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The Rhinoceros beetle, *Oryctes rhinoceros* is considered as one of the most successful insect pests, feeding mainly on the coconut palm, mainly because of the ability to choose a variety of breeding sites. In his review Bedford (1980) lists the number of breeding sites in various countries. These sites vary from tops of dead standing coconut palms that have been killed or damaged (Bedford, 1976; Cumberra, 1957; Leafman's 1920 and Surany, 1960) to coconut stems and logs on the ground (Bressitt, 1953; Orian, 1959). The other sites are decaying wood, compost and saw dust heaps in Tonga, Samoa and Fiji (Gressitt, 1953) heaps of decaying cocoa pod shells serve as breeding sites in New Ireland (Bedford, 1976b). In India (Kurian and Pillai, 1964) and Mauritius (Bedford, 19676a; Monty, 1978). Heaps of cattle dung are the most preferred and important sites. Other breeding sites are rubber stumps in Malasia (Ghosh, 1923), dead standing coconut trunks and falling logs in Madagaskar (Bedford, 1968). Leafman's (loc. cit) has shown that the floating logs containing larvae in tunnels might spread the pests to new areas.

Even though several methods have been adopted to control this pest at larval and adult condition, it has been found to be difficult to destroy this pest completely. In India it is reported that there is about a loss of 10% coconut yield because of the attack by this beetle *O. rhinoceros* (Menon and Pandalai, 1958). However, the
heaviest loss due to the *O. rhinoceros* attack so far have been reported from South Pacific Countries costing about US $1,10,000.

In this connection Bedford (1980) has pointed out that even though many integrated pest control methods are attempted for decades, the results are frequently unsatisfactory or disappointing and control was often affected by the economics of, and local attitudes towards the crop.

The larvae of *O. rhinoceros* prefer a temperature of 27 to 29 C and avoid higher or lower temperatures. They are usually attracted by the smell of ammonia and acetone (which may be present in the natural breeding sites). It prefers higher relative humidities 85-95% and avoid lower humidities (Costa and Ganesalingam, 1967).

For controlling this pest (*O. rhinoceros*) basically three methods are adopted. One is to kill the adults by physical methods (using the conventional traps), applying pesticides on the crown of coconut palms or by applying pesticides at the breeding site. One of the recommended method is that the breeding sites may completely be destroyed to control the larvae. This method may not be feasible in all cases. For instance, in India the heaps of the cow dung is the main breeding site for the adults and feeding sites for the larvae. Here the cow dung cannot be completely removed and destroyed for this is used as a manure in the neighbouring
crop fields. Therefore to control the larvae in such breeding site, is to apply the pesticides. But we have to face one risk in this method i.e. when these larvae are fed by the pountry and pig (which normally occurs in India) there is every possibility of the pesticides entering into the food chain when these contaminated pountry and pigs are consumed by the human. For this purpose we have to choose a pesticide and its concentrations to control the larvae in the breeding sites in such a way that it should be less harmful for the predators, human and also for the plants growing in the neighbouring areas.

A review of literature shows that for decades many of the insecticides/pesticides have been used to control the beetles at the larval/adult states. Nirua1 et al. (1951) have tried with eight insecticides including gammexene-D, Agrocide (50% BHC and 65% at its =isomer), Rothane, W.P. containing dichloro dipospho dichloreothane (DDD), Taxaphene, containing chlorinated camphene 10% aceto-arsenite of copper, lead arcenate, calcium arcenate and sodium arcenate, in the laboratory conditions. From their results they have concluded that when the breeding materials were sprayed with 0.01% BHC, complete control of these grubs was obtained. They have also pointed out that BHC ( =isomer) in the recommended doses is quite safe for higher animals and the vegetation. Catley (1969) on the other hand, has recommended the crown treatment of palms using a 1:9 mixture of 6.5% =isomer of BHC dust and sawdust applied to
the top most fine axils, affords the palm a good protection against the beetle attack for up to six weeks. Insecticides screening trials undertaken by Kurian (1967) has indicated that 0.1% BHC, Telorein and Aldrin effectively killed the III instar larvae for up to six months after treatment of the cow dung. Apart from this, biological control of the larvae by using virus has been recommended by Bedford (1976). From the available information on the insecticide Malathion, Spiller (1961) has listed a large number of insects, both larvae and adults, which can be controlled by Malathion treatment at different concentrations. Even though this list seems to be exhaustive there is no mention of its effect on O. rhinoceros (Larva/adult).

The available information on the control of O. rhinoceros (larvae/adult) give a clear picture of how and what percentage of this insect pest can be controlled. However, practically no information is available on the effect of these pesticides on the physiological activity of the beetle O. rhinoceros. Hence, two types of commonly used and highly recommended pesticides, Malathion and BHC have been used in the present study to see the effect on the organic constituents of the III instar larvae by applying the pesticides in the compost.

To get an overall picture of the effect of the pesticides on the III instar larvae were treated with different concentrations of pesticides and changes in the
total body weight were followed. Preliminary studies of LD 50 of BHC and Malathion on these larvae showed that 2.0 g/5 Kg of compost for 72 hrs found to be highly effective in controlling them. The results obtained have shown that an average body weight of 12.5 g got reduced to 8.52 g. This amounts to a loss of about 32% of total body weight after 72 hrs of treatment. This suggests that about 1/3 of the body weight is lost as a result of such treatment. Such a reduction may be accounted for by the reduction in water content/organic constituents.

Hence, the water content of the body wall and digestive system was calculated after treatment of the larvae with BHC and Malathion. The overall results obtained for BHC and Malathion show that there is a general decrease in percentage of water content from 97.02% of normal larvae to 93.12% after treatment with BHC, and from 97.02% to 92.77% after treatment with Malathion. This accounted for about 4% reduction in the water content of digestive system. Similarly in the body wall also there was a water loss of about 4%. From this observation it becomes clear that water loss may be due to pesticide treatment.

An analysis of the results obtained for organic constituents like protein, carbohydrate and lipids shows a diversified results in haemolymph, digestive system and body wall.
The protein content of haemolymph showed more or less a similar type of fluctuations after treatment with BHC and Malathion. In both the cases there was an initial increase in the percentage of the constituent after 24 hrs of treatment. However, this percentage decreased again and reached the minimum quantity after 72 hrs. The initial increase after 24 hrs of pesticide treatment might be due to physiological shock. Such a phenomenon has been recorded by Sudarshankumar (1991). In his observation he has noticed a simultaneous increase in the activity of enzymes amylase and invertase in III instar larvae of O. rhinoceros, using carbofuran and BHC.

While looking into protein content of digestive system it shows an initial increase after 24 hrs of treatment with BHC and Malathion. After 72 hrs this has decreased and reached the minimum value. However the effect of BHC appear to be more effective than that of Malathion.

The pattern of changes of protein content of body wall in response to BHC and Malathion appear to be more or less the same. The percentage of initial increase is about 32% with BHC and 35% with Malathion. However, after 48 hrs the quantity had come down once again. This decrease was more conspicuous with reference to BHC than with Malathion. This reflects a higher efficacy of BHC on the protein metabolism of the body wall.
The changes in carbohydrate content of haemolymph, digestive system and body wall do not present a clear picture at all.

In the case of haemolymph the percentage of carbohydrate decreased after 24 hrs of treatment with BHC and Malathion. But this decreased quantity increased once again after 48 hrs of treatment with BHC and Malathion. After 72 hrs there was either an increase or decrease with different concentrations.

While looking into changes in carbohydrate content of digestive system, a decreasing pattern was found when compared to that of protein. For instance in the digestive system of III instar larvae treated with BHC and Malathion the carbohydrate decreased and reached the minimum value after 24 hrs of treatment. Here again the decrease appears to be more conspicuous with Malathion than with BHC treatment. This suggests that as far as carbohydrate metabolism of the digestive system is concerned Malathion appears to be more effective than BHC (25 to 33% and 10 to 30% respectively).

With reference to the changes in the carbohydrate content of the body wall, the quantity declined after treatment with BHC for 48 hrs. It once again increased and reached the maximum value after 72 hrs. On the other hand such a decrease was uniform and reached the minimum after 72 hrs of treatment with Malathion. As such in the case of body wall there seems to be different types of effect on
carbohydrate metabolism after treatment with BHC and Malathion.

The pattern of changes in the lipid content seems to be complementary to that of protein. In the cases of haemolymph, digestive system and body wall, the quantity first decreased after 24 hrs of treatment with both BHC and Malathion. This pattern was reversed at 48 hrs. However, it decreased once again and reached the minimum value after 72 hrs. This may be due to the fact that the tissues were trying to revive the lipid metabolism after 24 hrs of treatment with the pesticides. But the second decrease after 72 hrs of treatment (before death of the larvae) indicates that the metabolic poisoning was continuous.

Generally one will expect a compensatory adjustment at least between protein-water under experimental condition. This has been generally proved in the case of several migratory animals including fishes (Love, 1970). But such a phenomenon does not appear at all under the experimental condition in the beetle larvae of O. rhinoceros. Here it may be that since the animals are continuously treated with metabolic poisons (BHC and Malathion) there might be some erratic changes in the metabolism of the constituents before they die.

The electrophoretic study of proteins after treating the larvae with BHC and Malathion for different intervals present still another pattern of changes. An overall
picture of various peaks of protein fractions after treatment with BHC and Malathion showed modifications - either they are reduced in number, or shifted from SMP to FMP and vice versa. It is therefore assumed that during different intervals of treatment from 24 to 72 hrs, the pesticides might have interfered in the metabolism of protein in haemolymph. Since there was change in the protein fraction in digestive system and in body wall there could have been a simultaneous modifications in the protein fractions in those tissues too. Not much information is available in the literature about the changes in the haemolymph proteins after pesticide treatment. (Wyatt, 1961) has given in detail the electrophoretic separation of haemolymph proteins of various insects under normal condition. Since there was a change in the protein fractions as a result of pesticide treatment, it may reflect the change in the other tissues. In the present study the pesticides were provided to the larvae through the compost on which they feed voraciously. The pesticides consumed through the digestive system could have been transported/translocated through the absorptive activity of the haemolymph. As such diffusion of pesticides might have occurred into the body wall. The other possibility is that the pesticide mixed in the compost might have entered the body wall (through diffusion?) and got accumulated there. The higher accumulation of Malathion was recorded through gas chromatographic analysis further confirms this view. In
translocation of the pesticides from the digestive system, haemolymph might have played an important role. That the circulatory system of insects play an important part in transporting the insecticide towards/away from the site of toxic action has been shown by Ahmad and Gardiner (1968). On the contrary (Gerolt. 1969 & 1975) has opined that the haemolymph is not an important mode of transport for such insecticides. That the pesticides have interfered in the protein metabolism has been indicated by the shifting of the peaks from SMP to FMP after 48 hrs both in digestive system and body wall. This phenomenon could be due to the increase in the quantity of protein of higher molecular weight. A comparison of the results obtained between the quantitative analysis of total protein and that of the protein fractions obtained through electrophoresis presents a diversified result. The quantitative increase of protein in both digestive system and body wall in the initial period of treatment (after 24 hrs) with BHC and Malathion can be explained due to the physiological shock at that stage. However, as the treatment time increased the protein concentration decreased. On the other hand through electrophoresis an increase in the protein fractions of higher molecular weight was observed at the later stages of treatment with BHC and Malathion. In the absence of any such previous observations by others, no plausible explanation can be given for this phenomenon.

A comparison of the three organic constituents
(Protein-water; Protein-lipids; lipids-carbohydrates) was attempted to study the compensatory adjustment taking place among the above constituents during the adverse conditions. The results showed clearly that no such adjustments take place. For there was always a positive correlation between these three i.e., a simultaneous increase or decrease of one component with the other. For instance, the values obtained for protein and lipids after pesticides treatment, the quantity of protein increased with the increase in quantity of lipids (there was always a positive slope whenever the values for above components were plotted). This was the case even when protein and water content was compared. This may be due to the fact that the pesticides, by interfering simultaneously in metabolic mechanisms in all the tissues, could have resulted in total reduction of those organic components which in turn might have reduced the total body weight.

From the studies using the pesticides on III instar larvae of O. rhinoceros, both Malathion and BHC seem to be equally effective in impairing the physiological activities of the larva. Hence it is tentatively suggested that these two pesticides can safely be used to control the beetles in the larval stage itself.