Will ar[illegible]. This species reacts with H_2O_2 liberating oxygen according to the mechanism reported earlier[11].

$$Cl\ldots Cl + H_2O_2 \longrightarrow HCl + H\text{–}O\text{–}O\text{–}Cl \quad (2)$$

$$H\text{-}O\ O\text{-}Cl \longrightarrow HCl + O_2. \quad (3)$$

6 October 1986

1. Spinks, J. W. T. and Woods, R. J., *An introduction to radiation chemistry*, John Wiley, New York, 1964.
2. Moorthy, P. N. and Rao, K. N., *Radiat. Eff.*, 1972, **14**, 113.
3. Balsubramanian, S., Vishwanathan, B., Rao, V. R. S., and Kuriacose, J., *Radiochem. Radiat. Chem. Symp.*, 1982, preprint vol., RD–10.
4. Voorhoeve, R. J. H., Johnson Jr. D. W., Remeika, J. P. and Gallagher, P. K., *Science*, 1977, **195**, 827.
5. Bernard, L. O., (ed.) *Hawk's Physiological Chemistry*, Tata-McGraw-Hill Pub. Co., Delhi, 1965, p. 444.
6. Ahnström, G., *Acta. Chem. Scand.*, 1965, **19**, 300.
7. Arnikar, H. J., Damle, P. S. and Chaure, B. D., *J. Chem. Phys.*, 1971, **55**, 3668.
8. Gopinathan, C., Damle, P. S. and Hart, E. J., *J. Phys. Chem.*, 1972, **76**, 3694.
9. Haward, R. E., Vosko, S. and Smoluchowski, R., *Phys. Rev.*, 1961, **122**, 1406.
10. Williams, F. E., *Phys. Rev.*, 1962, **126**, 70.
11. Cotton, F. A. and Wilkinson, G., *Advanced inorganic chemistry*, Wiley Eastern Ltd., New Delhi, 1972, p. 416.

INHIBITION OF RAT BRAIN SUCCINATE DEHYDROGENASE BY CARBAMATE AND ORGANOPHOSPHATE PESTICIDES

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ORAL administration of carbaryl and bavistin (Carbamate pesticides) and phosalone and elsan (organophosphate pesticides) has been found to inhibit rat brain succinate dehydrogenase activity significantly.

For acute effects

Normal, adult albino rats weighing 150–250 g were fed single dose of these pesticides orally along with groundnut oil at 50% of LD_{50}, (calculated according to body weight) and were sacrificed after 1 hr. The reported LD_{50} values for the pesticides are: carbaryl: 400–500 mg; bavistin: 6400 mg, phosalone. 120 mg and elsan: 350 mg per kg body weight[1–3].

For chronic effects

Weanling albino rats weighing 50–70 g were daily given pesticides at 5% of LD_{50} orally along with groundnut oil. Administration of pesticide was continued separately in four groups for 15 days and in the remaining four groups for 60 days and thereafter these were sacrificed.

Control groups were run simultaneously for each study. All the animals were maintained on Hindustan Gold Mohr rat feed.

Brain was immediately removed after sacrifice, washed in chilled normal saline and homogenized in isotonic solution (0.25 M sucrose, 0.01 M TRIS, 0.001 M EDTA) to form 10% homogenate. The cellular debris was removed by centrifugation at $700 \times g$ for 5 min. Succinate dehydrogenase (SD) activity was estimated in the supernatant according to Kun and Abood[4]. Protein in the supernatant was estimated according to Lowry[5].

The specific activity of brain SD in weanling rats was found to increase with age; however, in adult rats it showed decline (table 1). At the end of 1 hr after administration of 50% of LD_{50} of each pesticide, both the organophosphate pesticides (elsan and phosalone) inhibited brain SD significantly (15 and 27.3% respectively, $P < 0.05$). Carbamates (carbaryl and bavistin) were also found to exhibit inhibitory trend when fed at the same levels but it was not significant (7.6 and 14.7% respectively, $P > 0.05$).

Regular administration of these pesticides at one-tenth level of LD_{50} for 15 days (chronic administration) revealed significant inhibition of SD by phosalone (17.8%, $P < 0.01$) and carbaryl (14.1%, $P < 0.05$). Chronic administration of elsan and bavistin for the same period did not show much effect.

Chronic administration of all the four pesticides up to 60 days exhibited highly significant inhibition of SD ranging from 27.3 to 47.5%. Carbaryl was found to exert only 20.3% inhibition (table 1).

Inhibition of SD which is a very important enzyme of TCA-cycle and forms one of the steps of energy production site is bound to inhibit the whole cycle in the brain tissue and thus lower the energy output. This ought to inhibit the operation of electrochemical changes which all are endergonic reactions, making

Table 1 *Effect of pesticides on succinate dehydrogenase activity in rat brain*

Succinate dehydrogenase (activity/mg protein)*	50% of LD_{50} (adult rats)	5% of LD_{50} for 15 days (weanling rats)	5% of LD_{50} for 60 days (weanling rats)
Control group	29.64 ± 3.82	31.06 ± 2.45	51.85 ± 7.55
Carbaryl fed group	27.38 ± 7.24 (7.6) $P > 0.05$	26.68 ± 1.67 (14.1) $P < 0.05$	41.30 ± 4.48 (20.3) $P < 0.05$
Bavistin fed group	25.26 ± 4.38 (14.77) $P > 0.05$	28.79 ± 2.91 (7.3) $P > 0.05$	27.23 ± 1.82 (47.5) $P < 0.001$
Elsan fed group	25.20 ± 6.30 (15.0) $P < 0.05$	29.98 ± 3.37 (3.5) $P > 0.05$	37.70 ± 3.73 (27.3) $P < 0.01$
Phosalone fed group	21.55 ± 6.57 (27.3) $P < 0.05$	25.52 ± 1.94 (17.82) $P < 0.01$	29.20 ± 2.40 (43.7) $P < 0.001$

Number of rats in each group was five.
Figures in parentheses indicate per cent inhibition.
*Specific activity of the enzyme was defined as number of μg of TTC (Triphenyl tetrazolium chloride) reduced per hour per mg of protein at 37 C.

the overall brain functioning sluggish.

The authors are grateful to ICMR, New Delhi for financial assistance to one of the authors (SK).

30 July 1986

1. Matsumura, F. In: *Toxicology of insecticides*, Plenum Press, New York, 1976, p. 180.
2. BASF India Limited, Agrochemicals Division, Bombay, Technical Information Plant Protection.
3. Meister, R. T. In: *Farm chemicals handbook*, Meister Publishing Co., Ohio, 1976, p. D196.
4. Ernest Kun, and Abood, L. G., *Science*, 1949, **109**, 144.
5. Lowry, O. H., Rosebrough, N. J., Farr, A. L. and Randall, R. J., *J. Biol. Chem.*, 1951, **193**, 265.

TETRAZOLIUM REDUCING MICROORGANISMS INSIDE THE ROOT OF *BRASSICA* SPECIES

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MICROSCOPIC studies were carried out to study the presence of diazotrophs within the root tissue of mustard plants. The roots of mustard varieties Varuna (*Brassica juncea*) and ISN-129 (*B. napus*) grown in field and treated with strains M4 and W5 of *Azotobacter chroococcum* were taken as experimental material. The tetrazolium reduction technique[1] was used for the purpose. Free hand sections of the roots were observed under phase contrast and light microscope, using magnifications 150×, 400× and 1000× (L.M) and 250× and 400× (PH).

The roots were stained maroon with varying intensity at different sites. In general, there was more colour at the tip of the roots and around the place of origin of the secondary roots. In most cases the secondary roots were deeply stained.

In cross-sections (figure 1a) a number of coccoid, spiral and bacillus-shaped, deeply-stained cellular bodies of various sizes were observed. Some of these appeared to be motile. They were localized in certain areas like the cortex and around the xylem vessels. The bodies in the cortex appeared as a maroon band in the centre with no colour in the outer cortex and the pericyclic area under low magnification. The cells occurred singly or in aggregates around the xylem vessels. Some typical *Azotobacter*-like cells were seen moving very actively around the xylem vessels. Some spiral-shaped bodies with a typical *Azospirilum*-like motion were also seen.

Transverse sections of the secondary root region (figure 1b) showed a darkly-stained area at the origin of the secondary root with longitudinal streaks throughout the root. These streaks were mainly confined to the stelar region. The colourless roots showed no stained bodies inside the root tissue.

Results of microscopic observations indicated the presence of tetrazolium-reducing microorganisms in plants of two species of *Brassica*, which are dicotyledenous. Some of these microorganisms were confirmed by isolation and acetylene reduction assay to be diazotrophs. Till now, the presence of these organisms was reported[2,3] only in the monocot family Gramineae.

Seed inoculation with *Azotobacter* did not show much effect on the endorhizosphere microbial population, though in a few cases the uninoculated control was devoid of microflora. These observations