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Effect of Bio Chemical aspects of Chlorophyll content, Nitrogen content and Potassium content with Grain Yield in Sorghum Genotypes under Post Flowering Moisture Stress Conditions

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ABSTRACT

A field experiment was conducted during rabi 2012-13 at research farm of Directorate of Sorghum Research, Rajendranagar, Hyderabad. The treatments comprised to screen the promising germplasm, advanced breeding lines and landraces to identify the new sources and traits associated with post flowering drought tolerance in sorghum. The crop was sown under well watered and water stress condition to examine the potential of Sorghum genotypes to adapt to the post flowering drought. Well watered and water stress (two main treatments) conditions and 10 Sorghum genotypes viz; CRS 4, CRS 19, CRS 20, PEC 17, CSV 18, M 35-1, Phule chitra, Phule moulee, EP 57 and CRS 1. The experiment was laid out in split plot design and replicated thrice.). The chlorophyll, nitrogen and potassium content in the fully expanded third leaf from the top was also positively and significantly correlated with grain yield (r = 0.65, 0.51 and 0.72, respectively).

Key words: *Chlorophyll content, Nitrogen content, Potassium content, Sorghum genotypes, Moisture stress conditions.*

INTRODUCTION

Sorghum (*Sorghum bicolor* (L) Moench) is one of the world's most important nutritional cereal crops and also the major staple food crop of millions of people in semi-arid tropics (SAT). It is considered as the king of millets and extensively grown in Africa, China, USA, Mexico and India. Sorghum ranks fourth among the world's most important crops after wheat, rice and maize. Its current world production stands at 64.6 million tonnes while in India current production is 7.4 million tonnes. In India, Sorghum is cultivated in both rainy and post rainy *(rabi*) season, mainly as a rain fed crop with about 85% of the production concentrated in Maharashtra, Karnataka and Andhra Pradesh. The national average productivity of Sorghum is very low (880 kg/ha). In India, it is the major dry land crop currently grown in about 7.69 m ha during both *kharif* (3.2 m ha) and *rabi* (4.50 m ha) seasons with a production of 7.73 m t. Sorghum is usually grown in areas with low rainfall, where it is difficult to grow other food crops and feed grains.

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Its ability to adapt to a such challenging situations makes Sorghum an important food and feed crop in the arid and semi-arid regions of the world[1].

In India, Sorghum is primarily cultivated in two distinct seasons: June to October (rainy/*kharif*) and October to February (post-rainy/*rabi*). Though *kharif* Sorghum yields better, the grain quality is severely affected due to grain mold disease, making it unsuitable for consumption. *Rabi* Sorghum grains are preferred for human consumption as they mature in rain-free and dry climate. In post-rainy season, Sorghum grain and fodder yields are low as the crop is grown on residual moisture and often experiences severe terminal drought stress.

MATERIAL AND METHODS

Field experiment was conducted during winter (*rabi*) season, 2012-2013 at the research farm of Directorate of Sorghum Research (DSR), Rajendranagar, Hyderabad located at Latitude 17^0 19' N, Longitude 78^0 28' E and at an altitude of 542 m above the Mean Sea Levels with ten genotypes of Sorghum under stress (stress during post flowering period) and well watered conditions. The experimental field was brought to a fine tilth by two harrowing and levelled with wooden planks before laying out of the experiment. The seed were sown in furrows on 1st October, 2012, by dibbling. The spacing maintained was 60 cm between rows and 15 cm between plants. A basal dose of 20 kg ha^{-1} N and 20 kg ha^{-1} P_2O_5 was applied before final ploughing. The seed were hand sown and the field was irrigated to saturate the soil profile with water to ensure uniform germination. Entire plots were irrigated as per schedule till initiation of flowering and in water stress treatments irrigation was withheld from flower initiation to maturity.

Total chlorophyll content was determined by following DMSO method[3] at 30 DAF. Third fully expanded leaf from the top was brought in polyethylene bags kept in an ice box from the field and used to estimate chlorophyll content. The absorbance of the leaf extract was measured at 645 nm, and 663 nm in a UV- Vis spectrophotometer (Elico, SL - 159) and a blank was run using DMSO. The total chlorophyll content was calculated by using the following formula and expressed in mg g^{-1} fresh weight.

$$\text{Total chlorophyll} = 20.2\ (A_{645}) + 8.02\ (A_{663}) \times \frac{V}{1000 \times W \times A}$$

Where,

A_{645} Absorbance of the extract at 645nm

A_{663} Absorbance of the extract at 663nm

W Fresh weight of the sample (g)

A Path length of cuvette (cm)

V Final volume of the chlorophyll extracts (ml).

Nitrogen content was estimated in third fully expanded leaf from the top by modified micro Kjeldhal method[4] at 30 days after flowering and expressed in percentage.

Potassium content in third fully expanded leaf from the top was estimated at 30 days after flowering. Potassium was estimated by di acid digestion method using Flame photometer[4] and expressed in percentage.

RESULTS AND DISCUSSION

Biochemical parameters

Chlorophyll content (mg g^{-1} fr.wt.)

The data on chlorophyll content presented in table 1 indicated that there was a significant difference among the genotypes at 30 DAF. The chlorophyll content was maximum in PEC 17 (2.68 mg g^{-1} fr.wt.) followed by M 35-1 (2.24 mg g^{-1} fr.wt.) and EP 57 (2.20 mg g^{-1} fr.wt.). The lowest chlorophyll content was observed in CRS 1 (1.51 mg g^{-1} fr.wt.). Such variations in chlorophyll content in Sorghum genotypes during post rainy season was earlier reported by Shivalli,[7]. Sorghum cultivars superior in total chlorophyll and chlorophyll stability index indicate drought tolerance[6]. There was a significant difference between the treatments, during well watered and water stress conditions. There was decrease in chlorophyll content in all the genotypes due to the moisture stress imposed during post flowering period. Long term stress

at vegetative and reproductive phase reduced the chlorophyll content[8].

The interaction between genotypes and treatments was significant and among the genotypes PEC 17 recorded highest chlorophyll content in well watered (2.69 mg g^{-1} fr.wt.) and water stress (2.67 mg g^{-1} fr.wt.) conditions. The lowest chlorophyll content in well watered (1.55 mg g^{-1} fr.wt.) and water stress (1.47 mg g^{-1} fr.wt.) and conditions was observed in the genotype CRS 1.

Similar results reported Ashok Surweshi *et al.* reported that the hybrids, 117A x DRR 2, 117A x DRR-3 and 117A x DRR-1 and the parents DRR-2, DRR-1 and DRR-3 recorded higher chlorophyll content which resulted in higher yields. Shivalli[7] reported higher chlorophyll content in high yielding genotypes at 50 per cent flowering and dough stage in Sorghum.

Nitrogen content (%)

The data on nitrogen content presented in table 1 and depicted in figure 1 indicated the there was a significant difference among the genotypes at 30 DAF. The N content was maximum in PEC 17 (2.33%) followed by M 35-1 (2.09%) and EP 57 (2.05%). The lowest N content was observed in CRS 1 (1.44%). Garner *et al.*[2] observed the genotypic variation in overall nitrogen use efficiency (NUE) in Sorghum hybrids. There was a significant difference between the treatments, during well watered and water stress conditions. There was decrease in nitrogen content in all the genotypes due to the moisture stress imposed during post flowering period.

The interaction between genotypes and treatments was significant and among the genotypes PEC 17 recorded highest nitrogen content in well watered (2.36%) and water stress (2.29%) conditions. The lowest nitrogen content in well watered (1.47) and water stress (1.40) conditions was observed in the genotype CRS 1.

Nitrogen metabolism is effected by soil and plant water deficit. Large differences in N uptake in response to water supply was reported by Kamoshita *et al.*[5].

Potassium content (%)

The data on potassium content presented in table 1 and depicted in figure 1 indicated that there was a significant difference among the genotypes at 30 DAF. The potassium content was maximum in PEC 17 (1.39%) followed by M 35-1 (1.12%) and EP 57 (0.98%). The lowest potassium content was observed in CRS 1 (0.70%). There was a significant difference between the treatments, during well watered and water stress conditions. There was decreased potassium content in all the genotypes due to the moisture stress induced during post flowering period.

The interaction between genotypes and treatments was significant and among the genotypes PEC 17 recorded highest potassium content in well watered (1.43%) and water stress (1.34%) conditions. The lowest potassium content in well watered (0.71%) and water stress (0.68%) conditions was observed in the genotype CRS 1.

Table 1: Chlorophyll content, N content and K content at 30 DAF of Sorghum genotypes under well watered and water stress conditions

	Chlorophyll content (mg g-1 fr wt)			N content (%)			K content (%)		
Genotypes	**WW**	**WS**	**Mean**	**WW**	**WS**	**Mean**	**WW**	**WS**	**Mean**
CRS 4	1.79	1.70	1.75	1.71	1.68	1.70	0.96	0.95	0.96
CRS 19	1.68	1.59	1.64	1.79	1.71	1.75	0.89	0.87	0.88
CRS 20	1.45	1.39	1.42	1.55	1.46	1.51	0.68	0.66	0.67
PEC 17	2.69	2.67	2.68	2.36	2.29	2.33	1.43	1.34	1.39
CSV 18	2.10	2.07	2.09	1.94	1.92	1.93	0.79	0.78	0.79
M35-1	2.28	2.19	2.24	2.10	2.08	2.09	1.13	1.10	1.12
Phule Chitra	1.55	1.47	1.51	1.13	1.08	1.11	0.54	0.50	0.52
Phule Moulee	1.74	1.68	1.71	1.60	1.52	1.56	0.83	0.80	0.82
EP 57	2.24	2.15	2.20	2.06	2.03	2.05	0.98	0.97	0.98
CRS 1	1.35	1.27	1.31	1.47	1.40	1.44	0.71	0.68	0.70
Mean	1.89	1.82	1.86	1.77	1.72	1.75	0.89	0.86	0.88
CD Genotypes (G)	0.18			0.07			0.06		
Treatments (T)	0.06			0.04			0.02		
G X T	0.21			0.12			0.08		
CV	6.85			4.34			5.47		

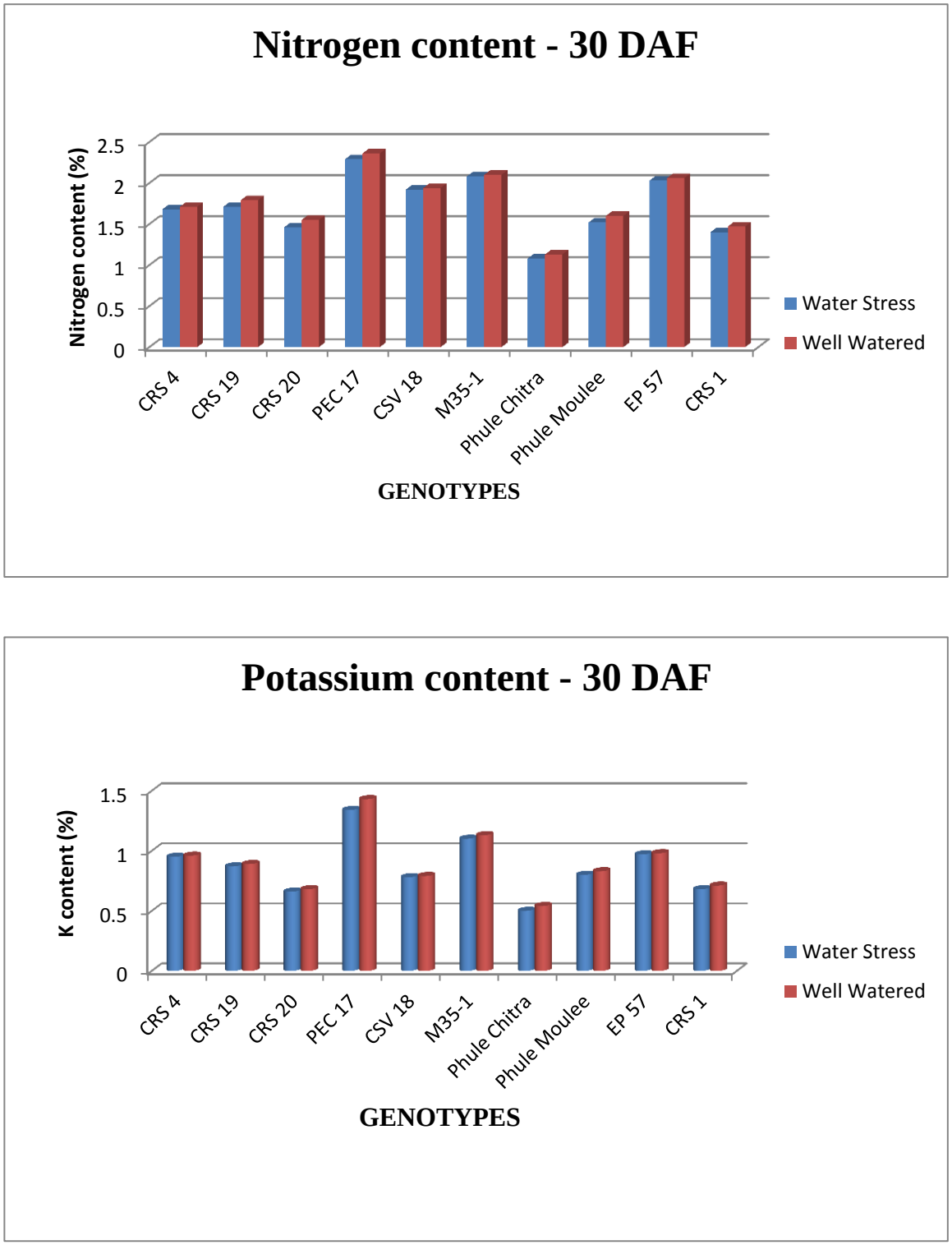

Fig 1: N content and K content at 30 DAF of Sorghum genotypes under well watered and water stress conditions.

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