

SUMITOMO CHEMICAL

Sumilarv[®]

—Insect Growth Regulator—

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An Insect Growth Regulator against Cockroaches

Introduction

Cockroaches, like flies and mosquitoes, are important household insect pests, but unlike the latter two, cockroach nymphs and adults live in the same place. This means that it is possible to control the nymph and the adult simultaneously by appropriate use of an insecticide. However, they usually live in places that are not readily accessible to human beings, which makes it extremely difficult to control cockroaches with conventional insecticides.

In general, exogenous application of Insect Growth Regulator (IGR) inhibits the emergence of fly and mosquito adults. It has already been reported that pyriproxyfen (Sumilarv[®]) shows an outstandingly effective larvicidal property against these insects (see *SP World* No.8). In this issue we would like to report the results of research on the effects of pyriproxyfen against cockroaches, and to discuss the possibilities of using it for cockroach control.

Effect on each stage of cockroach development

1. Adult

It is known that the exogenous application of IGR to adult cockroaches inhibits normal growth of the ovary, which results in a decrease in fertility. When a virgin female adult German cockroach is treated with pyriproxyfen, sterility results: ovary growth deteriorates; eggs are laid

with the ootheca still immature; or even if the ootheca is normal, none of the eggs mature. If an untreated female adult is mated with a IGR-treated male, normal progeny are produced. It is summarized that pyriproxyfen exerts no direct effect on the physiology of the adult male, but on that of the adult female, either sterilizing her or affecting early embryogenic development directly, killing the eggs.

For example, Fig. 1 shows the percent of reduction of the number of progeny of the first oviposition in German cockroaches treated with pyriproxyfen. Pyriproxyfen at 2 μ g per insect resulted in 60% inhibition; 10 μ g per insect resulted in 100% inhibition. This activity was superior to that of hydroprene.

2. Nymph

1) Inhibition of metamorphosis

Cockroaches treated with IGR in the nymphal stage show abnormal metamorphosis. Likewise, pyriproxyfen produces these abnormal insects and allows them to exist in the same manner as normal insects, except that their ability to propagate is impaired. This impairment is not hereditary. In order to quantify the degree of abnormality of emerged insects, a normal adult was scored as "zero," melanic coloration or abnormal wings as "one," and a nymph with supernumerary molts (or adultoid) as "two" (Fig. 2). As the dosage of pyriproxyfen is increased, so does

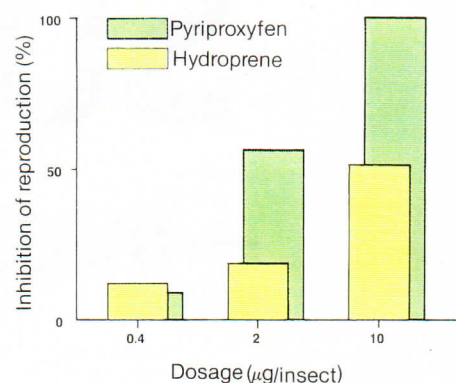


Fig. 1 Inhibition of reproduction by IGR for adult German cockroach*

*Emerged within a week before application

the score increase. It is apparent that a dose of not less than 0.1 μ g results in a mean score of "more than 1.0" (Fig. 3). The nymph becomes more susceptible as it grows older (Fig. 4). Therefore, it seems that this tendency in hemimetabolous insects is identical to that of holometabolous insects.

2) Inhibition of reproduction

Fig. 5 shows the relationship between the average score of abnormality in adult female German cockroaches (including adultoids) resulting from the above treatment, and the rate of inhibition of their reproduction. There is a high correlation between the two values; the greater the degree of abnormality, the stronger the inhibition of reproduction, resulting in a decrease in the number of progeny.

3) Death as adultoid

German cockroach nymphs, 3 weeks old, were reared in a 2-liter plastic container under unconfined contact with an overlaid plywood panel (15 × 15 cm) impregnated with pyriproxyfen. As shown in Fig. 6, the emergence of adults or adultoids was observed during the period of 40 to 70 days after treatment. The subsequent increase in cumulative mortality was apparent, and mortality increased with increased dosages of pyriproxyfen. The same phenomenon was observed in a similar test using the middle or last instar of the

nymph. These results indicate that the adultoids died during the course of further moulting.

Effects on cockroach population

To verify the above research findings, the following experiment was designed to study the extent to which pyriproxyfen as a IGR can affect the growth of a cockroach population. A population of German cockroaches composed of adults and various nymphal stages was reared in a 2.3ℓ container with a shelter impregnated

with pyriproxyfen. As shown in Fig. 7, the size of the population of the untreated control group increased about 20 times in four months. On the contrary, the group reared to the impregnated shelter at a dosage of 10 mg/m² (at 3.8 mg/m² when impregnated on the floor of the container) did not even double in size.

IGR as a cockroach control agent

The various effects that can be expected when IGR is used as a cockroach control agent are summa-

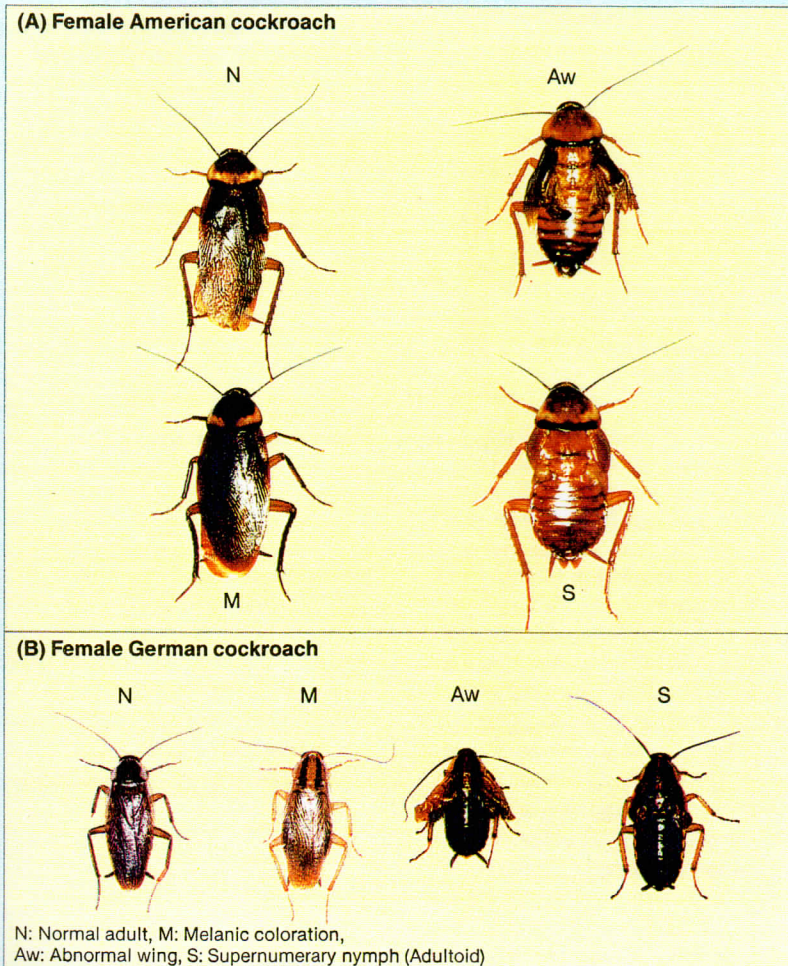


Fig. 2 Emergence inhibitions by pyriproxyfen against adult cockroaches

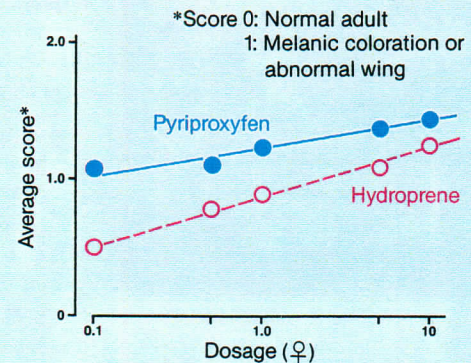


Fig. 3 Emergence inhibition activity against last instar female German cockroach nymphs by topical application method

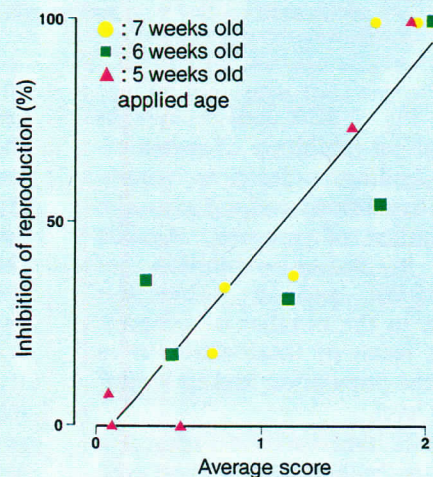


Fig. 5 Correlation between average score and rate of inhibition of reproduction

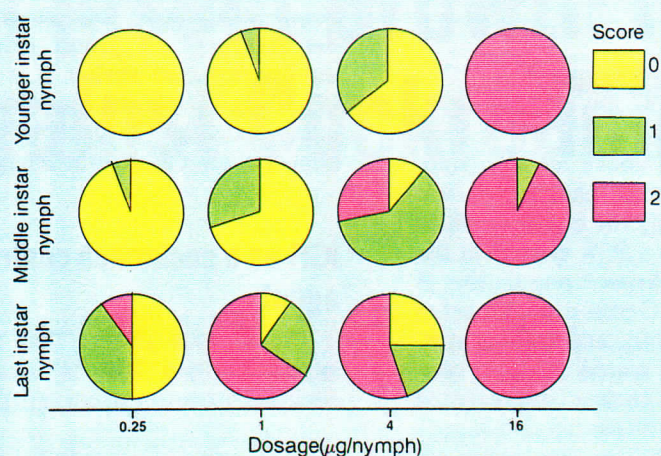


Fig. 4 Difference in susceptibility of German cockroach nymphs against pyriproxyfen

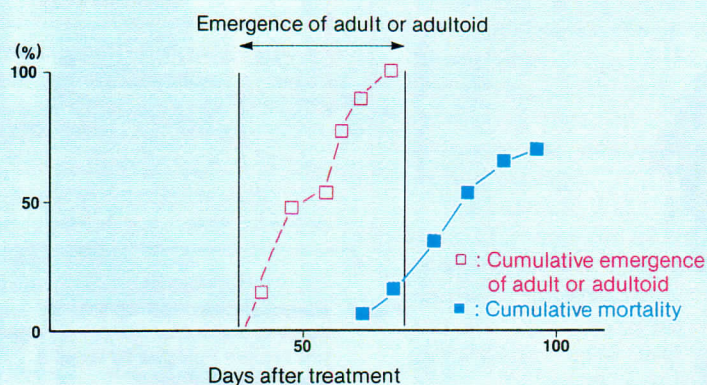


Fig. 6 Cumulative mortality of German cockroach by continuous contact with pyriproxyfen (40 mg/m²)

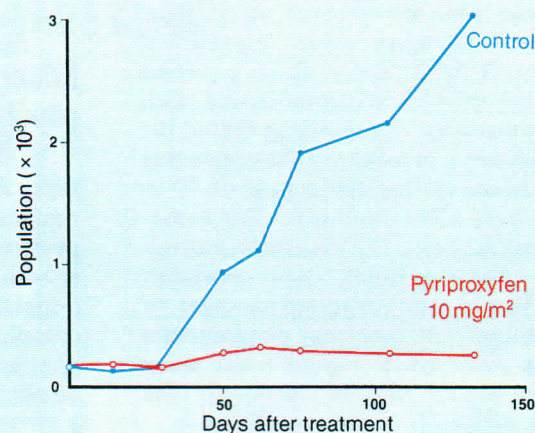


Fig. 7 Changes in size of population of German cockroaches reared in a container treated with pyriproxyfen

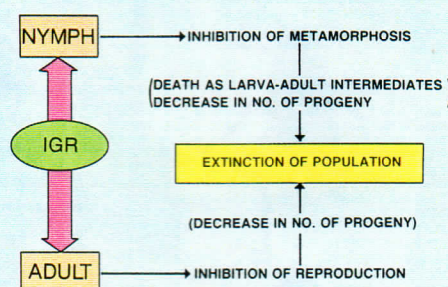


Fig. 8 Role of IGR in cockroach control

alized in Fig. 8. IGR used on nymphs brings about inhibition of metamorphosis, leading to death as nymph-adult intermediates and a decrease in the number of progeny. Against adults it causes inhibition of reproduction and a subsequent decrease in the number of progeny. The net result of these effects is to reduce the population and to hold it at a low level.

It would take time to suppress a population with IGR if it was used as the sole active ingredient. This "delayed effect" in cockroach control can be solved by the addition of a rapidly acting adulticide during the course of IGR treatment. As the effect is comparatively weak in youn-

ger instars, it is necessary to increase the formulation's effectiveness by keeping it active at least during the reproductive period of the target adult cockroach (1 to 2 months for the German cockroach), and selectivity in places where cockroaches swarm.

This will be the method of using IGR, which not only is effective in inhibiting reproduction over a long period of time, but also is effective over a comparatively wide area. Accordingly, more advanced product design, and the development of a product delivery system that can maintain exogenous IGR at a high level within the body, are required to demonstrate these effects to the

greatest extent possible. Further examination along the lines mentioned above is needed for methods of use, dosages, timing of application, etc. of pyriproxyfen under actual conditions. Pyriproxyfen holds out great expectations as a new type of cockroach control weapon. ♀

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