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*.

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RESPONSE OF INDIAN DESERT GERBILS (*MERIONES HURRIANAE*, JERDON) TO INTERNAL β-IRRADIATION

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It is well known that mammals exhibit a wide range of differences in their radioresponse and that the LD_{50} of X and γ-irradiations range between 150 to 1500 r[1]. There is now growing evidence that the members of the rodent family Cricetidae are highly radioresistant[2]. Chang *et al*[3] 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[4-6]. Radiobiological work on this desert rodent has not been taken up extensively except for studies with reference to its response to certain α- and β-internal emitters[7-10]. Present communication documents high radiosensitivity of Indian desert gerbil (*Meriones hurrianae*, Jerdon) to radiocalcium (^{45}Ca) internal β-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 ± 5 g were selected for study. Radiocalcium (^{45}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 ^{45}Ca (group I) did not cause any significant mortality. However, in the group given 74 KBq/g body weight of ^{45}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 ^{45}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*[11] 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[12]. 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[13] suggested that it is the longer transition time (120 hr) of the intestinal cells that imparts radioresistance to these animals.

Table 1 *Mortality data as a function of dose in Indian desert gerbil (Meriones hurrianae, Jerdon) after the injection of* ^{45}Ca

Animals	Number of animals	Dose, Days	1–8	9–10	11–12	13–14	15–16	17–18	19–24	25–27	28
Indian desert gerbil	50	37 KBq/g body weight	1	–	–	–	2	–	2	–	–
(*Meriones hurrianae*, Jerdon)	50	74 KBq/g body weight	2	4	4	12	10	10	4	4	–

Table 2 *Changes induced in the red blood corpuscles and haematocrit value after the administration of* ^{45}Ca *in Indian desert gerbils. Each value is the mean of 6–10 animals ± S.E.*

	Dose	Control	Days Posttreatment 1	3	5	7	9	14	28
RBC (cmm^{1}) × 10^{3}	37 KBq/g body weight of ^{45}Ca	10,700 ±724	9,950 ±105	9,117 ±240	8,184 ±226	8,870 ±217	9,550 ±407	10,830 ±380	11,500 ±615
Ht (%)		50.4 ±2.87	43.8 ±4.00	38.3 ±2.34	33.9 ±5.70	37.9 ±4.80	45.2 ±0.86	49.0 ±1.51	52.8 ±2.90
RBC (cmm^{1}) × 10^{3}	74 KBq/g body weight of ^{45}Ca	10,700 ±724	9,666 ±132	8,767 ±280	7,166 ±335	5,666 ±260	4,930 ±423	3,610 ±3,53	–
Ht (%)		50.4 ±2.87	41.4 ±5.26	33.2 ±0.90	27.6 ±1.63	20.6 ±0.27	14.8 ±2.80	9.2 ±1.54	–

According to Nelson[14] the intestinal mode of death kills X-irradiated gerbils between 7 and 10 days. Jacobson *et al*[11] concluded that neutron irradiation kills animals between 13 and 24 days (with no death before 9 days) from haematopoietic damage. In the present study, deaths generally occurred between 9–18 days with maximum mortality between 12 to 18 days after ^{45}Ca injection. It is postulated that mortality is due to haematopoietic damage with little contribution from GI tract injury.

Bone-seeking radionuclides irradiate bone marrow severely. Also, the extra skeletal parts of haematopoietic system are adversely affected resulting in a decline in regeneration ability of bone marrow. It is postulated that continuous irradiation results in great bone marrow damage and the gerbils are not able to survive the radiation injury. The data on RBC, WBC and Ht suggests that the recuperation after haematopoietic damage is not so vigorous (under continuous radiation stress) as to protect the animals from bone marrow syndrome death.

High radiosensitivity of Indian desert gerbil with internal irradiation in the present study is in contradiction to the previous reports of other workers on rodents (family cricetidae) including *M. unguiculatus* with external irradiation and family muridae with internal irradiation wherein these animals have been shown to be highly radioresistant. The studies made on a wild species such as Indian desert gerbils make it evident that inspite of such a great radioresistance of these animals to external irradiation, the response given to even small doses of internal irradiation is entirely different and drastic than anticipated and that the naturally occurring wild populations will be the first victims of the possible hazards of the radioactive fall outs and care should be taken as to when to contain and where to dispose the waste products of atomic age.

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GAMMA RADIATION INDUCED CHROMOSOME DAMAGE IN BARLEY SEEDS RESTORED BY GIBBERELLIC ACID

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THERE are a few earlier reports that gibberellic acid (GA_3) post-treatment reduced the effects of gamma radiation on plant growth[1-3], and cytological damage[4]. In these studies[4] the concentration of GA_3 used was quite substantial (1000 ppm). GA_3 is physiologically active at very low concentrations[5], which also promote cell elongation[2] and cell division[6]. The purpose of the present study is to determine whether low concentrations of GA_3 which are adequate for stimulating cellular activities would reduce the detectable cytological damage.

Seeds of barley var. C164 with a moisture content of 9% were irradiated with gamma ray doses from 10 to 40 kR at a dose rate of 800 R/minute. The seeds were germinated in 9 cm petriplates on a single layer of Whatman's filter paper in three replicates of 25 seeds each. The filter papers were soaked with distilled water or 10 ppm GA_3 solution. Subsequently only water was added to keep the filter paper wet. After 48 hr root tips were fixed in acetic alcohol (1:3) for cytological investigations. Seedling height was recorded on the seven day old seedlings grown in Petriplates.

Anaphase bridges and acentric fragments were recorded as a measure of cytological damage. Data were recorded on about 2000 cells from a large number of roots. The percentage of cells with abnormal anaphases and fragments increased with the radiation dose but, the frequency was less in the GA_3 post-treated seeds. The difference between the control and

Table 1 *Effect of post-gamma irradiation gibberellic acid treatment on % anaphase anomalies in the root tips of barley*

Dose kR	Without GA: Cells scored	Bridges	Fragments	Total	With GA: Cells scored	Bridges	Fragments	Total	Difference
0	3848	0	0.05	0.05	3870	0	0.05	0.05	0
5	2405	0.08	0.66	0.74	3166	0	0.19	0.19	0.55*
10	2191	0.14	0.87	1.01	2839	0	0.35	0.35	0.66*
20	2014	1.19	0.65	1.84	2853	0.07	0.56	0.63	1.21*
30	2044	1.47	0.93	2.40	2061	0.19	0.44	0.63	1.77*
40	1807	2.21	1.27	3.48	2361	0.42	1.44	1.86	1.62*

The differences were compared by Chi-Square test. Significant differences are marked with asterisks.