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Science for Environment Policy

Evaluating the sublethal effects of insecticides for effective integrated pest management

Parasitoid wasps (*Trichogramma pretiosum*) are increasingly being used as a biological control agent in agriculture. Since insecticides are often applied to the same crops, it is necessary to assess the effects of different insecticides on this insect. However, the majority of studies have focused on evaluating the lethal, but not sublethal, effects of insecticides. A new study has evaluated the sublethal effects on *T. pretiosum* of nine insecticides commonly used in soybean production in Brazil. Overall, just three of the nine insecticides tested did not appear to have any harmful sublethal effects on T. pretiosum. This study highlights the importance of considering sublethal, as well as lethal, effects when assessing insecticide selectivity.

Indiscriminate use of pesticides can produce unwanted effects on agro-ecosystems that are harmful for environmental and human health (e.g. selection of resistant insects, pest resurgence, environmental contamination). In light of this, the use of natural pest control mechanisms that reduce or minimise risks to human health and the environment is encouraged. One widely used biological control agent is *T. pretiosum*, a wasp that parasitises the eggs of lepidopteran (the second largest order of insects, including butterflies and moths) pests. This prevents them from reaching the larval phase, which is when they cause the greatest damage to crops.

Since *T. pretiosum* is likely to come into contact with insecticides, it is advisable to assess the effects of different insecticides on this insect, as this may impact the efficacy of this agent. While prior research on pesticide selectivity to *T. pretiosum* exists, the majority of studies have focused on lethal effects (e.g. acute toxicity). As a result, sublethal effects (e.g. physiological and behavioural changes that reduce or negate the agent's effectiveness as a biological control agent, such as changes to its development, sex ratio, fecundity, longevity, mobility, feeding, prey-search capacity, mating, etc.) have not yet been comprehensively accounted for.

A team of researchers set out to evaluate the sublethal effects of nine insecticides on *T. pretiosum*. They looked at nine insecticides belonging to different chemical groups, all of which are widely used to control the cotton bollworm moth (*Helicoverpa armigera)* on soybean crops in northeastern and midwestern Brazil. These insecticides included acephate, chlorantraniliprole, chlorfenapyr, chlorpyriphos, flubendiamide, indoxacarb, lambda-cyhalothrin + thiamethoxam, and methoxyfenozide teflubenzuron. In a series of laboratory experiments, the scientists investigated the effects of the insecticides on *T. pretiosum* adults and pupae. All insecticides were tested at the highest concentration recommended by the manufacturer.

A number of these insecticides were found to have harmful sublethal effects on *T. pretiosum*, including on parasitism capacity (i.e. insects' ability to effectively parasitise) and emergence rates (i.e. rate at which insects emerge from eggs). Using International Organisation for biological and integrated control (IOBC/WPRS) criteria[1], three of the tested insecticides were found to have harmful sublethal effects on the parasitism capacity of *T. pretiosum* adult females: chlorfenapyr reduced parasitism by 77.4%; while chlorpyriphos and lambda-cyhalothrin + thiamethoxam reduced parasitism by 98.5% and 96.1% respectively. Using the same criteria, two insecticides were found to have harmful sublethal effects on *T. pretiosum* emergence rates: lambda-cyhalothrin + thiamethoxam reduced pupal emergence rates by 48.9% (class 2) and chlorpyriphos reduced emergence rates by 80.1% (class 3). In addition, several of the tested insecticides were found to have harmful effects on subsequent generations of *T. pretiosum*, including on emergence rates, longevity and parasitism capacity.

Continued on next page.

1. Hassan, S. A. (1997). Métodos padronizados para testes de seletividade com ênfase em Trichogramma. In *Trichogramma e o controle biológico aplicado*, ed. by Parra, J. R. P. & Zucchi, R. A.: 207–233. Piracicaba: FEALQ.

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Evaluating the sublethal effects of insecticides for effective integrated pest management *(continued)*

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In total, sublethal effects were detected in six of the nine insecticides. Just three — teflubenzuron, indoxacarb and methoxyfenozide — appeared to have no harmful effects on *T. pretiosum* parasitism capacity and pupae. According to the researchers, these three insecticides can therefore be considered selective for this parasitoid. However, it is worth noting that further research in semi-field and field conditions is required to confirm these findings, as it is likely that the parasitoid would be subjected to lower levels of insecticide in real-world conditions.

More broadly, this research highlights the importance of considering sublethal, as well as lethal, effects when evaluating a chemical for selectivity. Many of the insecticides tested in this study are classified as toxicologically innocuous according to IOBC/WPRS criteria, but nonetheless were found to significantly impair parasitoid development and subsequent efficiency as a biological control agent. This has important implications for the development of effective pest management programmes, in which chemical control agents, if required, should be as selective as possible in order to reduce potential negative impacts on the agro-ecosystem.