Physiological variation in growth and yield of *Rabi*-sorghum genotypes

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ABSTRACT
A field experiment was conducted in Medium block soils at Regional Agricultural Research Station, Bijapur, University of Agricultural Sciences, Dharwad (Karnataka) during *Rabi* season 2006-07. Among the genotypes RSLG 1119, RSLG871, RSV 423, and Maulee have given higher yields compared to other genotypes. The factors that favoured the higher yields were leaf area index, chlorophyll content, relative water content, and panicle dry weight. The production of dry matter alone donot help in realizing the higher yield. In case of higher yielder there was a efficient dry matter production as well as translocation from source to sink. Less number of factors in moderate and only few factors have favoured the low yielders. It was observed that the differential performance of genotypes were due to difference in dry matter partitioning efficiency.

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Key words : Sorghum, Dry matter production, Harvest index, Relative water content

INTRODUCTION

Sorghum [*Sorghum bicolar* (L.) Moench] is a globally important cereal crop. It is grown next to wheat, rice and maize. It has wider adoptability and is being grown in Africa, America, Asia and other parts of the globe. Among the crops, since the sorghum stands first to give more yield even under moisture stress conditions, it is a crop for dry regions and scanty rainfall area.

Rabi Sorghum is grown in parts of Maharashtra, Karnataka and Andhra Pradesh during *Rabi* season, the crop experiences a complex stress situation such as increasing temperature, hot and dry winds after anthesis, reducing or depleting soil moisture in the season. Since, the degree of stress tolerance varies with genotypes, some are very well adopted to dry conditions than others (Bapat *et al.*, 1975). An effort was made to assess the performance of various genotypes in terms of their various growth, physiological and yield parameters under receding soil moisture conditions in shallow soils.

MATERIALS AND METHODS

A field experiment was conducted in medium soils at Regional Agricultural Research Station, Bijapur, University of Agricultural Sciences, Dharwad (Karnataka) during *Rabi* season of 2006-07. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The genotypes used were RSLG1119, RSLG871, RSV423, PVR616, PVR617, IS23399, PVR624, SSV84, CRS9, CRS10, CRS11, SPV1546, Maulee (C), M35-1(C), and CSV216R (C),.The seeds were hand dibbled at the spacing of 60 cm x 15 cm during fourth week of September. The plot size was 13.5m^2. The inputs, fertilizer dose and plant protection measures were followed as per the recommended practices.

The observations recorded were plant height at maturity, days to 50 per cent flowering, days to physiological maturity, Leaf area index(LAI) at 50 per cent flowering, leaf and stem dry weight at 50 per cent flowering and at maturity, total chlorophyll, chlorophyll stability index, relative water content (RWC), total biomass, yield and yield components. The LAI was computed by adopting the formula given by Stickler (1961). The relative water content by using the formula given by Barss and Weatherly (1962).

RESULTS AND DISCUSSION

The production of total biomass and its translocation towards sink are vital in realizing the higher yield. This biomass production is governed by leaf characters such as LAI, presence of functional mesophyll tissue particularly after anthesis and relative water content (RWC) of leaves. LAI indicates an area available for interception of light energy. The leaf dry weight indicates the amount of mesophyll available for carbon assimilation. The homeostasis of a leaf is maintained by relative water content. If the LAI is higher leaf weight and RWC the biomass production and its translocation towards sink will be high. The total biomass at the maturity indicates the potential of genotype to harvest solar energy. There was increase in total biomass in all the genotypes as the crop

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advanced towards maturity. The grain yield of a genotype depends on quantum of dry weight translocation towards sink. The stem is a reservoir of biomass in case of sorghum. Dry matter is translocated from stem to panicle. This is evident by the reduction of stem dry weight at maturity and increase of panicle dry weight from days to 50 per cent flowering to physiological maturity.

Among the genotypes, RSLG1119 (2080kg/ha), RSLG871 (1885kg/ha), RSV423 (1843 kg/ha), and PVR 616 (1706kg/ha) gave higher yields compared to other genotypes. In case of RSLG1119, leaf area index, (4.00), leaf dry weight at 50 per cent flowering (156.6 g/m^2) and at physiological maturity(88.3g/m^2), chlorophyll content(3.03mg/g fresh wt) and RWC (86%) (Table1) were higher. Higher leaf dry weight coupled with chlorophyll and relative water content enhanced the biomass production. The stem dry weight reduced from 387.3 g m^2 (at 50% flowering) to 281.6g m^2(at maturity) where as the panicle dry weight increased from 76.6g to 273.3g between these two stages. The increased panicle weight indicated the efficient translocation of photosynthates. This was reflected on the higher harvest index (41.3%) and 1000 grain weight (32.9) resulting in higher grain yield. In case of genotype RSLG 871, LAI (3.96), leaf dry weight at 50 per cent flowering (137.0 g), chlorophyll (3.0 mg/g fresh wt),RWC (85 %), stem weight (341.6g/m^2) were high. These helped RSLG871 to produce more amounts of carbohydrates and transfer the same to grains. This favored higher harvest index(41.0%) and higher 1000 grain weight (31.3g) and contributed to higher yield (Table 1). Similar trend was noticed in case of genotypes RSV 423, PVR-616 and Maulee with respect to some of the growth and yield parameters.

The genotypes CRS 9, SSV 84, SPV 1546, CSV 216R and M35-1 gave lower yields (moderate yields) compared to the above said genotypes. However, among these genotypes, Maulee recorded higher yield. In this genotype there was drastic enhancement of panicle dry weight from 50 per cent flowering (71g) to physiological maturity (266.1g). LAI, (3.76),stem weight at maturity (245.0g) were moderate. As a result, the harvest index of (38.3%) was slightly lower compared, that in case of genotypes which gave higher yields. In case of SSV 84, the stem dry weight reduced from 187.0 g to 71.6g and panicle dry weight increased from 71.6 g to 267.0 from 50% flowering to physiological maturity. These results are in conformity with the findings of Chimmad and Kamtar (2003) and Suryavanshi *et al.* (2007).

Among the remaining genotypes, the genotype PSSV 84 recorded lowest leaf dry weight both during 50 per cent flowering (113.6 g) and physiological maturity (68.6

Table 1 : Phenology, leaf dry weight, LAI chlorophyll and RWC of sorghum genotypes grown under medium soils

Sr. No.	Entry	Plant height (cm)	Days to 50% flowering	Days to physiological maturity	LAI	Leaf dry wt. at 50% flowering (g/m^2)	Leaf dry wt. at Physiological maturity (g/m^2)	Percent reduction in leaf dry weight from 50% flowering to Physiological maturity	Chlorophyll content in leaf mg/ g fresh wt.	RWC (%)
1.	RSLG 1119	210.0	76.0	114.6	4.00	156.6	88.3	43.61	3.03	86.0
2.	RSLG 871	198.3	76.0	115.0	3.96	137.0	82.0	40.15	3.00	85.0
3.	RSV 423	192.6	74.3	116.6	3.86	112.6	70.0	37.83	2.70	82.3
4.	PVR 616	194.6	78.0	119.6	3.63	145.0	85.0	41.38	2.60	82.2
5.	PVR 617	199.3	74.0	116.0	3.86	115.0	70.1	39.04	2.30	80.3
6.	IS 23399	143.3	68.3	106.0	3.50	130.0	80.0	38.46	1.93	76.6
7.	PVR 624	200.0	85.0	121.6	3.93	145.0	90.3	37.72	2.50	82.0
8.	SSV 84	128.0	75.0	117.6	3.60	113.6	68.6	39.61	2.60	84.0
9.	CRS 9	183.6	71.3	109.6	3.66	127.0	75.0	40.94	2.56	78.6
10.	CRS 10	192.0	68.0	106.0	3.56	129.3	89.3	30.94	2.90	81.0
11.	CRS 11	163.6	71.3	107.6	4.00	130.0	97.6	24.92	3.00	77.1
12.	SPV 1546	190.0	73.0	110.0	3.16	137.0	91.6	33.14	2.60	77.0
13.	Maulee (C)	188.6	72.0	113.6	3.76	133.3	86.6	35.03	2.93	82.0
14.	M 35-1 (C)	186.0	79.0	120.6	3.63	193.3	83.0	57.06	2.76	79.6
15.	CSV 216 R (C)	196.0	81.0	121.3	3.96	117.3	76.0	35.21	2.56	79.6
S.E.		2.05	0.50	0.55	0.16	0.28	4.20		0.50	1.10
C.D. (P=0.05)		6.14	1.51	1.61	0.48	8.41	12.60		1.56	3.32

Table 2 : Stem dry weight, panicle dry weight, total biomass, harvest index and yield of sorghum genotypes under medium soils

Sr. No.	Entry	Stem dry wt. (g/m²)			Panicle dry wt. (g/m²) at			Total biomass (g/m²) at		1000 Grain wt. (g)	Harvest index (%)	Grain yield (kg /ha)
		Days to 50% flowering	Days to physiological maturity	% decrease in leaf dry weight	50% flowering	Physiological maturity	% increase	50% flowering (g/m²)	Physiological maturity			
1.	RSLG 1119	387.3	281.6	27.29	76.6	274.3	258	614.0	654.3	32.9	41.3	2080
2.	RSLG 871	341.6	244.3	28.48	72.0	265.0	268	556.0	592.0	31.3	41.0	1885
3.	RSV 423	321.6	213.3	33.68	68.3	258.3	278	504.3	541.6	30.0	37.7	1843
4.	PVR 616	351.6	248.3	29.38	63.3	265.0	319	568.3	598.3	27.3	37.3	1706
5.	PVR 617	301.6	200.0	33.69	63.6	250.0	293	480.3	520.0	25.8	39.9	1093
6.	IS 23399	315.6	217.6	31.05	68.3	259.0	279	514.0	555.0	24.8	36.9	1091
7.	PVR 624	319.6	218.3	31.70	62.3	255.0	309	527.0	565.3	26.8	35.0	1446
8.	SSV 84	291.6	187.0	35.87	71.6	267.0	273	476.3	522.6	23.7	30.2	963
9.	CRS 9	315.0	207.0	34.29	60.0	251.6	319	502.0	533.6	26.8	38.0	1483
10.	CRS 10	327.0	220.0	32.72	72.6	265.0	265	528.3	574.3	26.6	40.3	1535
11.	CRS 11	333.3	214.0	35.79	74.6	263.3	253	536.3	579.6	28.3	35.6	1373
12.	SPV 1546	320.0	216.6	32.31	70.0	251.6	259	527.0	560.0	25.8	37.6	1460
13.	Maulee (C)	352.6	245.0	30.52	71.0	266.0	275	556.0	597.6	31.0	38.3	1676
14.	M 35-1 (C)	345.0	241.6	29.97	64.6	260.0	302	539.6	582.6	30.2	37.1	1506
15.	CSV 216 R (C)	325.0	217.6	33.05	62.6	242.6	288	504.6	537.0	27.8	35.6	1533
S.E.		3.80	3.60		2.8	2.1		11.3	13.5	0.50	0.38	15.2
C.D. (P=0.05)		11.40	10.81		8.4	6.3		33.9	39.4	1.51	1.14	45.6

g). The Harvest index (30.2%) was also less. As a result of this, the genotype could not harvest sufficient solar energy. This resulted in the lower total biomass both at 50 per cent flowering (473.6 g) and at physiological maturity (522.6 g). This reflected on the lower 1000 seed weight (23.7) and harvest index (30.2 %). Due to all these factors the genotype gave lower yields of 963 kg/ha (Table2). Among the genotypes few are high yielders, some are moderate yielders and others are low yielders. The differential performance of the genotypes is due differential portioning ability.

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