Effects of insect growth regulators with juvenile hormone activity against Callosobruchus maculatus (F.) (Coleoptera: Bruchidae)

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With 2 tables

Abstract

Five insect growth regulators, CGA-29170, CGA-45128, MV-678, RO-20458, and fenoxycarb, that exhibit juvenile hormone activity were evaluated for biological and residual activity against the southern cowpea weevil, Callosobruchus maculatus (F.). The compounds were mixed with cowpea seeds at concentrations of 10, 25, 50, and 100 mg/kg, and the residual activity was evaluated at 2-week to 9-month posttreatment intervals. Most JHA-treatments showed high initial activity at these concentrations. A peak emergence in all treatments was significantly suppressed, where did not exceed 29.5% at the lower concentrations of 10 and/or 25 mg/kg at 9-month posttreatment interval.

1 Introduction

Current control methods employed against stored-product insects include the use of fumigants and organophosphorus protectant insecticides. During recent years, the increasing incidence of insect resistance to both groups of compounds has enhanced the need to develop more effective and relatively safer insecticides. In the search for new control technique, insect growth regulators (IGRs) with juvenile hormone activity have been receiving a great deal of attention in stored-product insect control (Main and Mulla, 1982 a). Unlike conventional grain protectants, IGRs possess novel modes of action, affecting disruption in development or reproduction processes of some insects.

There has been an increasing interest in the evaluation and use of a number of juvenile hormone analogues (JHAs) against storage insects (Thomas and Bhattachar-Thomas, 1966; Pallos et al., 1971; Metwally et al., 1972; Bhattachar-Thomas, 1973; Strong and Dickman, 1973; Loschmann, 1975; McGregor and Kramer, 1975; El-Tantawi et al., 1976; Kramer et al., 1981; Mian and Mulla, 1982a, b; Rup and Chopra, 1984).

In view of the residual activity of these compounds, further experimental evidence was needed to evaluate the...
persistence of the IGRs residues in a treated grain commodity over a period of time (Loschavo, 1976; Mian and Mulla, 1982a, b, 1983; Kramer et al., 1985; Coburn, 1988).

The present study is conducted to determine the effectiveness of five IGR compounds that exhibit juvenile hormone activity as surface protectants of cowpea seeds against the southern cowpea weevil, Callosobruchus maculatus (F.).

2 Material and Methods

The 5 IGRs used were: MV-678 [1-(8-methoxy-4,8-dimethylnonyl)-4-(methylthyl)benzene (47.92% EC)], RO-20458 [(E)-3-[5-(4-ethylphenoxy)-3-methyl-3-pentenyl-2,2-dimethylxirane] (47.92% EC)], fenoxycarb [ethyl(2-[p-phenoxyphenoxy] ethyl)carbamate (25% WP)], CGA-29170 [1-(4-pentenyloxy)-4-phenoxybenzene (50% EC)], and CGA-45128 (50% EC).

The IGR stock solution were prepared in water giving a concentration of 10 mg of a.i./ml. Aliquots of stock solution were diluted, as necessary, to prepare solutions containing the quantity of IGR needed to give a calculated 100, 50, 25, and 10 mg/kg of cowpea seeds. The experimental procedure described by Mian and Mulla (1982a) for treating the commodity and for residual activity studies was followed with a simple modification, as follows: the appropriate amount of IGR was pipetting 5 ml of each solution into a jar containing 100 g of seeds and mixing thoroughly to ensure an even coating of seeds. The treated samples were left overnight in open jars for evaporation of the water. Next day, the samples were transferred to paper bags enclosed in poly ethylene bags and were stored in sealed cans in the laboratory. Samples mixed with water and handled in the aforementioned manner served as checks. The residual activity of IGRs against C. maculatus was determined at 2 weeks and 1-, 4-, 6-, and 9-month posttreatment intervals in cowpea seeds.

For bioassay, 15 g of treated seeds were placed into each of three 13-cm petri dishes. Ten 1- to 2-day-old C. maculatus sexed pairs, from a laboratory colony, were added to each dish. Beetles were allowed to mate and oviposit and were removed after one week. We determine the number of eggs on each seed and the unhatched eggs were also counted. After 2 weeks, the samples were examined daily for F1-progeny and the counts were terminated after ca. one week of emergence.

All tests were carried out at temperature of 27 ± 1°C and 60 ± 5% relative humidity (RH). All data were analyzed statistically, and means were compared for significantly difference by using Duncan's (1955) multiple range test (P@ ± 0.05).

3 Results and Discussion

Table 2 shows the subsequent F1-progeny production of parent adults preexposed to JHA-treated seeds for several intervals. In general, CGA-45128 appeared to be the most active compound causing highly reduction in the F1-progeny, at the lower concentration of 10 mg/kg, at 2-week posttreatment interval, extending over a period of 9 months. MV-678, CGA-29170, and fenoxycarb applied at 50, 50, and 25 mg/kg, respectively, showed similar activity, however, the residual activity of the latter decreased after 4 months. RO-20458, however, was less active, and showed high initial activity at these lower concentrations. Moreover, as evidenced by the data, adult emergence in all JHA-treatments was significantly suppressed, where did not exceed 29.5% at the lower concentrations of 10 and/or 25 mg/kg, at 9-month posttreatment interval. Mian and Mulla (1982a) reported that IGRs diflubenzuron (5 ppm) and methoprene (10 ppm) did not cause significant reductions in the F1-progeny when the treated grain was infested with Sitophilus oryzae (L.) 1 day after treatment. In agreement of our present study, Mian and Mulla (1982b) suggested that an initial interval of 2-weeks was selected between treatments with IGRs and bioassay to allow some time for residue penetration of IGRs. Their results demonstrated that the initial activity (69.9%) of BAY SIR 8514, at the lower concentration of 1 ppm and 2-week intervals, rose to > 90% at the 2-month interval until a very high level of control (95 to 99%) was achieved from 4 to 12 months posttreatment. Our data, also, in concur with those reported by Mian and Mulla (1982b) who indicated that at the higher concentrations of 5 and 10 ppm, the activity of BAY SIR 8514 had almost similar trend in residual activity as the lower concentrations. Kramer et al. (1985) indicated that fenoxycarb could be an effective long-term protectant for stored rice and other grains. Similar results were obtained by Coburn (1988), in which fenoxycarb controlled 4 major species of stored-product insects; Sitotroga cerealella, Rhizopertha dominica, S. oryzae, and T. castanenum, for 18 months in rough rice treated with 5 or 10 ppm and stored in small