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AMITRAZ : A NEW HORTICULTURAL MITICIDE

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Summary

Amitraz, formerly coded BTS 27 419, is a novel compound that is primarily an acaricide but possesses strong insecticidal properties. An introduction to the chemical is given, including chemical and physical properties, toxicology, spectrum of activity, compatibility with other pesticides, and crop safety. Reference to trial work in New Zealand assessing efficacy against European red mite (*Panonychus ulmi*) is made.

INTRODUCTION

The continuing search for acaricides with a novel mode of action is necessitated by the ability of phytophagous mites of economic importance to develop tolerance to chemicals to which they are exposed. Such mites include European red mite (ERM) and two-spotted mite (*Tetranychus urticae*) which are important pests of horticultural crops in many countries, including New Zealand.

The use of amitraz as a miticide for crop use was first described by Weighton *et al* (1972). The chemical was introduced the following year by The Boots Company Ltd, under the code number BTS 27 419.

Structural formula of amitraz

Empirical formula $\text{C}_{19}\text{H}_{23}\text{N}_3$ (293.4)

CHEMICAL AND PHYSICAL PROPERTIES

The pure compound is an off-white, crystalline, odourless solid, with a melting point of 87-88°C. It is not hygroscopic. It is readily soluble in most organic solvents, but very sparingly soluble in water (less than 1 ppm at room temperature). It is unstable at low pH and a slow deterioration of the moist compound occurs on prolonged standing.

FORMULATIONS FOR CROP USE

- (i) An emulsifiable concentrate containing 200 g amitraz per litre (20%).
 - (ii) A wettable powder containing 500 g amitraz per kg (50%).
- Each of these formulations contain chemical stabilizers to protect the amitraz from hydrolysis. Although the liquid is considered to be more active than the powder, both formulations are under evaluation in this

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country, where fruit-finish (use on apples) considerations are as important as efficacy in the selection of a miticide.

TOXICOLOGY AND METABOLISM IN ANIMALS

The acute oral LD50 for rats is 800 mg/kg, for mice about 1600 mg/kg; the acute dermal LD50 for rats is greater than 1600 mg/kg. No pathological effects were observed in rats fed 200 ppm in the diet, or in dogs dosed at 1 mg/kg/day for two years. Animal studies have shown that amitraz does not persist *in vivo*, but is rapidly degraded, eventually yielding conjugated 4-amino-3-methyl-benzoic acid which is excreted in the urine.

RESIDUE STUDIES IN PLANTS

Amitraz itself does not persist long on or in fruit. Very little if any, penetrates into the pulp, and surface residue decays rapidly and is usually not detectable after 14-21 days. Residue studies of amitraz and its primary metabolite have been made on fruit in many countries. Recent New Zealand studies on the combined residues in apples and peaches after spraying with a relatively strong (0.06%) solution show residue disappearance rate to be very similar to overseas results.

SPECTRUM OF ACTIVITY

Amitraz is primarily an acaricide, but it does possess potent insecticidal properties. It has been registered for use in many countries, mainly for the control of European red mite and two-spotted mite. Insecticidal activity is limited to scale insects, caterpillars, aphids and some leaf hoppers. No evaluation of amitraz as an insecticide has been made in this country. The activity of greatest interest is the ability of amitraz to control red spider mites resistant to organophosphorus and bridged diphenyl compounds (Harrison *et al* 1972).

An evaluation of the toxicity of amitraz to honey bees when applied to apple trees in flower has been reported by Palmer-Jones and Clinch (1973). Their finding was no bee mortality, with no evidence of repellancy to bees when amitraz was applied at 0.04% (high volume spray). Recent studies suggest that predatory mites such as *Typhlodromus pyri* and *Amblyseius fallacis* do not escape the miticidal activity of amitraz. One trial completed by the authors and co-operators in a Nelson orchard (1977/78) indicated that 7 days after treatment, amitraz at 0.03% had reduced *T. pyri* numbers while numbers in untreated trees increased.

MODE OF ACTION

Amitraz is active on all stages of red spider mites, with greater potency on eggs and larvae. Biochemical studies indicate that it is only a weak cholinesterase inhibitor, and therefore, the compound appears to possess a novel mode of action. The exact nature of this action has not been elucidated. Clinically, the compound produces slow death, often 72 hours before ultimate effect is seen. Gemrich *et al* (1976) commented on compounds which exhibited a repellancy for mites and insects, evidenced by mite "walkoff" or "spindown". This activity can be caused by sub-lethal doses of amitraz, and has been observed with other compounds of somewhat similar structure.

Translocation within the plant has been indicated with soil-applied amitraz. On French beans (*Phaseolus vulgaris*) 100% mortality of two-spotted mite eggs and larvae was obtained with a soil drench of 250 ppm amitraz. Movement of leaf applied material does not appear to take place to any significant extent. Translaminar movement of amitraz through the leaves has been reported for several crop species. However, in

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a single trial in New Zealand using apple leaves, such movement was not confirmed (MacKenzie unpublished).

PERSISTENCE

Under constant laboratory conditions, amitraz maintains full activity for 24 days using two-spotted mite eggs and larvae as the indicator. Under field conditions, the persistence of amitraz plays a part in the miticidal effect of any one treatment, with breakdown of the chemical generally resulting in near zero levels of the compound after 14-21 days.

FIELD TRIAL DATA

During the past 7 years, amitraz has been evaluated for the control of red spider mites and related species in over thirty countries, in trials covering a wide range of acaricidal resistance, crops and climatic conditions. The general finding has been that *Panonychus* spp. are controlled by 0.03% - 0.04% amitraz, with *Tetranychus* spp. requiring the higher range of 0.04% - 0.05% amitraz. In New Zealand, the authors have evaluated efficacy against European red mite on apples and on stone fruit in trials commencing in 1976. A brief summary of two such trials, with their results, follow.

STONE FRUIT

Alexandra, Central Otago. Replication: 1 tree x 4
Crop: nectarine, var. 'Deltur'. Treatment dates: 3.11.76 and 25.11.76.
Target spp: European red mite. Volume of application: 1800 litres/ha.

Treatment	Rate g/100 litres	% control on 3 dates		
		5.11.76	24.11.76	17.3.78 (harvest)
amitraz WP	30	82.5	44.2	63.3
amitraz EC	40	96.1	97.9	98.7
amitraz WP	50	90.4	99.3	99.2
amitraz WP	60	95.0	97.6	99.7
cyhexatin WP	20	79.0	99.2	99.2
untreated		0	0	0
(No. mites/leaf)		(16)	(11)	(5)

An early season two spray programme has given season-long protection against European red mite, with amitraz in an EC formulation (0.04%) and in a WP formulation (0.05%) performing as well as cyhexatin 0.02%.

POME FRUIT

Kumeu, Auckland district. Replication: 1 tree x 6
Crop: apple, var. 'Gravenstein'. Treatment date: 14.3.78 (post harvest)
Target spp: European red mite. Volume of application: 3600 litres/ha.

Treatment	Rate g/100 litres	% control	
		17.3.78	20.3.78
amitraz EC	30	77.9	85.2
amitraz EC	60	94.4	97.4
untreated		0	0
(No. mites/leaf)		(5)	(8)

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A late season single spray application to reduce numbers of winter-egg laying female adult European red mites has given a satisfactory result with amitraz (0.03%).

COMPATIBILITY

Both formulations of amitraz have been found to be compatible with most commonly used insecticides and fungicides. Results have been found to be uncertain in mixtures with parathion and Bordeaux mixture and combination with these chemicals is not advised. In New Zealand, no problems have been encountered during or following tank-mix applications of amitraz with azinphos-methyl or benomyl when applied to nectarines; applications of amitraz with captafol or triforine when applied to peaches or applications of amitraz with azinphos-methyl, benomyl, captafol, carbendazim, dinocap, mancozeb or metiram when applied to apples.

CROP SAFETY

Overseas studies have revealed no toxic symptoms on either fruit or leaves of a large number of varieties of stone and pome fruit, citrus, ornamentals and other horticultural crops. An exception has been a toxic effect seen on pears in the Eastern Australian States during 1972/73. The only studies on pome fruit in New Zealand have been on apples. Detailed assessments of fruit finish, particularly incidence of smooth and rough russet, have been made following the use, at critical times, of either formulation of amitraz, with no adverse chemical effects recorded. Varieties have included 'Cox's Orange Pippin' and 'Golden Delicious' (Auckland, 1977 harvest), 'Sturmer' and 'Red Delicious' (Motueka, 1978 harvest); 'Cox's Orange Pippin', 'Golden Delicious' and 'Kidd's Orange' (Auckland, 1978 harvest).

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