	27.0	28.6	28.0	25.5	28.2	27.3	72.0	122.0	20.0	78.8
Phule Mauli	33.1	27.6	28.4	27.7	27.0	27.4	26.5	72.3	110.0	20.6	68.9
B-35	31.3	29.0	31.4	27.6	26.5	26.5	26.5	71.6	119.3	17.9	75.0
R-16	30.1	29.0	31.4	28.4	28.1	26.7	26.0	67.6	116.0	19.1	74.9
Mean	32.0	29.9	30.9	28.9	27.6	26.3	26.6	64.9	110.7	21.4	73.9
P = 0.05	1.1	1.2	0.1	0.1	0.1	0.1	0.7	2.4	0.6	2.1	2.6

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