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BOARD OF
PESTICIDES CONTROL

DEPARTMENT OF AGRICULTURE,
CONSERVATION & FORESTRY

Tebufenozide and BT_K: Toxicity and Risk Assessment

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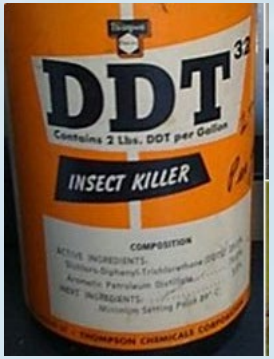
Risk considers both:

1) the hazard



2) and the likelihood of exposure to the hazard.

For pesticides, exposure includes drinking water, diet, dermal, and inhalation routes.

What makes an effective pesticide?

- **Capable of solving the problem, *e.g.* spruce budworm outbreak.**
  - **Insect potency at low concentrations**
  - **Minimal applications**

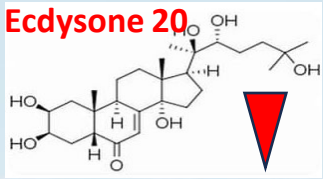
- **Does not create other problems (*i.e.* adverse events).**
  - **Low toxicity to off-target organisms including humans, wildlife, aquatic organisms, insects, *etc*.**
  - **Low environmental impact. Does the pesticide volatilize, leach into groundwater, bioaccumulate, or persist in the soil?**

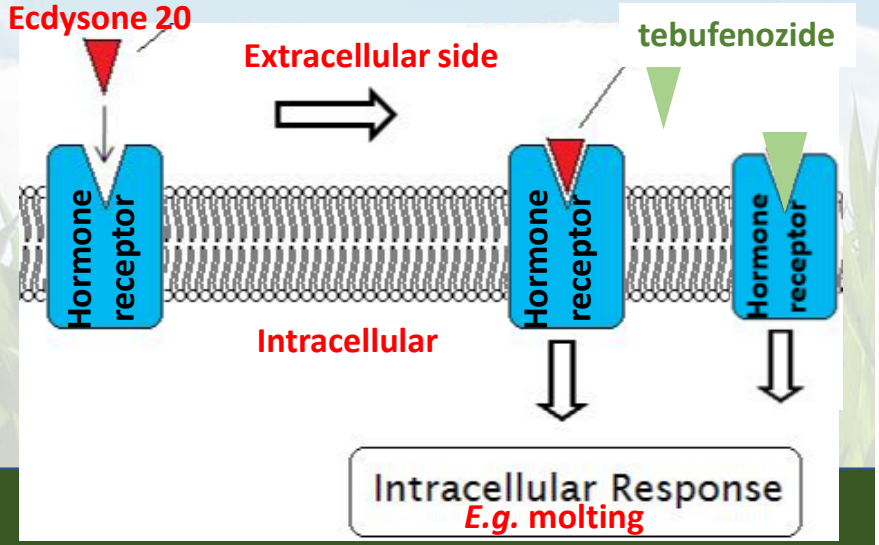
TEBUFENOZIDE

Understanding the biology of spruce budworm guides the effective design of insecticides.

- **Molting is an essential developmental process in spruce budworm**
  - **This process is regulated by the molting hormone, ecdysone 20.**
  - **This hormone is highly specific to the SBW's hormone receptor.**

Ecdysone 20





Tebufenozide has greater affinity to the hormone receptor compared to Ecdysone 20. This initiates premature molting. The disruption of the physiological and developmental process in SBW causes lethality.

TEBUFENOZIDE

I. Risk Assessment for humans and mammals

Toxicity is determined by LD_{50} assays in laboratories

- **Lethal dose for 50% of the individuals**
- **these data inform thresholds for human toxicity**

Examples of LD_{50} data in rats

	rat (mg/kg)
cyanide	3.6
DDT	87
aspirin	250
table salt	3000
Tebufenozide	>5000

EPA Categories

Table 2. Categories of Toxicity for Terrestrial Organisms

Oral dose LD_{50} (mg/kg-bw)	Toxicity Category
< 10	Very highly toxic
10 - 50	Highly toxic
51 - 500	Moderately toxic
501 - 2000	Slightly toxic
> 2000	Practically nontoxic

Conclusion: practically non-toxic to mammals, including humans.
It is also practically non-toxic to birds, earthworms, and reptiles.

TEBUFENOZIDE

II. Risk Assessment for other organisms

LD_{50} for honey bees is 234 ug/bee

Table 3. Categories of Toxicity for Bee (EPA)

Bee Acute Contact LD_{50} (µg/bee)	Toxicity Category
<2	Highly toxic
2 – 10.99	Moderately toxic
≥ 11	Practically nontoxic

- In contrast, LD_{50} assays indicate that tebufenozide is slightly to moderately toxic to aquatic life (*e.g.* trout, water fleas, lobster, *etc*).

  - However, the risk to aquatic organisms is minimal because:
    1. the applied concentration is lower than the LD_{50} conc. (↓toxicity)
    2. risk of exposure is low (risk for lobsters < trout < water fleas)
       - 100 foot setback from streams and water surfaces.

- Consumption of tebufenozide will be lethal to non-target caterpillars.

III. Environmental Risk Assessment

The chemical properties of tebufenozide prevents:

- Volatilization- movement into the atmosphere
- Leaching- movement into the groundwater
- Persistence in the soil- 90% is broken down in 100 days
- Bioaccumulation in the food chain
  - 90% is excreted in fish after 15 days.
  - In trout, less than 0.5% of ingested tebufenozide would remain in edible tissue after 15 days.
    - Extremely low risk to anglers.

Additional information about Tebufenozide

- No evidence that it is carcinogenic, neurotoxic, or an endocrine disruptor in humans.

- Recipient of EPA's first Green Chemistry Award in 1998.

BTk

- Bt_k contains spores of the naturally occurring bacterium *Bacillus thuringiensis*, subspecies *kurstaki* (Btk).

- Spores contain a dormant endotoxin that is only activated in caterpillars upon consumption.

- Used to control insects for > 50 years.

- Used on organic crops in Maine.

I. Organismal Risk Assessment for BT_k

- Even less toxic than tebufenozide.

  - EPA has waived the maximum residue limit on crops and food.
  - LD50 in rats is >5000 mg/kg. It is practically nontoxic to mammals, birds, aquatic organisms, and most insects.
  - However, it will be toxic to nontarget caterpillars upon consumption.

BTk

II. Environmental Risk Assessment

- Half-life on leaves is 2-4 days.
- Low-persistence in soil (10-fold decrease after 2 weeks).
- Low risk of leaching (trapped in the top 3 inches of soil and quickly degrades).
- No risk of bioaccumulation in the food chain.

Conclusions

- Environmental risks associated with tebufenozide and BTk are anticipated to be minimal.
- Risk of tebufenozide and BTk to most organisms is low at the expected environmental concentrations.
- Anticipated low risk to birds that prey upon caterpillars; foraging habits might be altered.
- Consumption of both insecticides will be lethal to nontarget caterpillars.

Questions?

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