

## NEUTRAL INVERTASE AS A STABLE PARAMETER FOR ASSESSING DROUGHT TOLERANCE IN SUGARCANE

N. B. SINGH and R. G. SINGH

Division of Cane Physiology and Biochemistry,  
U.P. Council of Sugarcane Research,  
Shahjahanpur 242001, India.

MOST of the morphophysiochemical parameters which characterise drought tolerance in plants did not always show a consistent trend. The involvement of enzymes in drought phenomenon is rather not understood, except that the overall activity is declined due to severe stress<sup>1</sup>. The present paper incorporates information on invertase (s) which are known to play a predominant role in sugar metabolism by regulating its synthesis, transformation and storage in sugarcane plants<sup>2-4</sup>.

Sugarcane cultivars, viz. Co 1148 and CoS 770, differing widely in their drought tolerance capacity were grown in field at two levels of soil moisture, viz.

0.30 (normal) and 0.75 atm (stress). The moisture stress was regulated by installing Larkens Vacuum Gauge tensiometer at 30 cm depth of soil. Together with this the soil moisture was also determined gravimetrically. When the required level of moisture stress has developed the crop was reirrigated with 10 ha cm water in the case of 0.30 atm treatment. In 0.75 atm treatment it was irrigated with 2.5 ha cm water only. In this way the crop plants were subjected to severe stress continuously for six months before the tissues of first fully opened leaves were assayed for the determination of acid and neutral invertase<sup>2</sup>.

Acid and neutral invertase which are mainly concerned with growth and ripening processes, respectively, showed significantly greater activity in the leaves of Co 1148 (drought tolerant) than CoS 770 (drought susceptible). Whereas the moisture stress decreased the activity of acid invertase significantly, it did not show pronounced effect on neutral invertase (table 1). In Co 1148 the activity of this enzyme due to stress was least affected.

The exact role of neutral invertase in drought

Table 1 Effect of variety, soil moisture and their interaction on the activity of acid and neutral invertase in sugarcane

Treatment	Year					
	1981-82			1982-83		
	Co 1148	CoS 770	Mean	Co 1148	CoS 770	Mean
<i>Acid invertase in leaf (<math>\mu\text{g}</math> hexose produced/g fresh leaf/hour)</i>						
Normal moisture	88.666	78.666	83.666	85.166	77.600	81.383
Moisture stress	66.500	40.333	53.416	67.700	36.400	52.050
Mean	77.853	59.500		76.433	57.000	
CD at 5% for V			5.474			9.922
CD at 5% for M			29.820			17.970
CD at 5% for V x M			17.528			10.064
<i>Neutral invertase in leaf (<math>\mu\text{g}</math> hexose produced/g fresh leaf/hr)</i>						
Normal moisture	84.000	76.333	80.166	87.100	77.133	82.116
Moisture stress	83.000	58.666	70.833	87.666	64.333	76.000
Mean	83.5000	67.500		87.383	70.733	
CD at 5% for V			5.474			9.948
CD at 5% for M			NS			NS
CD at 5% for V x M			NS			NS
Per cent decrease in the activity of acid and neutral invertase due to moisture stress (mean of two years)						
Attribute	Co 1148		CoS 770			
Acid invertase	22.2		52.2			
Neutral invertase	0.203		19.9			

tolerance is not known. However, the minimum reduction in its activity due to stress signifies that the synthesis and conversion of sugars continued to an appreciable rate even under stress condition. As a consequence the food material was available to protect the plants from drought.

Thus the sugarcane cultivars with initial high level of neutral invertase which did not decline much when subjected to stress may be regarded as drought tolerant and *vice-versa*.

28 February 1984; Revised 29 May 1984

1. Todd, G. W., *Water deficit and plant growth*, Academic Press, New York, 1972, p. 170.
2. Hatch, M. D. and Glasziou, K. T., *Plant Physiol.*, 1963, 38, 344.
3. Alexander, A. G., *Sugarcane Physiology*, Elsevier Scientific publishing Company, Amsterdam-London-New York, 1973.
4. Madan, V. K., Singh, K., Pandey, H. P. and Saxena, Y. R., *Int. Sugar J.*, 1981, 83, 163.

## RESPONSE OF INDIAN DESERT GERBILS (*MERIONES HURRIANAE*, JERDON) TO INTERNAL $\beta$ -IRRADIATION

N. K. GUPTA

Department of Bioscience, Himachal Pradesh University, Shimla 171005, India.

It is well known that mammals exhibit a wide range of differences in their radioresponse and that the LD<sub>50</sub> of X and  $\gamma$ -irradiations range between 150 to 1500 r<sup>1</sup>. There is now growing evidence that the members of the rodent family Cricetidae are highly radioresistant<sup>2</sup>. Chang *et al*<sup>3</sup> have shown that the mongolian gerbil (*Meriones unguiculatus*) displays a high degree of resistance to gamma radiation. Closely related to this gerbil is the Indian desert gerbil (*Meriones hurrianae*, Jerdon) which has also been shown to be highly radioresistant to external gamma irradiation<sup>4-6</sup>. Radiobiological work on this desert rodent has not been taken up extensively except for studies with reference to its response to certain  $\alpha$ - and  $\beta$ -internal emitters<sup>7-10</sup>. Present communication documents high radiosensitivity of Indian desert gerbil (*Meriones hurrianae*, Jerdon) to radiocalcium (<sup>45</sup>Ca) internal  $\beta$ -irradiation and the results are reported here.

Indian desert gerbils were procured from the vicinity of Jaipur, Rajasthan (India) and maintained in the laboratory providing wet grams and water *ad libitum*. Young and adult healthy animals weighing 75  $\pm$  5 g were selected for study. Radiocalcium (<sup>45</sup>Ca) (sp. activity 666 GBq/g Ca) in the form of calcium chloride in dilute hydrochloric acid (obtained from Bhabha Atomic Research Centre, Bombay, India) and neutralized with sodium hydroxide was injected intraperitoneally at the dose levels of 37 KBq/g and 74 KBq/g body weight. The animals were autopsied at intervals of 1, 3, 5, 7, 14 and 28 days after injection. Blood samples (for RBC, WBC and haematocrit) and intestine were studied for histopathological damage.

From table 1 it can be seen that dose of 37 KBq/g body weight of <sup>45</sup>Ca (group I) did not cause any significant mortality. However, in the group given 74 KBq/g body weight of <sup>45</sup>Ca (group II) high mortality was seen. First mortality was observed on 7 days post treatment. Maximum mortality was seen between 9th and 18th day after <sup>45</sup>Ca administration. No animal could survive at the last interval studied *i.e.* 28 day post treatment.

Animals of both groups showed a significant decrease in the number of both red blood cells and white blood cells. The haematocrit percentage also declined. In group II, the number of RBC and Ht value reached a minimum between 9 and 14 days, no trend of repair was seen (table 2). Animals suffered radiation sickness from 3rd day onward in group II. Diarrhoea was seen between 5th and 7th day. Intestine on autopsy revealed denudation of villi and haemorrhage on 5th and 7th days respectively. However, a trend towards reparation was evident on 9th day. By 14th day post treatment, almost complete recovery of intestinal mucosa was observed.

The mortality observed in the present study could be due either to bone marrow syndrome or to the GI tract injury. Bacterial infection as a contributing factor is not ruled out. Since no significant mortality was observed during 5-10 days of post treatment it can be concluded that GI syndrome was not responsible for the high mortality. Jacobson *et al*<sup>11</sup> speculated that the gerbils relative radioresistance was due to their ability to withstand bone marrow injury and their vigorous recuperation of haematopoietic damage. This could be related to high concentration of serotonin in gerbil spleen<sup>12</sup>. They felt that gerbils suffer as much damage as other mammals but unlike others they are able to recuperate after radioexposure. On the other hand Bhartiya and Srivastava<sup>13</sup> suggested that it is the longer transition time (120 hr) of the intestinal cells that imparts radioresistance to these animals.