Toxicological studies on some stored Grain Insects

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INTRODUCTION

Insects destory at least 5 percent of the world production of cereal grains from time of harvest to consumption. Losses to harvested produce may be of quantity or quality. These include loss in weight and food value, heating of grains, deterioration in grain constituents and low germination of seeds.

Both temperature and humidity have a profound effect on the development of insects. Under unfavourable conditions of temperature or humidity, the rate of development is retarded or may be completely arrested. Moreover, these two factors may have an influence on the susceptibility of insects to insecticides used to protect stored grain from insect infestation.

Several factors are involved in determining the toxicity of insecticides to stored grain pests. The type of the used insecticide, its dose, the period of exposure and the species of insect together with the prevailing environmental conditions seem to be among the most important of these factors.

The present investigation was, thus carried out to explain the toxicity of certain insecticides to the confused flour beetle, <u>Tribolium confusum</u> Duv., and the granary weevil, *Sitophilus granarius* (L.) taking into consideration the previously mentioned factors.

The confused flour beetle, *Tribolium confusum* (Duv.) is a serious pest of a wide range of grain products. It occurs in large numbers in flour mills and bakeries where it is regarded as the most destructive beetle of stored flour.

The granary weevil, *Sitophilus granarious* (L.) is one of the oldest known insects and one of the worst pests in stored grains all over the world.

Both adults and larvae feed voraciously on a wide variety of grains. In severe infestation, grains may be reduced to mere shells.

The present work is divided into three main parts. Part I deals with the comparative toxicity of malathion, fenthion, and Baythion to both insects. The interrelation of certain environmental factors on the effectiveness of the used insecticides has been studied in Part II. The residual efficiency of insecticides on stored wheat grain has been discussed in part III

Review of Literature

1. Efficiency of insecticides against stored grain insects:

Parkin (1958), directed attention to the need for more detailed assessment of the stability of malathion to heat, moisture and alkalinity, as factors affecting the effectiveness of insecticides applied to grain for protection against storage pests. He stated that consideration had to be given to the moisture content, the storage temperature and the kind and condition of grain.

Dyte, (1960), found that a lacquer containing [illegible] percent by weight of malathion proved toxic to several species of coleoptera that infested stored products when they were confined on surfaces treated with it.

Abo Elghar and Badawy (1961) reported that malathion was highly effective against stored insects than Katelsous. Moreover, Malathion when added to Katelsous noticeably increased its effectiveness.

In his study on the efficiency of Malathion for the control of Tribolium castaneum (Hbst.) Gedevari (1964) found that the mortality was highest in whole grains on which the concentration of malathion per sq. cm. also was highest and decreased as particle size decreased.

Lemon, (1966), studied the relative susceptibilities of T. confusum Duv. and T. castaneum (Hbst.) to organophosphorus insecticides. He found that fenthion, fenitrothion, Imidan, dicapthon, dimethoate and chlorthion produced ~~higher mortalities~~ than malathion. Diazinon was more effective than malathion against T. castaneum, but was less effective against T. confusum.

Teotia and Singh (1966), studied the immediate and residual action of malathion, Carbaryl (Sevin) and dusts against Sitophilus oryzae L. in stored maize and rice grais. Adults of S. oryzae were confined in the grain for 48 hours in batches of 25 insects per ... of grain, immediately after treatment and at monthly intervals therafter. The minimum amounts of insecticides initially giving total mortality of the

...vels proved to be 300 p.p.m. Carbaryl and 10 p.p.m. BHC for maize and rice, and 2 and 3 p.p.m. malathion for some grains, respectively. Although malathion showed the highest initial toxicity, carbaryl at 300 p.p.m. declined only slightly in effectiveness during the two months after treatment, whereas malathion and BHC lost much of their toxicity after one month. To produce an effect in maize and rice comparable to that of carbaryl at 300 p.p.m., malathion would have to be applied at 3 and 4 p.p.m. and BHC at 20 and 25 p.p.m., respectively. The effectiveness of all the products declined more rapidly in rice than in maize.

Speirs et al, (1967), stated that the resistance of the red flour beetle to malathion was directly related to the length of time for which the insecticide had been used for insect control in the premises concerned. Strains having unknown exposure to malathion in warehouses were nearly as susceptible as the laboratory strain. The $L_{D_{50}}$ for the most resistant strain was 11.3 times as great as that of the susceptible laboratory strain.

Strong (1968) examined the toxicity of 48 insecticides to adults of <u>T. confusum</u> Duv. and <u>S. granarius</u> (L.). He found that Bay 77488, Bay 78182, [illegible] and Gardona killed 100% of the test insects at one or more of the used concentration. Insecticides grouped for potential use as direct sprays and residual surface treatments in sanitation programmes were less safe than malathion, but equal to or safer than diazinon. Of the compounds included in that group, Bay 37341, fenitrothion (Bay 41831), Bay 79330, [illegible], [illegible]rmothion (CP 53926), diazinon, dicapthon, dursban and fenthion killed 100% of the two species of test insects at one or more of the used concentrations.

Strong <u>et al</u>, (1969), studied the toxicity of malathion to eight strains of <u>T. confusum</u> Duv. and [illegible] strains of <u>T. castaneum</u> L. The data obtained for each strain was compared with that of a standard laboratory culture of the same species. When the value 1 was assigned to the L_C values obtained with the standard laboratory cultures, the susceptibility values of field strains of <u>T. confusum</u> Duv. ranged

... 0.64 to 1.19 at the $L_{C_{50}}$ level and from 0.76 ... 3... at the $L_{C_{95}}$. The differences in susceptibility ... field strains were attributed to the normal ...etic plasticity of the species. There was no in...ation of resistance to malathion in the samples of ... natural populations used to provide culture stocks ... field strains.

Champ et al, (1970) studied the malathion re...sistance in **T. castaneum** (Hbst) associated with groundnuts and cereals in storage by exposure to in...secticide - impregnated filter paper. Resistant strains associated with groundnuts showed tolerance ... dichlorvos, fenitrothion, tetrachlorvinphos (Gardona), phoxim, Cynanophos, difenphos (Abate), ...azinon, dursban, Hoe 2910, Carbaryl, promecarb, DDT ... (lindane). In all instances, the malathion resistant strains were found to be resistant also to γBHC.

Strong, (1970) studied the comparative sus...ceptibility of the confused flour beetle, T. confusum, ... the red flour beetle, T. castaneum, to 12 organo-... insecticides by direct application of spray solutions to adult insects with a potter laboratory spray tower. He found that the order in effectiveness of insecticides against the confused flour beetle LC_{95} was as the following:

Fenthion > Gardona > fenitrothion > Bay 77488 Dursban > Bay 78182 > dichlorvos > C9491 (novanol) > malathion > abate > dicapthon > diazinon. He added that at LC_{50} and LC_{95}, C 9491 and Gardona were more toxic to confused than to red flour beetles, and all other insecticides were more toxic to the red than to the confused flour beetle.

Lehman, et al (1972) found that in topical application tests, the toxicity of Ciba-9491 (novanol), Gardona and Penick SBP - 1382 to larvae of Plodia interpunctella was greater than that of malathion. Gardona proved to be more toxic than malathion to adults of confused flour beetle, T. confusum Duv.

2- Effect of temperature and relative humidity on the efficiency of insecticides:

Hartzell and Wilcoxon, (1932), stated that adults of the rose chafer, Macrodactylus subspinosus F., when sprayed with Pyrethrum at a dose insufficient