each other, in a radial sounding. These ratios can then be analysed and interpreted using the following guidelines: (i) For isotrophic and homogeneous formations, the azimuthal ratio remains unity for all current electrode separations; (ii) When the formations are anisotropic due to textural variations such as foliation, etc. the ratios *either* increase or decrease from unity to some values after which they may level off; (iii) When the ratios vary from less than one to more than one or vice versa, it indicates the presence of lateral inhomogeneities within the electrode spread zone. However, even a distinct horizontal discontinuity at depth may give rise to such an anomaly, but in this case, the transition of the ratios from less than one to more than one or vice versa will be very gradual and over very large electrode separations.

Figure 1 shows the results of some of the field studies carried out to demonstrate the effectiveness of the suggested method. The graphs drawn are for $\rho a_{(\alpha)}/\rho a_{(\beta)}$, which is the azimuthal ratio, versus the current electrode separation. In the figure, curve A can be interpreted as representing a nearly homogeneous and isotropic formation. It is from Kolar, Karnataka, where granitic-gneiss underlies a thin soil cover. Curve B, obtained from Varthur, near Bangalore in Karnataka, again underlain by granitic-gneiss, can be said to be obtained from an anisotropic formation. Curve C is from an area underlain by Charnockite with an exposed dolerite dyke nearby (Chingleput, Tamil Nadu). The gentle slope of the graph reflects low resistivity contrast between the country rock and dyke, since the soil cover here is very thin. Curves D and E, from Anekal, Karnataka, where granitic-gneiss underlain soil cover, with an exposed dyke nearby clearly reflect the sharp resistivity contrast, by their steep slopes. Thus, the presence of lateral inhomogeneities and the relative resistivity contrast are brought out by the azimuthal ratio graphs. The method suggested is fast, simple, more informative and can be employed in the field itself.

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EFFECT OF HEAVY METALS ON SUPEROXIDE DISMUTASE ACTIVITY IN *PENNISETUM TYPHOIDEUM* SEEDLINGS

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SUPEROXIDE dismutase (SOD) is an indispensable enzyme for oxygen-utilizing organisms where it protects the cells against the deleterious effects of superoxide radicals. The cellular content of SOD in the procaryotes and eucaryotes is governed by the growth conditions[1]. It has been reported that the presence of high nutrient levels of metal ions in the growing medium of plants effected the growth and showed qualitative and quantitative changes in enzymatic activities[2]. The present communication reports the effect of heavy metals on SOD activity in the bajra (*P. typhoideum*) seedlings.

Healthy seeds of bajra were thoroughly washed with deionized water and then soaked in distilled water for 8 h. The imbibed seeds were allowed to germinate in the presence of different metal ions viz. copper, lead, manganese and mercury (added as $CuSO_4$, $CH_3COOHPb$, $MnCl_2$ and $HgCl_2$ respectively) at different concentrations. Control sets of seedlings were grown with distilled water. Seedlings were collected at 48 h and 96 h intervals and homogenized separately in 0.01 M sodium phosphate buffer of pH 7.6. The homogenate was passed through two layers of cheese cloth and the filtrate obtained was centrifuged at 3000 *g* for 10 min. The supernatant obtained was dialysed against the phosphate buffer for 24 h at 4°C and the SOD activity was assayed[3]. Isoenzymes of SOD were analysed by polyacrylamide gel electrophoresis and activity staining as described earlier[4]. The protein[5] and chlorophyll[6] content of the seedlings were estimated.

Results (table 1) indicate that except lead, all other metal ions at 100 μM level (lower concentrations did not have much effect) reduced (13–27%) the levels of SOD in bajra seedling in the order Hg > Mn > Cu. This indicates that mercury inhibited the SOD activity. The inhibition with the other two metal ions was slight at this concentration. There was no induction of new isoenzyme apart from the three isoenzymes of SOD as reported earlier[7]. This is in contrast to the observation made in *Pisum sativum* leaves[2] where a new Mn^{2+} containing SOD was shown to be induced by

Table 1 *Effect of heavy metals on SOD activity and chlorophyll content in bajra seedlings*

Metal ion treatment		48 h		96 h	
		SOD*	Chlorophyll⁺	SOD*	Chlorophyll⁺
Control		5.1 ± 0.05	63 ± 0.15	6.6 ± 0.1	240 ± 0.25
Copper	50 μM	5.0 ± 0.1 (2.0)	58 ± 0.2 (8.0)	6.5 ± 0.05 (1.5)	225 ± 0.15 (6.3)
	100 μM	4.6 ± 0.02 (9.8)	50 ± 0.12 (20.6)	5.7 ± 0.1 (13.6)	210 ± 0.1 (12.5)
Lead	50 μM	5.0 ± 0.05 (2.0)	60 ± 0.1 (4.8)	6.4 ± 0.25 (3.0)	230 ± 0.15 (4.2)
	100 μM	4.8 ± 0.2 (5.8)	57 ± 0.2 (9.5)	6.2 ± 0.1 (6.0)	222 ± 0.18 (7.5)
Manganese	50 μM	4.9 ± 0.01 (4.0)	50 ± 0.1 (20.6)	6.1 ± 0.01 (7.6)	220 ± 0.1 (8.3)
	100 μM	4.5 ± 0.02 (11.8)	40 ± 0.15 (36.5)	5.4 ± 0.01 (18.2)	185 ± 0.15 (23.0)
Mercury	50 μM	4.5 ± 0.15 (11.8)	40 ± 0.2 (36.6)	5.7 ± 0.2 (13.6)	200 ± 0.25 (16.7)
	100 μM	4.0 ± 0.05 (21.6)	28 ± 0.14 (55.6)	4.8 ± 0.15 (27.3)	100 ± 0.07 (58.3)

Values are mean of 4 replications; ± S D; *Units/mg protein; ⁺μg/g wt of the seedling; Values in parentheses indicate per cent decrease over the control.

moderate nutrient levels of zinc or manganese in the growing medium. Mercury markedly decreased the chlorophyll content of the seedlings as compared to the other metal ions examined. The decrease in the chlorophyll content and SOD activity suggests that some heavy metals especially mercury and to a slight extent copper and manganese (not lead) may have inhibitory effect at the level of chloroplast biogenesis where superoxide radicals will be generated due to photochemical reactions.

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OPTIMUM FREQUENCY OF ADDITION OF NUTRIENT SOLUTION FOR MASS PRODUCTION OF *GLOMUS FASCICULATUM* INOCULUM

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VESICULAR-ARBUSCULAR mycorrhizal (VAM) fungi are associated with increased growth of many plant species. The obligate symbiotic nature of VAM fungi presently dictates that all VAM inoculum must be grown on roots of an appropriate host plant in pot culture[1]. It is advantageous to produce VAM in a partially, if not completely, artificial substrate. In such conditions, addition of a nutrient solution for VAM multiplication becomes necessary. Of the various nutrient solutions, Ruakura nutrient solution has proved to be the best for plant growth[2]. The present study was undertaken to determine the optimum frequency of addition of Ruakura nutrient