BACILLUS THURINGIENSIS: A SELECTIVE LARVICIDE

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Bacillus thuringiensis, or "Bt", is a bacterium which has been commercialised as "Dipel" or "Thuricide HP". It selectively destroys insects, specifically caterpillars. The bacterium is produced in liquid media in large tanks similar to those used to produce antibiotics and its world-wide production annually is a $40 million industry. Bt formulations are imported from the United States but local production is planned. In Australia, its greatest market is in cotton, but overseas it is also extensively used in forestry and on horticultural crops. One of its advantages is non-disruption of existing natural control on the crop. Another is the absence of a withholding period, which means that it can be used on food crops right up to harvest.

Its use as an insecticide for 25 years despite formidable competition from conventional insecticides is largely due to its safety and compatibility, mainly with natural control but also with chemical insecticides. For example, a chemical ovicide is frequently used in conjunction with Bt for early-season Heliothis control. This combination is particularly useful in districts where a mite problem could be induced by the use of a broad spectrum insecticide which would destroy the natural mite predators. In Thailand, its use against cabbage moth larvae is essential because of resistance to all alternative insecticides.

Mode of action. The toxicity of Bt is due to a diamond-shaped protein crystal produced within the bacterial cell. If they are eaten, the crystals are broken down to toxic fragments in the insect's gut. These toxic fragments work within minutes, damaging the gut lining and preventing further feeding. Death of the insect may not occur for a couple of days, even though feeding has ceased and this can be disconcerting to growers. For this reason, mortality assessments should not be done less than three days after application.

Bt acts as specific, biological toxin. The life of the toxin on the crop is short, and the bacterium does not spread from one insect to the next, as can the Heliothis virus in "Elcar". Timing should be directed against newly-hatched caterpillars, but its rapidity of action means that timing is not as critical as with the virus, which may take 4 to 7 days to take effect. Resistance to the Bt toxin has not been observed in field populations, although the capacity for it to develop does exist.

Strain selection. Bt exists as a number of strains having differing toxicities. For example, 10 non-commercial strains we tested in the laboratory differed 400-fold in their potency for Heliothis armigera and H. punctigera. However their rankings for the two species were similar, suggesting that further strains need be screened only against one or other species. None of these strains was appreciably more potent than the current commercial strain. By contrast,

experimental strains from the United States were up to 10 times as potent for H. armigera as the commercial strain. Some of the experimental strains have been genetically manipulated, and this methodology offers promise for the production of other superior strains. However, their superiority under field conditions in Australia must first be demonstrated.

Problem. A factor which mitigates against the wider adoption of Bt on cotton is the lack of an equivalent replacement ovicide for chlordimeform. Chlordimeform, which is "soft" on predators, was the ovicide most commonly used with Bt, but was withdrawn from the market for safety reasons.

Mixtures. Because it kills only caterpillars, Bt may be disadvantaged in combatting a pest complex which may be damaging a crop. However, using it with reduced rates of chemical insecticides at may be feasible. This could be less disruptive to the natural control within the crop and may help retard the development of insecticide resistance.

Bt-insecticide combinations are currently being laboratory-tested, and promising mixtures will be tested in the crop situation by D.P.I.. The ability to conserve natural control and extend the life of presently effective insecticides is of vital long-term importance to the cotton industry.