# THE EFFICACY OF STARYCIDE® (TRIFLUMURON) AGAINST THE GERMAN COCKROACH, *BLATTELLA GERMANICA* (L.)

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**Abstract**—Triflumuron is a substituted benzoylphenyl urea compound with a good chitin synthesis inhibition activity. Trial data is presented to demonstrate the efficacy of triflumuron applied as a 480 g/litre suspension concentrate, product name Starycide®, against the German cockroach.

Two experimental methods and their importance in elucidating the insect development inhibition of triflumuron are described. The first method is a choice test in which the cockroaches only come in contact with the product as they cross a treated barrier in search of food or water. The second involves forced exposure to treated surfaces.

In the choice tests the differing sensitivity of the various larval instars can be seen, the first and second stages being much more sensitive than the later instars. The influence of different surface types on the efficacy of the product is also examined, with the result that no significant differences could be found.

The forced contact tests have shown that frequent contacts with the treated surfaces are a deciding factor for the efficacy of triflumuron on the cockroach larvae. Frequent short exposures are more effective than single contacts, even if these last for some time, and the applied quantity of active ingredient plays a subordinate role.

## INTRODUCTION

Triflumuron is a substituted benzoylphenol urea compound with a good chitin synthesis inhibition activity. Such growth inhibitors are known to specifically attack insects during the development of their larval stages. The effect of Triflumuron against numerous crop and public health pests has been described (Hammann and Sirrenberg 1980; Zoebelein *et al.*, 1980; Knapp and Herald 1983; Darriet *et al.*, 1985). A larvicidal effect on cockroaches has also been reported. Ross and Brady (1983) examined the contact activity of triflumuron against German cockroaches and demonstrated that triflumuron was more effective against the 1st and 2nd larval instars than against older stadia. Smith (1989) and Cooper (1990) report similar results.

The following is a report on laboratory tests with triflumuron on various larval instars of the German cockroach. Two test methods are described, to show the effect on the cockroach larvae with respect to the frequency and duration of contact with triflumuron.

The first method is a choice test in which the cockroaches only come into contact with the product when they cross a treated barrier in search of food or water. The second involves forced exposure to treated surfaces.

## METHODS AND MATERIALS

### Choice contact test

Makrolon boxes as shown in fig. 1 were used for this test. The floor of the boxes was lined with filter paper attached at the edges . The walls, above a height of 5 cm, were coated with talc to prevent the insects escaping. An inverted cardboard carton, accessible to the cockroaches through a narrow slot in the floor, served as harbourage for the cockroaches. One hundred 1st, 2nd or 3rd–4th instar cockroaches were placed in each box. The insects were encouraged to accept the cardboard carton as a harbourage by adding a moist piece of cellulose for 24 hours. After this time the source of the moisture was removed and two test surfaces were placed in the corners of the box furthest from the harbourage. These surfaces were either glazed ceramic tiles or plywood boards, treated one day previously, with either 50 or 100 mg a.i./$m^2$ triflumuron 480 SC. The treatment were carried out using a glass nozzle and compressed air (0.1 bar) to apply 100 mls of aqueous spray solution/$m^2$. A water source was placed in the middle of one of the surfaces and ground dog biscuits (Vipromix) as a food source in the middle of the other. An assessment was carried out weekly on the basis of



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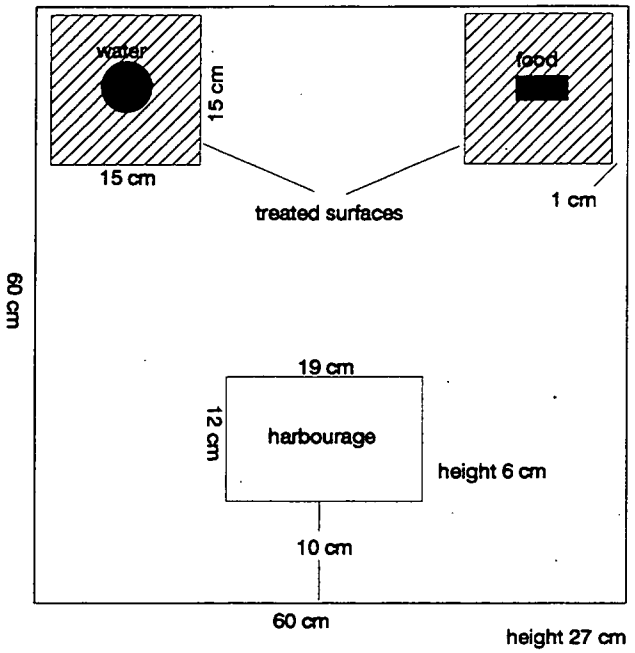


Fig. 1. Choice test with IGRs against cockroaches

percentage mortality until all cockroaches had died or the surviving insects had reached the adult stage. In the latter case ,the number of oothecae produced and the number of larvae hatching in the next generation were evaluated. The tests were conducted at a temperature of 25–26°C and at a relative humidity of 35–50%. The insects were maintained under neon lights with a 12-hour day/night rhythm.

Under these experimental conditions, the cockroaches only came into contact with the treated surfaces before, during and after the consumption of water or food, and were not forced to remain in permanent contact with the active ingredient. The treated area only represented about 10% of the surface area available to the cockroaches.

**Forced contact test**

Surfaces were treated as described in the choice contact test and the amounts applied were 25, 50 and 100 mg a.i./$m^2$. One day after the treatment, groups of five 2nd instar larvae were confined on the treated surfaces using a glass ring (dia. 9.5 cm, height 5.5 cm) coated with talc. Varying contact times were achieved by removing the cockroaches after certain periods. The exposure times tested were once per 24 hours, once per week for 24 hours (Friday), once per week for 5 minutes (Friday), twice 5 minutes per week (Thursday and Monday), three times 5 minutes per week and three times 1 minute per week (Fridays, Mondays and Wednesdays). After removal from the treated surfaces, the insects were maintained in transparent plastic beakers supplied with water (tablet tube 1.5 cm dia., 5.5 cm long), food ( plastic stopper filled with 425 mg ground dog biscuits) and a harbourage (7 cm dia. filter paper folded 3 times). The cockroaches were held at a temperature of 22–23°, a relative humidity of 55–65% and a 12 hour day/night rhythm under neon light and assessed for mortality at weekly intervals.

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## RESULTS

### Choice contact test

It was found that a dose of 50 mg triflumuron a.i./m² applied on plywood affected each larval instar differently (Fig. 2). The best activity was achieved against the L1 larvae, of which only two larvae (1 male and 1 female) managed to complete development to the adult stage within 16 weeks. These together produced two oothecae from which 53 nymphs hatched. In the case of the L2 instar 3 male and 5 females developed to the adult stage and produced nine oothecae from which 188 nymphs hatched. Against the L3-4 instars, 18 males and 16 females developed to the adult stage and produced 26 oothecae from which 854 nymphs hatched. In all these cases triflumuron did not reduce the hatching rate.

When the application rate was raised to 100 mg triflumuron a.i./m² (Fig. 3), the efficacy was improved but still varied distinctly with the stage of development of the larvae. With this dose there was a 100% elimination of the L1 instars within six weeks. Against the L2 instars, 2 males and 1 female completed development to the adult stage and although they produced three oothecae, no larvae hatched from them. Against the L3-4 instars, 7 males and 12 females completed development to the adult stage, and produced 25 oothecae from which 713 larvae hatched.

In order to test the effect of triflumuron on other surfaces, we also tested the dose of 50 mg a.i./m² (Fig. 4) on glazed tiles. The results show that triflumuron exhibits the same efficacy profile on this surface. The younger L1 and L2 larval instars were controlled better than the older L3-4 instars. When the dose was increased to 100 mg a.i./m² (Fig. 5), the effect against the individual larval instars was similar but somewhat faster.

### Forced contact test

As Fig. 6 shows, cockroaches in the 2nd larval stage were exposed for certain times and at different frequencies on non-porous glazed tiles, which had been treated with 25, 50 and 100 mg a.i./m².

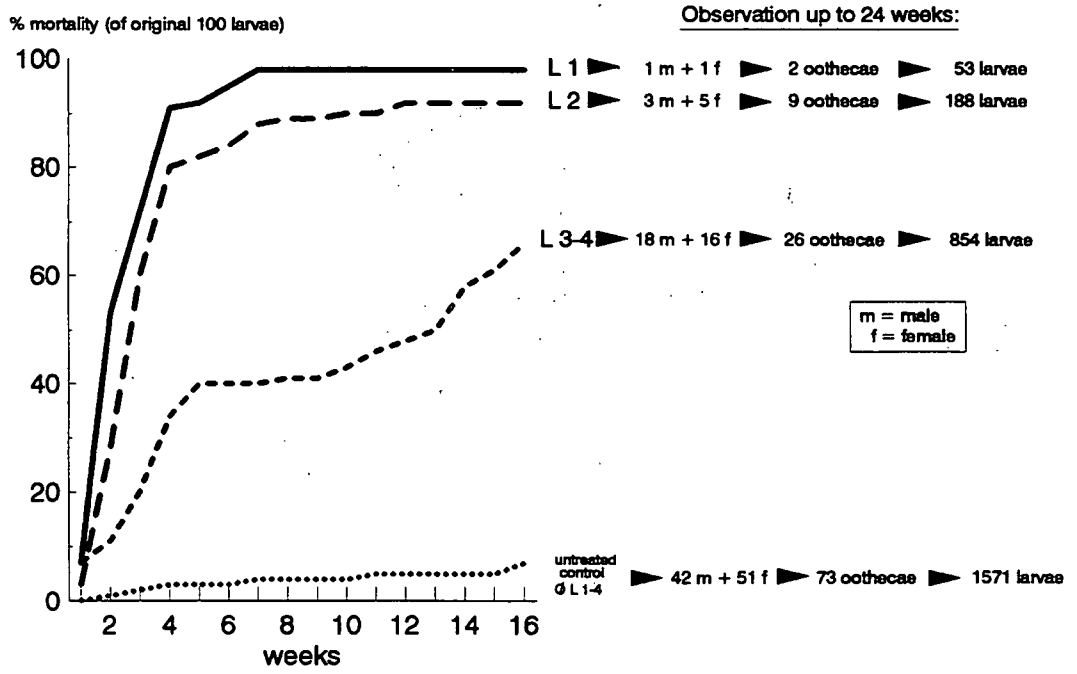


Fig. 2. Efficacy of triflumuron (50 mg a.i./m²) on plywood against 1st, 2nd and 3rd–4th instars of *Blattella germanica*.

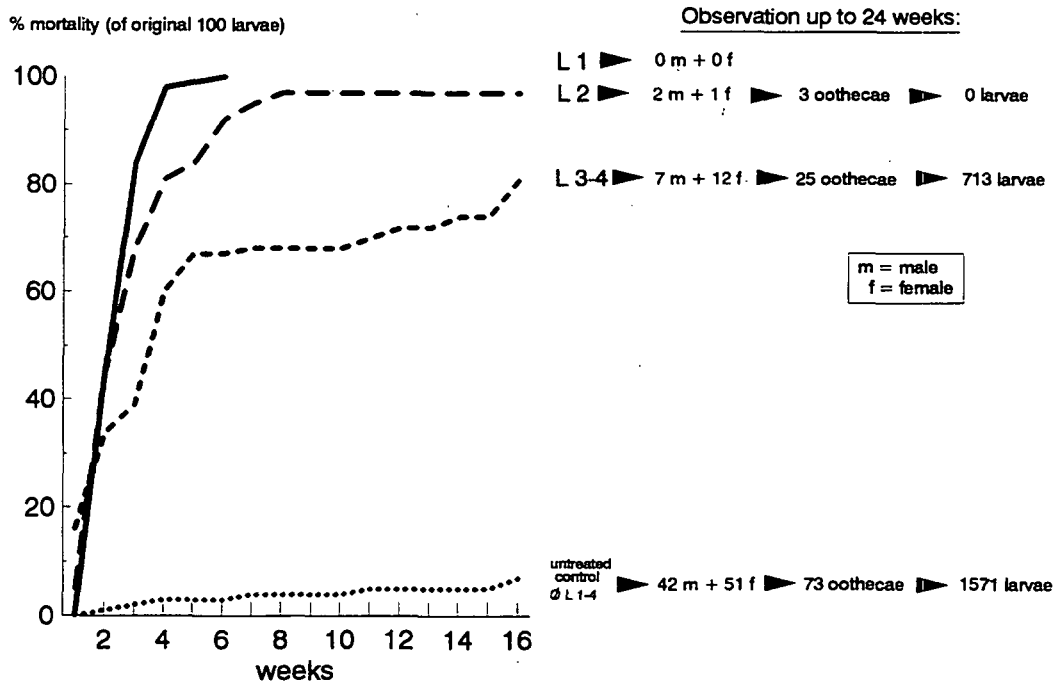


Fig. 3. Efficacy of triflumuron (100 mg a.i./m$^2$) on plywood against 1st, 2nd and 3rd–4th larval instars of *Blattella germanica*.

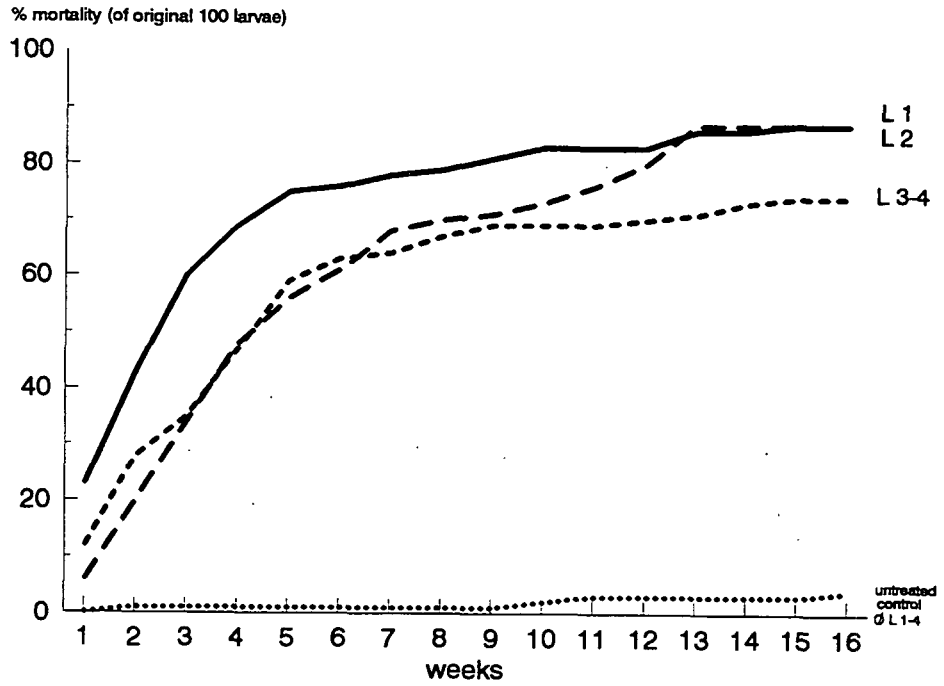


Fig. 4. Efficacy of triflumuron (50 mg a.i./m$^2$) on plywood against 1st, 2nd and 3rd–4th larval instars of *Blattella germanica*.

The results show that following a single contact of 24 hours, only 20 % of the larvae were killed within 9 weeks. In addition there was only a slight difference between a weekly exposure for 24 hours per week and a weekly exposure of only 5 minutes. Application rates of 25 and 50 mg a.i./m$^2$

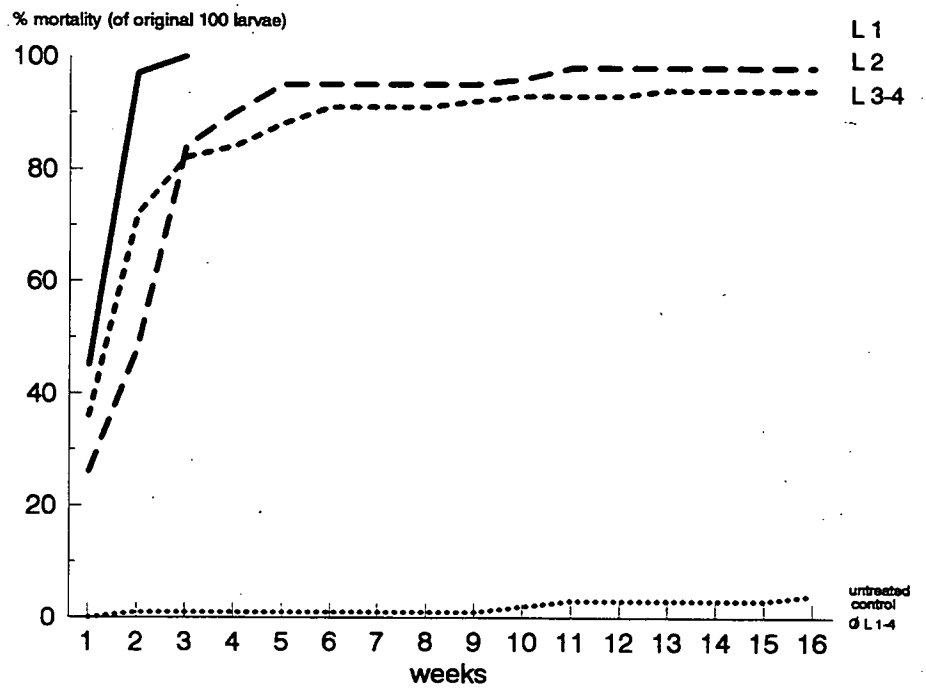


Fig. 5. Efficacy of triflumuron (100 mg a.i./m$^2$) on plywood against 1st, 2nd and 3rd–4th larval instars of *Blattella germanica*.

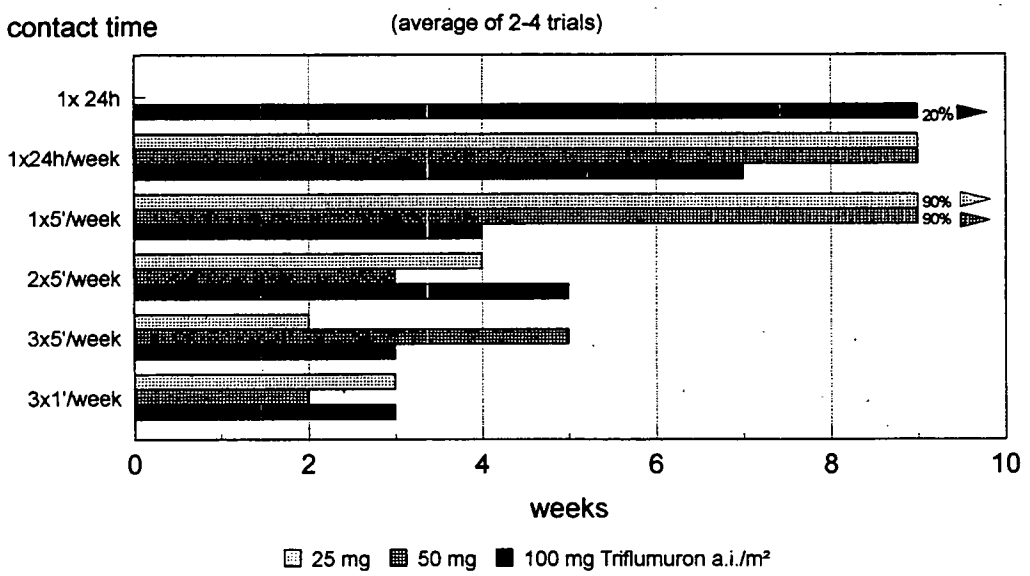


Fig. 6. Different contact times. Weeks required for 100% mortality of 2nd larval instar *Blattella germanica* on glazed tiles.

resulted in 90–100% mortality within nine weeks. With a dose of 100 mg a.i./m$^2$, 100% mortality was obtained within 4-7 weeks.

If however the contact frequency was increased to 2 × 5 minutes or 3 × 5 minutes/week, the effect was dramatically increased. In these cases all the larvae, at all doses tested were killed within 2–5 weeks. Even if the contact time was reduced to 3 × 1 minute/week, a 100%mortality was achieved

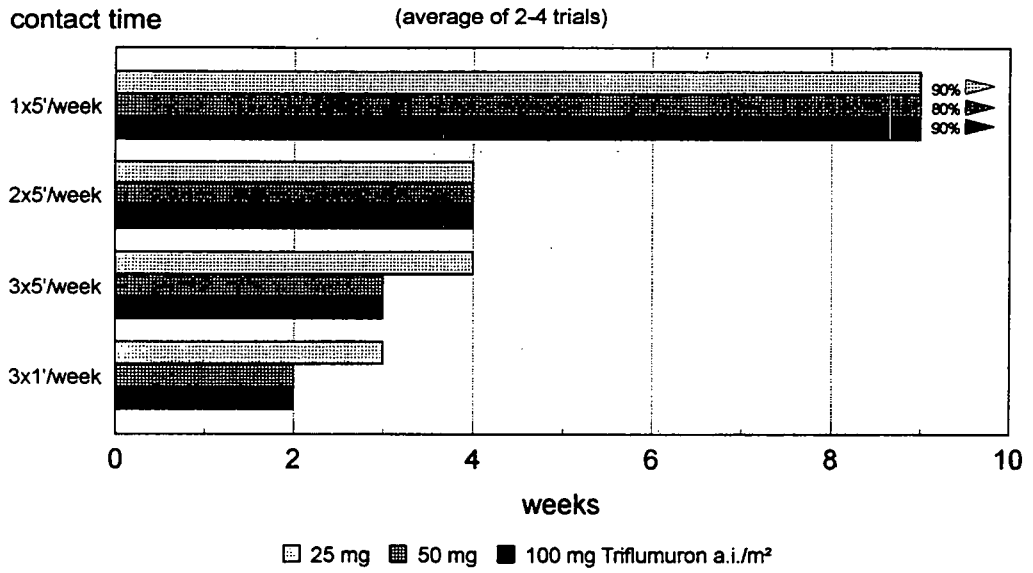


Fig. 7. Different contact times. Weeks required for 100% mortality of 2nd larval instar *Blattella germanica* on unglazed tiles

within 2–3 weeks. The test shows that frequent contacts even for only brief periods, produces a good effect, regardless of the dose within the range of 25 to 100 mg a.i./m$^2$.

To confirm these results, tests were also carried out with the 2nd larval stage on the more critical surface of absorbent unglazed tiles (Fig. 7). In this case only the contact times of 1 ×, 2 × and 3 × 5 minutes, as well as 3 × 1 minute/week were tested. Here too it was apparent that a single exposure per week resulted in only an 80% to 90% mortality within 9 weeks. Two or three exposures per week greatly increased the efficacy so that 100% mortality was achieved within 3–4 weeks. It was also apparent that a 3 × one-minute contact per week was sufficient to control all the larvae within 2–3 weeks.

## DISCUSSION

These tests have confirmed that triflumuron is more effective against the younger larval stages of the cockroach species *Blattella germanica* than against the older stages. No effect on the hatching rate of the oothecae was observed, even though these oothecae were produced by cockroaches exposed to triflumuron at intervals throughout their development.

The results indicate that the frequency of contact with the active ingredient is the deciding factor for the efficacy of triflumuron against the cockroach larvae. Shorter but frequently repeated exposures are more efficacious than a single exposure even when the single exposure is longer. The applied dose is less significant than the frequency of exposure. The material of which the surfaces were made had virtually no effect on the efficacy of triflumuron.

The results indicate that the active ingredient concentration in the larvae reaches a level, after just a short period. This effect cannot be increased by longer contact and higher doses. Only more frequent, brief contacts during development led to an increase in efficacy.

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