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DIFFERENT VARIATION IN PHYSIOLOGICAL AND BIOCHEMICAL ACTIVITIES CAUSED BY WATER STRESS IN CENCHRUSSPECIES

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ABSTRACT

Cenchrus is an important component of major grass cover of world. Similar to the other major tropical grasses most of the species in genus Cenchrus are also apomictic in nature hence correct and precise identification of accessions and species are problematic and dubious.Protein content, Reducing, non reducing sugarand total sugar content, phenol content β-carotene and chlorophyll content was studied in eight species of Cenchrus subjected to water stress by withholding water .The mechanism of tolerance to moisture stress in its different species may lead to better understanding the biochemical and physiological mechanism at species level and specially with reference to their growth habit (annual perennial).Chlorophyll and B carotene content decline in all the species. Reducing, nonreducing and total sugar content in root of the plant increase with the progress of stress. In most of the species Phenol content increase with parallel to total soluble protein content. The result suggest that the stress response were incongruous amongCenchrusSpecies consisting two different nature of growth habit i.e., annual and perennial.

Keywords- *Cenchrus species, chlorophyll, β-carotene, Protein,Phenol, Reducing and Nonreducing sugar.*

I. INTRODUCTION

Environmental stresses exert theireffect through the formation of activated oxygen species. The moisture stress directly influence the root pressure stomatal closure , photosynthesis, respiration, transpiration enzymatic activity , growth of root and shoot, shrinkage of tissue, internal relation, flow of oleoresin latex and other process(Kramer,1962).Although drought is one of the important environmental stress knowledge on drought tolerance of different *cenchrus* species in scanty.Most of the changes caused by water stress are adaptive in nature which enables plant to survive in stressed environment and result of change in the polypeptide levelas well as chlorophyll phenol synthesis in it and also the accumulation of many solute.

Osmotic adjustment (OA) is higher in plant due to accumulation of sugar and amino acids. The sugar contributes 50% towards OA in fully expanded sorghum leaves. While they do not contribute to decrease in osmotic potential in fully expanded sunflower leaves(Jones *et al*. 1980) Accumulation of soluble sugar, free amino acids and protein during stress play important role in (OA) in sorghum (Yadav *et al*. 2002)

*Cenchrus*being one of the most important grass of many world widegrassland , the mechanism to tolerance to moisture stress in its different species may lead to a better understanding the biochemical mechanism at species leveland specially with reference to their growth habit (annual/perennial). Being apomictic in nature the selection of species having better drought tolerance behavior and appropriate mechanism will lead to screening of lines collected from different part of country under plant genetic resources programmes.

II. MATERIAL AND METHODS

Seeds of six species of *Cenchrus* viz., *C. ciliaris*L. IG-69-3108 (India) *C. setigerus*Vahl.EC-397331 (Uganda), *C.pennisetiformis*Hochst and Steud.exSteud. EC-397528 (Kenya),*C. echinatus* L. EC-397342 (Australia), *C. myosuroides*Kunth EC-397345 (Paraguay) and *C. glaucus* C. R. Mudaliar and SundararajEC-397614 (USA)C.Priieurri EC-397325, C.biflorus EC 397378 were germinated and a nursery bed wasprepared in the month of June at Indian Grassland and FodderResearch Institute, Jhansi. After 15 days of germination, threeseedlings of each species were transferred to pots (20 cm x 15 cm)containing 2 kg locally available red laterite soil having 11-

15%water holding capacity with farm yard manure (FYM) (3:1) in eachpots. After two weeks of establishment each pot was thinned to oneplant. Each species had three replications arranged in threerandomized blocks. In total each species was represented ninetimes. The pots was irrigated regularly. After one month of growth one set of pot kept munder water stress by withholding the irrigation for on to four days and another set of pot was watered regularly. After four days of stress plant was watered and denoted as re-watered plants. All experiment is carried out in three replication.Third leaves from the top of the plant were taken and used for experimental analysis.

Protein extract was prepared by grounding leaves with ice cold pestle mortaruntill no fibrous residue was seen. Protein in ground sample was estimated by Lowry method (Lowary*et al.*,1951) In one ml of water5µml of enzyme extract is taken and in same test tube 5 ml of reagent C was added to each test tube after 10 minute incubation .5 ml of Folin-C-ocalteau reagent was added and mixed well. All test tube kept in room temperature in dark for 30 minute. Blue color was developed and OD was recorded at 660nm. Standard graph of protein was constructed using known amount of bovine serum albumin (BSA) to calculate the amount of protein on unknown sample.

Total phenol were estimated in oven dried sample by following the procedure of Malick and Singh(1980). Absorbance was recorded at 650nmStandard graph was constructed to calculate the amount of phenols in unknown samples.

Sugar with reducing property (arising out of the presence of a potential aldehyde and or keto group) termed as reducing sugar were estimated using Nelson Somogyi method (Somogyi, 1952). Read the absorbance of blue color at 620 nm after 10 minute. Standard graph was plotted using glucose to calculate the amount of sugar in unknown sample. Chlorophyll a , b and total carotene were calculated using Arnon's formulas (Arnon,1949).The optical density (OD) was recorded at four wavelength (663, 654, 510 and 480nm).

III. RESULT AND DISCUSSION

Eight species of *Cenchrus* used in the present study indicated that chlorophyll a content was more in control plants of each species. which gradually decline with increase of stress. The highest decline in chlorophyll a content from control to the maximum level of stress was observed in *C. glaucus* (1.779 mg/g fr wt) and minimum in *C. prieurri* (0.36mg/g fr wt).Similar to Chlorophyll b also declined with increase of moisture stress in all eight species of *Cenchrus* and presented in (Table.1).The level of chlorophyll b content ranged from 0.52 to 0.20mg/g frwt in control and 0.36 to 0.07mg/g frwt in stress(maximum). The level of total chlorophyll content in all eight species of *cenchrus* was affected by moisture stress.On the basis of total chlorophyll content eight species of *Cenchrus* was grouped in two categories. The first one comprises higher level of chlorophyll content *(C.ciliaris,C.setigerus, C.prieurri,C.myosuorides,andC.echinatus.*) and second group has three species namely(*C. Pennisetiformis ,C. biflorus ,C. glaucus.*). However in general the level of chlorophyll a decreased with increasing magnitude of stress. Moisture stress inhibit the biosynthetic precursors of chlorophyll a wheat leaves and resulted in ultimate decrease in chlorophyll content (Makhmubov,1983). Moisture stress significantly reduce Chl a and b concentration , the chl a/b ratio stomatal conductance or photosynthesis. However a strong recover of these traits was noticed after re- watering (Awal and Ikeda, 2002).

The carotene content decrease upon stress in all species of *Cenchrus* and present in (Table1).At highest level of stress the maximum value of it was observed in *C. myosuroides*and minimum in both *C. Pennisetiformis ,C. biflorus*..Then plant was watered after maximum stress the level of chlorophyll a,,b and a plus b and carotene returned back to the level of control situation.

Total soluble protein measured at different days of water stress indicated increase with increase in magnitude of water stress. In control the level of protein in eight species of *Cenchrus* ranged from 14.28 to 27.88 –mg/g fr wt. After two days of stress protein level changed significantly *C.ciliaris*and*C. prieurri*. In *C. myosuroides*the protein level decrease significantly from14.28 to 9.74 –mg/g frwt after two days of water stress however increased with increased of stress and reached to maximum levelmeasured at eight days of stress. Maximum increase (263.5%)over control at eight days of stress was noticed in*C. myosuroides* and minimum (25.7%) in *C.setigerus.* Maximum

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increase in total soluble protein in *C.myosuroids* over control indicated that this particular species showed better ability in comparison to other species to maintain the osmotic level as it have been suggested that in general increase in aminoacid level is one of the major attributes of water stress to maintain the osmotic level(Good and Zalpachinski, 1994). Better performing lines of rice also showed higher level of protein under stresss(Reddy*etal*., 1998).

Table 1: change in physiological attributes caused by water stress in eight Cenchrus species.

Species	Chlorophyll a **(mg/g frwt)**		Chlorophyll b **(mg/g frwt)**		Total chlorophyll **(mg/g frwt)**		Carotene **mg/g frwt)**	
	Control	Stress	Control	Stress	Control	Stress	Control	Stress
C. ciliaris	1.084	0.277	0.144	0.081	1.224	0.358	2.59	1.61
C.setigerus	1.309	0.691	0.926	0.042	2.235	0.731	3.34	2.24
C.pennisetiformis	2.027	1.028	1.143	0.024	3.17	1.052	4.93	3.01
C.prieurri	1.327	1.313	0.797	0.866	2.124	2.179	2.83	3.09
C.biflorus	2.289	1.178	1.544	0.766	3.833	1.944	4.88	2.96
C.echinatus	2.291	0.524	1.633	0.039	3.924	0.563	4.88	1.56
C.myosuorides	1.473	10418	0.617	0.784	2.891	2.202	2.96	3.97
C.glaucus	2.077	1.14	0.139	0.448	2.216	1.588	3.51	2.71
Mean	1.734	0.946	0.866	0.381	2.702	1.327	3.74	2.64

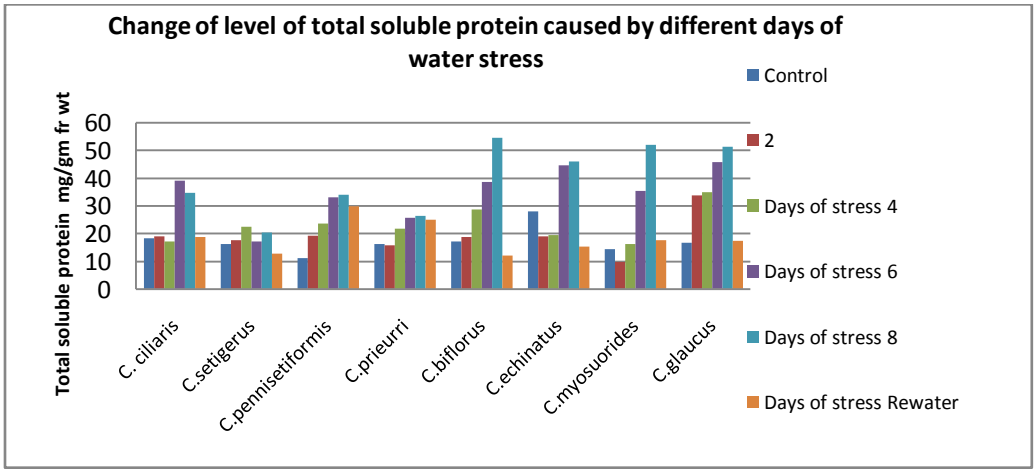

Figure:1.

The significant increase in sugar in stress plant in six out of eight species of *Cenchrus* indicated (Table .2) its role in imparting tolerance against stress. However it has been suggested that sugar accumulation is less sensitive to drought than photosynthesis irrespective of drought tolerance in sorghum (Massacci*etal*.,1996)

Table 2: Effect of moisture stress on reducing ,non reducing sugars and phenol in leaves of eight Cenchrus species

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Species	Reducing sugar		Non reducing sugar		Total sugar		Phenol	
	Control	Stress	Control	Stress	Control	Stress	Control	Stress
C. ciliaris	3.12	4.47	8.93	9.77	12.05	14.24	11.86	7.32
C.setigerus	3.48	2.94	16.81	20.63	20.29	23.57	6.84	8.63
C.pennisetiformis	3.21	6.42	11.99	22.75	15.20	29.17	8.51	12.44
C.prieurri	1.5	4.54	8.9	14.4	10.40	18.9	2.70	7.63
C.biflorus	9.3	12.78	5.2	4.6	14.50	17.38	2.02	5.62
C.echinatus	3.51	4.35	7.45	10.63	10.96	14.98	10.4	7.32
C.myosuorides	3.33	2.43	20.75	23.2	24.08	25.63	9.24	6.84
C.glaucus	2.34	4.41	19.99	20.92	23.33	25.33	1.95	12.07
Mean	3.723	5.292	12.50	15.68	16.226	21.157	7.810	8.483

IV. CONCLUSION

The carotene content decrease upon stress in all species of *Cenchrus.* Total soluble protein measured at different days of water stress indicated increase with increase in magnitude of water stress. Better performing lines of rice also showed higher level of protein under stress. The significant increase in sugar in stress plant in six out of eight species of *Cenchrus* indicated its role in imparting tolerance against stress.

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