INSECT GROWTH REGULATORS: SOME EFFECTS OF ALTOSID™ ON TRIBOLIUM CASTANEUM (HERBST).

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INTRODUCTION: Insect growth regulators(IGR) display activity similar to that exerted by the naturally occurring insect hormones and thereby have potential as insect control agents, particularly as postharvest protectants for stored agricultural products. Studies on Altosid™, a novel juvenile hormone analogue of trans - trans - dienoate structure without an epoxide function[1], have revealed it to be active at 5 ppm and above by either inhibiting or impairing development in a number of stored-product insects[2,3]. The purpose of this study was to assess the effects of relatively low concentrations of altosid on development and reproductive productivity of adults reared in treated media using *Tribolium castaneum* (Herbst) as the test insect.

MATERIAL AND METHODS: An insecticide susceptible strain of *T. castaneum* (VTC 45) was used in the tests, having been reared at 25°C and 60 - 70% R.H. on a mixture of wholemeal flour and dried yeast powder in the proportions 12:1.

Flour (wholemeal) media incorporating altosid (isopropyl 11-methoxy-3, 7, 11-trimethyl-2, 4-dodecadienoate) were prepared in the manner described by Williams and Amos[3] to give concentrations of 0.001, 0.01, 0.1, 1.0, 5.0 and 20.0 ppm; medium treated only with acetone (the solvent used for altosid) served as a control.

To assess possible effects on development, 3 replicate batches of 50 eggs (<24 hours old) laid in untreated flour were each placed in 20 g of medium in a 240 ml glass jar and incubated at 25°C and 60 - 70% R.H. After 4 weeks the jars were examined periodically and adults together with any adultoids (pupal-adult intermediates) were removed. Adults were sexed and examined for morphological deformity discernable at magnifications of X20 - 30.

Productivity of morphologically normal and deformed adults reared in a treated medium (0.1 ppm altosid) was assessed by crossing these individuals with normal (control) adults reared in untreated flour. Test adults were produced by placing eggs (<24 hours old) into the treated and control flour medium in 240 ml glass jars. These jars were examined periodically for pupae which were removed, sexed and placed in small petri dishes to provide supplies of virgin adults. Each virgin adult (<2 days old) reared in the treated medium was examined for morphological deformity and then placed in a 75 ml plastic vial containing 5 g of untreated medium together with a morphologically normal virgin adult reared in the untreated medium; 30 pairs were set up for each cross. At

weekly intervals for a period of 4 weeks the adult crosses were transferred to fresh, untreated flour, and the vials incubated to assess progeny production.

RESULTS AND DISCUSSION: Effects of altosid on development are shown in Fig. 1. Development was completely inhibited at 5 and 20 ppm thus confirming previous findings[2,3]. At 1 ppm relatively few individuals completed development and all were morphologically deformed; the majority of individuals developed into adultoids (pupal - adult intermediates). Further reduction in altosid concentration to 0.1 ppm and less resulted in approximately the same number of individuals completing development as in the control. However, at 0.1 ppm about half of the adults were morphologically deformed and some adultoids were produced whereas at lower concentrations the incidence of morphological deformity was similar to that of the control. Morphological deformity ranged from aberrations of the tarsi, legs reduced to small unchitinised stump-like appendages, lack of differentiation of the antennal club which was often poorly chitinised, retention of urogomphi, to crumpled and greatly diverging wings and elytra.

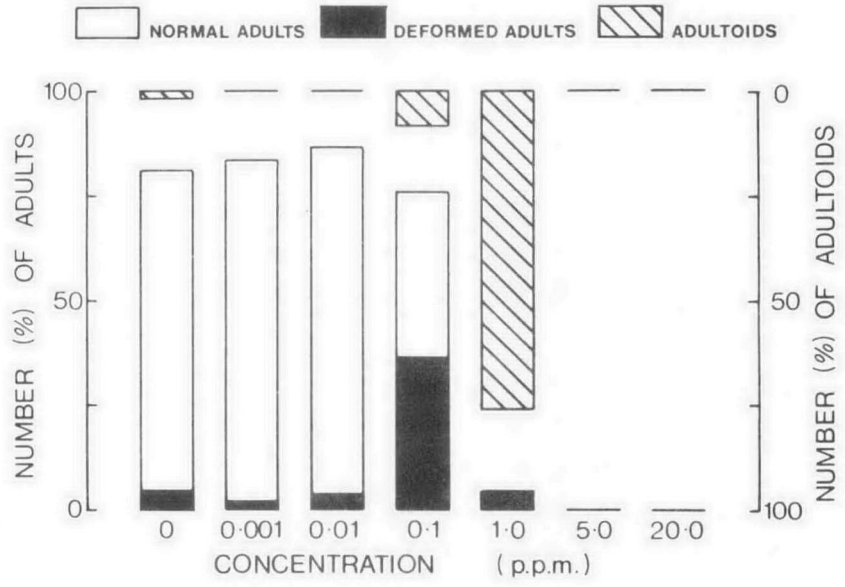

Figure 1. Production of morphologically normal and deformed adults, and adultoids, of *T. castaneum* when reared in media containing various concentrations of Altosid.

The viability, in terms of number of adults able to produce progeny, and reproductive performance, expressed as the number of progeny produced by viable adults in the first 4 weeks of life, together with productivity which in effect compounds

viability and reproductive performance, of adults reared in the medium containing 0.1 ppm altosid are shown in Fig. 2. Both viability and reproductive performance of morphologically normal female adults were little different from those of the control; this was also reflected by their similarity in productivity. In contrast, the viability of deformed females was markedly reduced but, surprisingly, reproductive performance of viable individuals was not greatly affected. However, the marked reduction in viability was sufficient to reduce considerably the overall productivity of the deformed females. With males, rearing in the treated medium resulted in viability and reproductive performance being reduced for both morphologically normal and deformed individuals although this was more pronounced in the latter. These effects were reflected by the overall productivity of males.

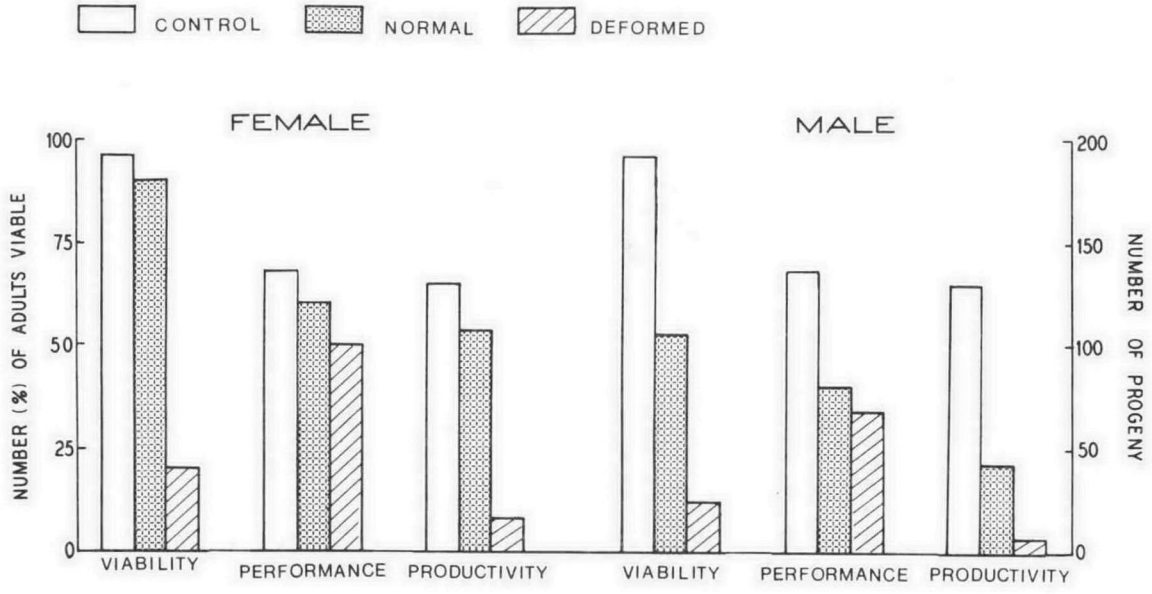

Figure 2. Viability, reproductive performance and productivity of morphologically normal and deformed *T. castaneum* adults which were reared in media containing various concentrations of Altosid.

As productivity was only markedly reduced in deformed females, it appears that there was some form of morphological rather than physiological impairment to successful breeding e.g. retention of pupal cuticle over genital regions. Since productivity of males was greatly reduced irrespective of morphological deformity, some degree of physiological as well as morphological

impairment to successful breeding would appear to be involved. These effects which impair the insects' reproductive processes have not previously been observed for flour beetles exposed to sub-lethal concentrations of altosid although it is known that insect hormones and their analogues may possess similar activity[4]. Such sub-lethal effects of altosid and similar IGR's may confer an advantage when used as protectants for stored products for they could extend the period of protection by retarding or even preventing the establishment of an insect infestation.

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