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Physiological variability parameters in growth and development in introgressed stay green lines of sorghum

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SUMMARY

A field experiment entitled Physiological variability parameters in growth and development in introgressed stay green lines of sorghum [*Sorghum bicolor* (L.) Moench] was conducted at the Experimental Farm of Sorghum Research Station, Marathwada Agricultural University, Parbhani. The introgressed stay green genotype S35SG 06026 recorded more plant height, number of leaves per plant, leaf area per plant, leaf area index, length x breadth of leaf, over other genotypes and all the checks at all growth stages under rainfed condition. The introgressed genotype S35SG 06027 flowered earlier than other genotypes and checks, The mean leaf dry weight was more in introgressed genotype S35SG 06026 followed by S35SG 07001. The Introgressed stay green genotype S35SG 06026 and S35SG 07001 showed maximum total dry matter and chlorophyll content per plant throughout the period of crop growth over other genotype and all the checks. Introgressed stay green genotype S35SG 06026 expressed more AGR. The introgressed line S35SG 06026 expressed more RGR followed by S35SG 07001. Introgressed stay green genotypes S35SG 06026 and S35SG 07001 recorded higher NAR than all other genotypes and checks. The introgressed stay green genotype S35SG 06026 recorded highest crop growth rate over all other genotypes and checks. Introgressed stay green genotype S35SG 06026 recorded significantly higher green and dry fodder yield over all the checks

Key words : Introgressed, Stay green, Physiological variability growth development in sorghum

Sorghum [*Sorghum bicolor* (L.) Moench] is self pollinating crop and belongs to graminae family. Sorghum is the fifth most important cereal crop in the world. It is dietary staple food of more than 500 million people in more than 30 countries of Africa, Asia, Oceania and the America. Sorghum carries out C4 photosynthesis which makes it adoptable to fluctuating environmental condition. Drought stress is the second most important abiotic constraint after soil nutrient deficiency for sorghum production globally. It is well adopted to semi-arid environment as it makes efficient use of available water in the soil under limited water conditions. Hence, it is regarded model crop for studying drought tolerance among grass species. Drought condition may occur at any stages of its growth which cause premature leaf senescence which in turn may be leads to stalk lodging and significant yield losses. The plant character associated with tolerance to terminal drought is called "stay green". In stay green senescence start on schedule but proceeds thereafter comparatively slow and chlorophyll in retained. The character is consider as valuable trait as it improves, genotype adaptation to drought stress condition. The lines are photosynthetically active as compared to genotypes not possessing this trait.

Therefore, the study was undertaken among the character of S35 based stay green QTLs introgressed backcross progenies to assess to study the variability parameters in growth and development.

MATERIALS AND METHODS

Experiment was conducted at the Experimental Farm of Sorghum Research Station, Marathwada Agricultural University, Parbhani during *Kharif* season (2008-09). Soil was medium black with moderate moisture retention capacity. Experiment was conducted on 24 genotypes in Randomised Block Design with three replications. The seeds were sown by dibbling method with 45 cm x 15 cm spacing with net plot size 2.70 m x 1.35 m. All the recommended packages of practices were followed to grow the crop. The five samples plant from each line were harvested separately and bagged properly after labeling it. These five plants were selected from each plot for recording biometric observations. The observations were recorded on characters *viz*., plant height, number of leaves, length x breadth, leaf area per plant, leaf area index, days to 50 per cent flowering, days to physiological maturity, chlorophyll content, total dry weight per plant, green fodder yield, dry fodder yield. The absolute growth

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rate (AGR), relative growth rate (RGR), net assimilation rate (NAR), crop growth rate (CGR) was calculated. The statistical analysis of data was carried out by analysis of variance method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The data on mean values are present in the Table 1 and 2. The introgressed stay green genotype S35SG 06026 recorded significantly the highest plant height followed by genotype S35SG 07001 at second position over all the checks. The genotype S35SG 06026 recorded the highest mean number of functional leaves per plant at all stages of crop growth. The genotype S35SG 06026 recorded high length x breadth of leaf at all the stages of crop growth followed by S35SG 07001, S35SG 06016. Introgressed stay green genotype S35SG 06026 has significantly recorded more leaf area per plant (dm^2) and leaf area index over all the genotypes and checks

The introgressed stay green genotype S35SG 06027 flowered earlier than all checks and all other genotypes followed by S35SG 06025 which was statistically at par with check CSH 16. Introgressed genotypes *viz.*, S35SG 06027, S35SG 06025, S35SG 06034, S35SG 07003 matured earlier than all the checks and are statistically at par with the check CSH 16.

The above results are in agreement with Babu and Reddy (1971), Rosenow *et al*. (1977), Rao and Singh

Table 1 : Mean performance of sorghum genotypes for yield attributing characters

Sr. No.	Introgressed genotypes	Plant height (cm)	No. of leaves/ Plant	Length x breadth (cm)	Leaf area per plant (dm^2)	Leaf area index	Days to 50% flowering	Days to physiological maturity
1.	S 35 SG 06001	210.87	11.33	744.47	5.53	8.54	73.66	122.87
2.	S 35 SG 06003	184.67	10.86	513.22	4.77	8.68	85.00	135.00
3.	S 35 SG 07001	224.33	11.86	819.03	5.97	9.16	69.33	118.83
4.	S 35 SG 07002	193.07	10.60	587.17	4.92	6.78	69.77	119.39
5.	S 35 SG 07003	180.33	10.53	581.64	4.00	6.81	64.31	112.80
6.	S 35 SG 06032	203.67	10.40	530.20	4.03	7.75	63.77	113.54
7.	S 35 SG 06034	172.47	10.80	450.52	3.42	5.88	63.77	112.59
8.	S 35 SG 06035	161.00	10.80	560.40	4.02	6.45	64.80	114.03
9.	S 35 SG 06025	177.67	10.86	788.62	5.42	8.86	62.97	112.31
10.	S 35 SG 06026	230.00	12.93	833.37	7.57	11.57	69.53	118.69
11.	S 35 SG 06027	210.67	11.73	723.2	5.38	9.11	62.00	111.73
12.	S 35 SG 06014	220.00	10.13	743.80	4.91	8.78	64.66	114.00
13.	S 35 SG 06015	175.00	11.46	539.97	5.47	8.77	69.33	119.17
14.	S 35 SG 06016	217.20	10.92	797.20	4.59	8.40	71.55	123.17
15.	S 35 SG 06021-A	220.33	11.26	736.19	5.66	8.72	68.50	120.50
16.	S 35 SG 06021-B	181.60	11.73	540.26	4.39	7.15	69.66	119.44
17.	S 35 SG 06022	220.20	10.86	738.03	5.46	8.43	71.06	121.68
	Recurrent parent							
18.	ICSV 111	196.00	10.46	748.81	4.96	7.37	68.55	119.26
19.	S 35	196.00	10.80	642.57	4.74	7.55	64.88	114.33
	Donar parent							
20.	B 35	55.333	9.86	541.43	3.11	5.21	69.44	120.27
21.	E 36-1	157.33	10.40	720.39	5.37	8.37	81.27	130.83
	Checks							
22.	RSSV 9	223.67	10.20	572.96	4.88	7.84	66.22	115.07
23.	HES 4	204.00	9.93	606.13	4.59	7.36	70.22	120.34
24.	CSH 16	184.33	10.73	620.10	4.87	7.45	63.22	112.97
	Mean	191.66	10.89	653.32	4.92	7.96	68.64	118.45
	S.E. ±	13.581	0.51	49.788	0.50	0.67	0.813	0.870
	C.D. (P=0.05)	37.587	1.14	137.79	1.399	1.87	2.25	2.40

(1978), McBee and Miller (1982), Kulkarni *et al*. (1983), Chowdhary *et al*. (1987), Van Oosterom *et al*. (1996), Rana *et al*. (1998), Andrew *et al*. (2000), Borell *et al*. (2000), Howarth and Howarth (2000), Yadav *et al*. (2002), Kadam *et al*. (2002), Awari *et al*. (2003).

The data on mean values is present in the Table 2. At harvest genotype S35SG 06026 recorded significantly and consistently high total dry matter per plant over check. While the genotype S35SG 06026 and S35SG 07001 were statistically at par with each other.

Introgressed stay green genotype S35SG 06026 have higher chlorophyll content which was consistently high at all growth stages of the crop growth. These result are in agreement with the result reported by Xu *et al*. (2000) and Hou *et al*. (1987) reported that crop drought tolerance associated with as increased chlorophyll content.

Introgressed genotype S35SG 06026 recorded the highest AGR over all the checks. These result supported by Patil *et al*. (2002) and Kim and Han (1990). The introgressed genotypes S35SG 06026 genotype like S35SG 07001, S35SG 06022, S35SG 06021-B, S35SG 06026 recurrent parent ICSV 111 recorded significantly highest RGR over check. The donar parent E 36-1 recorded significantly highest RGR over all the checks. This result

Table 2 : Mean performance of sorghum genotypes for Total dry weight/plant (g) AGR (g/day/plant), RGR(g/g/plant), NAR (g/dm²/day), CGR (g/m²/day), chlorophyll content (mg/g), green and dry fodder yield (kg/plot), grain yield (kg/plot) and harvest index (%)

Sr. No.	Introgressed genotypes	Total dry weight/ plant (g)	AGR (g/day/ plant)	RGR (g/g plant)	NAR (g/dm^2/ day)	CGR (g/m^2/ day)	Chlorpyll content (mg/g)	Green fodder yield (q/ha)	Dry fodder yield (q/ha)	Grain yield (kg/plot)	Harvest index (%)
1.	S 35 SG 06001	319.00	2.613	0.0130	0.708	9.18	0.373	27.26	16.81	2.31	12.08
2.	S 35 SG 06003	327.67	2.098	0.0166	0.451	5.26	0.329	30.87	17.70	3.37	15.93
3.	S 35 SG 07001	369.10	2.699	0.0223	0.816	11.25	0.523	32.85	16.49	4.85	22.72
4.	S 35 SG 07002	358.97	1.796	0.0203	0.529	5.18	0.248	26.62	15.07	1.89	11.14
5.	S 35 SG 07003	304.74	2.473	0.0095	0.779	8.09	0.321	27.29	16.13	3.62	18.32
6.	S 35 SG 06032	306.08	1.964	0.0163	0.592	6.09	0.284	26.43	12.36	3.54	22.26
7.	S 35 SG 06034	224.77	1.403	0.0123	0.713	6.09	0.276	20.34	8.21	2.95	26.43
8.	S 35 SG 06035	288.20	1.325	0.0220	0.574	5.14	0.352	25.43	14.56	1.78	10.89
9.	S 35 SG 06025	333.33	1.796	0.0196	0.433	5.27	0.296	20.64	12.92	2.21	16.70
10.	S 35 SG 06026	447.90	2.982	0.0250	1.045	18.18	0.542	34.20	18.05	6.91	29.03
11.	S 35 SG 06027	360.21	1.768	0.0133	0.533	6.29	0.254	29.67	15.14	1.52	9.12
12.	S 35 SG 06014	316.01	1.431	0.0133	0.765	10.10	0.331	25.03	17.60	2.66	13.12
13.	S 35 SG 06015	280.27	1.812	0.0136	0.664	8.32	0.376	21.49	9.88	3.71	27.29
14.	S 35 SG 06016	328.60	2.221	0.0200	0.428	5.10	0.409	27.15	14.54	1.62	10.02
15.	S 35 SG 06021-A	292.00	2.243	0.0210	0.660	8.27	0.341	24.12	15.86	3.24	16.64
16.	S 35 SG 06021-B	320.50	1.917	0.0176	0.276	3.01	0.246	25.42	14.52	1.61	9.21
17.	S 35 SG 06022	290.27	1.853	0.0220	0.842	11.03	0.321	23.80	12.06	4.35	25.51
	Recurrent parent										
18.	ICSV 111	263.50	1.638	0.0136	0.492	4.32	0.254	24.51	10.42	2.84	21.96
19.	S 35	261.90	2.242	0.0190	0.538	6.20	0.261	20.86	9.38	2.15	16.92
	Donar parent										
20.	B 35	204.67	1.307	0.0173	0.473	4.00	0.298	11.39	7.99	2.34	23.00
21.	E 36-1	330.83	1.262	0.0283	0.344	4.05	0.173	29.02	17.65	1.64	8.50
	Checks										
22.	RSSV 9	258.13	1.323	0.0130	0.663	7.29	0.299	15.11	13.92	3.20	16.73
23.	HES 4	288.17	1.788	0.0160	0.528	5.09	0.255	23.65	14.93	4.82	24.40
24.	CSH 16	268.27	1.907	0.0180	0.533	6.06	0.234	19.91	7.99	2.90	26.62
	Mean	305.96	1.911	0.0176	0.618	7.03	0.316	24.71	13.67	2.92	18.10
	S.E. ±	31.208	0.312	0.0030	0.104	0.68	0.045	2.117	0.48	0.088	0.79
	C.D. (P=0.05)	86.369	0.863	0.0089	0.288	1.89	0.126	5.858	1.34	0.244	2.20

supported by Patil *et al*. (2002) and Burondkar *et al*. (1988).

Introgressed stay green genotype S35SG 06026 recorded the highest NAR which shows significant superior performance over the rest of genotypes and all the checks. Introgressed stay green genotype S35SG 06026 recorded higher CGR overall genotypes and checks. Similar results were indicated by Burondkar *et al*. (1988), Patil *et al*. (2002) and Soza *et al*. (1973).

The data regarding CGR showed significant varietal differences. Similar result were indicated by Santamaria *et al*. (1990) and Baba *et al*. (2003) and Borell *et al*. (2000).

The data regarding fodder yield indicated that the varietal differences were significant. The introgressed genotype S35SG 06026 recorded higher green and dry fodder yield over all the checks.

High fodder yield may be because of its moderate height, high number of leaves, high leaf area, high leaf dry matter, high stem dry matter and high total dry matter. These similar differences in green and dry fodder yield in sorghum were reported by Rana *et al*. (1998) and Yadav *et al*. (2002).

Introgressed genotype S35SG 06026 recorded significantly higher grain yield followed by S35SG 07001, S35SG 06022 over check HES 4. Grain yield per hectare can be attributed to its more plant height, number of leaves, leaf area, total dry matter and chlorophyll content. Number of research workers and Awari *et al*. (2003) observed yield contributing characters. Henzell *et al*. (1992) reported positive association between green leaf duration and grain yield in sorghum. Thomas and Smart (1993) reported that photosynthesis is maintained for longer than normal in stay green type that they may yield more in crops for which carbohydrate is main harvest component.

Harvest index is a function of grain yield and dry matter production higher harvest index in variable leads to higher grain yield.

The Introgressed genotype S35SG 06026 recorded higher harvest index than all the genotype followed by S35SG 06015 on par to each other. These results agreement with the findings of Andrew *et al*. (2000).

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