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Activity of CGA-28772 Against Stored-Product Insects[1]

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ABSTRACT: A new insect growth regulator was effective as a progeny suppressant of several stored product insects when it was applied to diet at 50 ppm or less. CGA-28772 [5-[(4-phenoxyphenoxy)-methyl]-1,3-benzodioxole] prevented development of F_1 progeny of *Plodia interpunctella, Ephestia cautella, Sitotroga cerealella, Oryzaephilus surinamensis* and *Tribolium confusum* at <0.1–10 ppm levels in wheat media. It was at least 2× less active toward *Rhyzopertha dominica, Sitophilus oryzae* and *S. granarius. O. surinamensis* exhibited adult mortality at 10–100 ppm levels.

A nonneurotoxic insecticide which acts as an insect growth regulator is CGA-28772 [5-[(4-phenoxyphenoxy)-methyl]-1,3-benzodioxole]. The mechanism by which this compound disrupts the normal development of insects is unknown at the present time. Nevertheless it is active against numerous species representing various insect orders and has a relatively low mammalian toxicity (D. V. Alleman, Ciba-Geigy Corp., unpublished data). Therefore, this benzodioxole might be useful as a protectant of stored products. We applied it to wheat and evaluated its activity against three lepidopteran and five coleopteran species that infest stored products.

Materials and Methods

CGA-28772 was obtained from Ciba-Geigy Corp. (Greensboro, NC) as a 95% pure white crystalline powder and was stored at −10°C. All insects were obtained from laboratory cultures and had no prior exposure to insecticides. They include the Indianmeal moth, *Plodia interpunctella* (Hübner); Angoumois grain moth, *Sitotroga cerealella* (Olivier); almond moth, *Ephestia cautella* (Hübner), sawtoothed grain beetle, *Oryzaephilus surinamensis* (L.); confused flour beetle, *Tribolium confusum* (Herbst); lesser grain borer, *Rhyzopertha dominica* (F.); rice weevil, *Sitophilus oryzae* (L.); and granary

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Table 1. Activity of CGA-28772 against development of lepidopteran and coleopteran insects exposed from egg stage in wheat.

Species	Average no. F_1 adult insects in untreated sample[a]	ED_{95} (ppm)[b]
1. Indianmeal moth	25	<0.1
2. Almond moth	58	~1
3. Angoumois grain moth	54	2.2 (1.3–4.9)
4. Sawtoothed grain beetle	76	2.7 (2.0–4.0)
5. Confused flour beetle	115	7.6 (6.4–9.3)
6. Lesser grain borer	120	22.4 (14.2–40.4)
7. Granary weevil	298	~20
8. Rice weevil	183	54.1 (42.3–71.0)

[a] Whole kernel wheat diet used for all species except Indianmeal moth for which ground wheat medium was used.
[b] 95% confidence limits given in parentheses.

weevil, *S. granarius* (L.). 'Lancato' wheat was used in all tests and tempered to a moisture of 12.5% as determined by a Motomco® moisture meter (Motomco, Inc., Clerk, NJ).

Twenty-five or fifty coleopteran adults or lepidopteran eggs were added to 100 g whole wheat or ground wheat moth medium, respectively (Kinsinger, 1975) that had been treated with 0.1–100 ppm of the test compound (McGregor and Kramer, 1976; Kramer and McGregor, 1979) by pipetting 5 ml acetone or methanol solution onto the diet and mixing thoroughly until the solvent evaporated. The treated diet was allowed to equilibrate for at least 24 h before testing.

All experiments were conducted at 27° ± 2°C and 60° ± 5% RH with four replications for each dose. Toxicity to the coleopterans was determined after 21 days of exposure; for lepidopterans, percentage mortality was calculated from the differences between the number of eggs added and the number of adults that emerged after 6 weeks. For coleopterans, the number of original parent insects were removed after three weeks and the total dead and live progeny determined after 9 weeks. When the progeny was reduced >20%, the samples were reexamined after 9 more weeks. Values were corrected for mortality in untreated samples and the corrected values were then used to estimate the ppm in the diet required to suppress 95% of the control population (Finney, 1952).

Results and Discussion

When applied to the diet and tested for insect growth regulating activity, the diphenoxybenzodioxole compound was not acutely toxic to six of the seven species of stored product insects examined. Only *O. surinamensis* suffered adult mortality (100%) at 10 ppm. However, the dioxole derivative

suppressed progeny from all species at 50 ppm levels or less (Table 1). Larval progeny were unable to pupate normally, an insecticidal action usually associated with insect growth regulators of the juvenile hormone type (Staal, 1975).

The most susceptible species were Lepidoptera: *P. interpunctella* ($ED_{95} < 0.1$ ppm), followed by *E. cautella* ($ED_{95} \sim 1$ ppm) and *S. cerealella* ($ED_{95} = 2$ ppm). The most affected coleopteran was *O. surinamensis* whose progeny were suppressed at 3 ppm. *T. confusum* was slightly less susceptible ($ED_{95} = 8$ ppm). Three beetle species, *R. dominica, S. oryzae* and *S. granarius,* exhibited ED_{95} values of 20 ppm or more. The most tolerant stored product insect was the rice weevil ($ED_{95} = 50$ ppm).

CGA-28772 showed significant insect growth regulating activity against the 8 stored product Lepidoptera and Coleoptera. This compound, therefore, has good potential for development as a commodity protectant. It possesses very low mammalian toxicity, thus making it relatively safe for application to stored food.

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