Tebufenozide

There are several pesticidal formulations that contain the active ingredient **tebufenozide.** This chemical mimics a hormone that promotes molting in winged insects belonging to the *Lepidoptera* family. Tebufenozide has insecticidal properties, as it can accelerate molting prematurely in the larvae stage of moths and butterflies, resulting in mortality.

Tebufenozide has been well studied over the past thirty years, and does not adversely affect plants, birds, fish, and invertebrates at expected environmental concentrations (EEC) when used according to the label. In 1998, the pesticide received EPA's Green Chemistry award due to its (*i*) very low toxicity to animals, (*ii*) low ability to persist in soils and bioaccumulate in organisms, and (*iii*) specificity to *Lepidoptera*, *i.e.* non-target insects such as bees, beetles, *etc*. are not adversely affected at low concentrations. Therefore, tebufenozide is an option for controlling moths- including spruce budworm- and its efficacy in boreal forests is well documented.

The EPA classifies the ingestion and inhalation of tebufenozide as "practically nontoxic" to mammals and birds, and well below a level of concern when the pesticide is applied as directed. This assessment is in general agreement with similar regulating agencies in Canada and the EU; this finding is based on evidence that the pesticide is not a carcinogen, mutagen, neurotoxin, or an endocrine disruptor. This assessment also applies to the byproducts stemming from the metabolism of tebufenozide.

However, the use of any pesticide including tebufenozide comes with risk. Toxicological testing reveals potential threats to the health of some organisms and the environment at very high concentrations, *i.e.* in the event of an accidental spill or the direct spraying of an individual. Tebufenozide is a moderate eye and skin irritant and likely poses the greatest risk to applicators. At extremely high doses, ingestion and inhalation of tebufenozide damages the hemoglobin in red blood cells. Therefore, direct exposure of tebufenozide poses elevated risk to infants and individuals who have genetically inherited hemoglobin disorders (*e.g.* sickle-cell anemia, thalassemia, *etc*). However, harmful exposure *via* contaminated crops is not anticipated in the event of accidental drift. For example, two months after apple trees were directly sprayed with a second application of tebufenozide, only 0.1% of the pesticide was found on the fruit; consumption of apples at this EEC would not cause adverse health effects in humans or wildlife.

Aquatic organisms most sensitive to tebufenozide are midges and water fleas. Notably, toxicology testing reveals that lobster and most other marine invertebrates are not sensitive species. Given that tebufenozide dissolves poorly in water, it has a very low chance of leaching from the soil and contaminating subsurface groundwater and aquifers. Despite tebufenozide's low toxicity to fish and other aquatic invertebrates, it can persist in aquatic

sediments and bioaccumulate to low levels in fish. In bluegill sunfish, more than 90% of the pesticide is excreted after 15 days; less than 5% of the remaining pesticide resides in edible tissue. At this low concentration, consumption of trout in the fall is not anticipated to be a health concern for anglers venturing into the North Maine Woods.

Although tebufenozide is practically non-toxic to birds, it is feasible that they will be indirectly affected if their diet primarily depends upon moths and butterflies. Increased foraging was observed in warblers inhabiting a forest sprayed with tebufenozide, but this did not affect survival or clutch size compared to an unsprayed forest.

Tebufenozide does not volatize and enter the atmosphere from water surfaces or the soil. Its poor solubility in water comes with the tradeoff that it will bind to organic matter that typically resides in the top 5 inches of the soil. In one field study containing sandy loam (a soil texture common in Maine's northern townships), 90% of tebufenozide is broken down within 100 days. The aerial application of tebufenozide is not predicted to be a threat to soil fertility or soil invertebrates. For example, earthworms were not adversely affected when soil was spiked with tebufenozide at a concentration 100-fold greater than EEC.

In summary, tebufenozide specifically targets moths and butterflies, and is not expected to be lethal to most non-target organisms at EEC. Environmental risks include transient accumulation in soils, reduced fitness in microscopic aquatic invertebrates, low biomagnification in fish, and altered feeding behaviors in birds that prey upon moths and butterflies.

References

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