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SHORT COMMUNICATION

INFLUENCE OF MOISTURE STRESS ON THE ACTIVITY OF OXIDATIVE ENZYMES IN SUGARCANE

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In sugarcane, moisture stress imposed at the formative phase increased the activity of peroxidase, polyphenol oxidase and IAA oxidase. The peroxidase and IAA oxidase activity doubled during moisture stress condition, while the increase in polyphenol oxidase activity was four fold. The activity of these enzymes reverted to normal level with the relief of stress. There was a concomitant decline in the rate of expansion of young internode with decreasing relative water content and increase in the activity of oxidative enzymes, irrespective of varieties.

***Key words*: IAA oxidase, internodal elongation, moisture stress, oxidative enzymes.**

Moisture stress has been regarded as one of the major constraints in realising higher productivity in crop plants. Sugarcane crop experiences moisture stress at its growth period viz., the formative phase, in all the agroclimatic zones of India with varying duration and intensity. The impact of moisture stress on growth, physiological functioning, yield components and juice quality is well documented in sugarcane (Venkataramana *et al.* 1986, Naidu and Venkataramana 1988). It has been reported that the activity of oxidative and hydrolysing enzymes increase linearly with the intensity of stress while the snythesising enzymes decline (Todd 1960) and at a severe stress, considerable alterations are observed. The present study, therefore, analysed the influence of moisture stress on oxidative enzymes in sugarcane varieties in relation to their internodal elongation.

Single bud setts of sugarcane varieties Co 8021, Co 419, Co 740 and Co 312 were planted in pots (20 kg capacity). Two healthy clumps were maintained in each pot. Moisture stress was imposed at formative phase by withholding water to a set of pots (20 nos), in two cycles of a fortnight duration each, while another set was maintained as control (free of moisture stress). In between two cycles of stress treatment watering was given once to study the revival pattern. Moisture stress treatment was terminated after the second cycle of stress. Soil moisture content was estimated gravimetrically and expressed in per cent. Relative water content (RWC %) was recorded as per standard procedure. Internodal length was recorded at weekly intervals in the tagged internodes (internodes formed just prior to stress treatment). The rate of increment in length was expressed as mm/day. Observations on enzyme activity were recorded during the stress as well as on relief of stress. Enzyme peroxidase was assayed as per Luck (1963), using pyrogallol as substrate. The activity was expressed as change in absorbance at 420 nm and unit activity expressed as ΔA 420/g/min. Polyphenol oxidase was assayed using catechol as substrate (Mahadevan and Sridhar 1974). The increase in the activity was recorded at 495 nm in a spectrophotometer. IAA oxidase activity was assayed by measuring the residual IAA in the reaction mixture with Salper's reagent (Gordon and Paleg 1957) and expressed as $\mu molg^{-1}h^{-1}$.

Soil moisture depleted by about 65% in the moisture stress treatment as compared to control as stress attained a critical level. Relative water content of leaf tissues

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declined in response to the moisture stress. Genotype and treatment interaction was significant (Table 1). Genotypes with better tolerance recorded higher RWC under moisture stress (76.6 and 72.0% in Co 740 and Co 312 respectively) as compared to the sensitive genotypes Co 419 and Co 8021, which recorded lower RWC.

Table 1. Soil moisture content and relative water content as affected by moisture stress.

Varieties	Soil moisture content (%)		Relative water content (%)	
	C	MS	C	MS
Co 8021	23.06	7.84	87.70	66.11
Co 740	22.81	7.95	89.77	76.60
Co 419	24.23	7.77	85.66	61.50
Co 3121	23.26	7.88	85.37	72.06
	SED: 0.708	LSD: 2.02	SED: 2.669	LSD: 7.27

(C: control; MS: moisture stress)

The oxidative enzymes i.e. peroxidase, polyphenol oxidase and catalase are known to deplete the pool of free radicals from accumulating to toxic levels during stress situations. Their role as scavenging system to maintain the metabolic functions of the cells to ward off the adverse impact of stress environment is well documented (Smirnoff and Colombe 1988). In the present study, activity of all the three enzymes increased due to the stress treatment (Table 2). Peroxidase activity doubled during stress and reverted back to normal level after relief from moisture stress. However, the drought susceptible variety Co 8021 showed slightly higher activity even after relief of stress. Yang-Li *et al.* (1995) also reported increased peroxidase activity in response to drought treatment in resistant genotypes of sugarcane. Polyphenol oxidase activity showed similar trend. In general, polyphenol oxidase activity was very low compared to other enzymes. However, the magnitude of increase (4-5 fold) in the activity under stress condition was very high. Variety Co 312 and Co 740 recorded relatively higher peroxidase activity under stress condition. Similar results of increase in the oxidative enzymes/ antioxidant system in drought tolerance have been reported in wheat genotypes (Sairam *et al.* 1998). IAA oxidase activity increased 2-3 fold in the genotypes in response to moisture stress treatment (Table 2). Upon relief from moisutre stress, the IAA oxidase activity declined and maintained at par with control levels. The role of IAA oxidase in depriving the IAA availability for growth assumes importance under moisture stress conditions. In the present study, the drought tolerant genotypes recorded higher activity of oxidases as compared to sensitive genotypes. The protective role of free radical scavengers on drought resistance has been reported in sugarcane (Chen *et al.* 1994).

The internodal elongation rate declined under moisture stress and the expansion rate almost ceased as the moisture stress reached critical limits (Fig. 1). Among the varieties, there were no significant differences in the internodal elongation rate under stress condition, which implies that in general, water deficit was detrimental to the crop growth. Crop growth rates decline under moisture stress especially the expansion growth of newly produced leaves (Passioura and Gardner 1990).

Table 2. Activity of oxidative enzymes under moisture stress.

Varieties	Peroxidase activity ($\Delta A_{420} min^{-1} g^{-1}$ fw)			Polyphenol oxidase ($\Delta A_{495} min^{-1} g^{-1}$ fw)			IAA oxidase ($\mu mol\ h^{-1} g^{-1}$ fw)		
	C	MS	PS	C	MS	PS	C	MS	PS
Co 8021	2.1	4.07	3.12	0.072	0.20	0.096	0.90	2.59	1.12
Co 740	2.0	4.68	2.98	0.025	0.17	0.056	1.08	2.01	1.11
Co 419	1.3	3.23	1.83	0.035	0.21	0.073	0.93	2.91	1.20
Co 312	2.0	5.17	2.72	0.037	0.23	0.077	1.13	1.97	1.23
SED:		0.22			0.009			0.087	
LSD (1%)		0.57			0.025			0.232	

(C: Control; MS: moisture stress; PS: post stress)

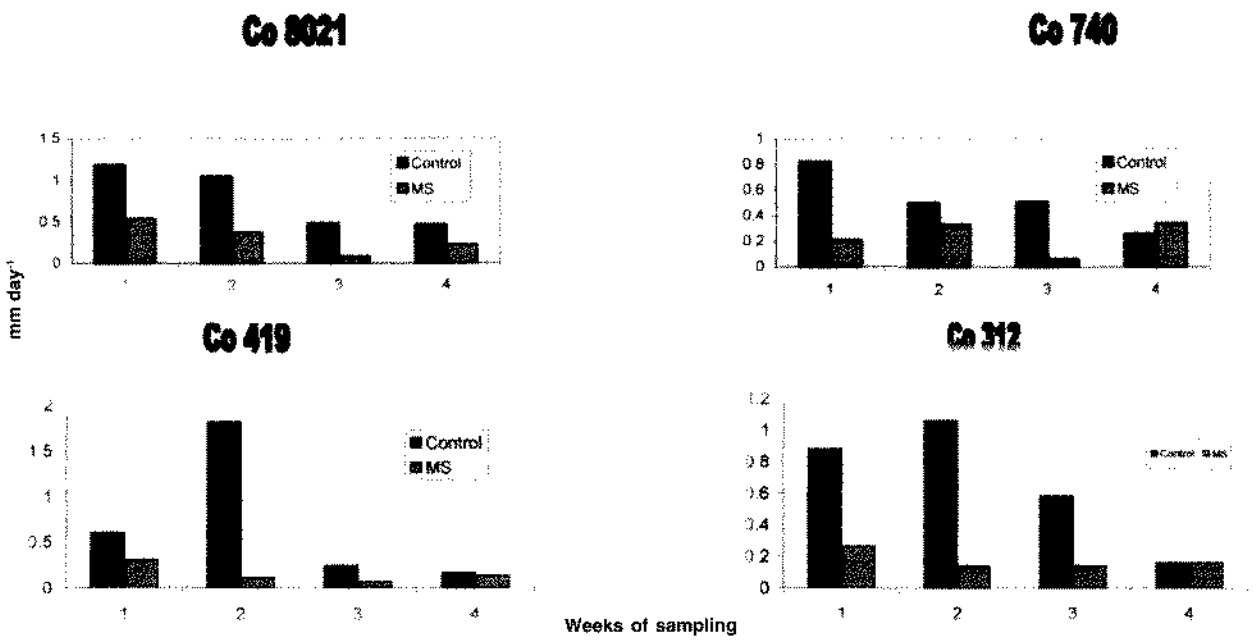

Fig. 1. Rate of internodal elongation under moisture stress

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