BISCLOFENTEZIN — A NOVEL COMPOUND FOR CONTROL OF PHYTOPHAGOUS MITES

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SUMMARY

Bisclofentizin (NC 21314) is a new specific miticide with long residual activity, acting primarily as an ovicide with some effect on juvenile stages. Laboratory tests and field observations have shown bisclofentizin to be tolerated by predatory mites and beneficial insects. In two season's experimental use in New Zealand, bisclofentizin has provided season long control of European red mite (*Panonychus ulmi*) on apples following a single application at greentip. An early post-blossom application has provided good control of populations of two spotted mite (*Tetranychus urticae*).

INTRODUCTION

Integrated control of phytophagous mites is now an established management practice in the major apple growing regions of New Zealand. Following investigations conducted by DSIR entomologists and others during the 1970's, a programme of "integrated mite control" (IMC) was developed (Wearing *et al* 1978). This encouraged the establishment of azinphos-methyl resistant predatory mite populations, and identified the periods in the season when European red mite is most susceptible to applications of selective miticides. This enabled the number of miticide applications to be reduced considerably. Selective chemicals will continue to play an essential role in the operation of IMC. At present the whole approach of IMC relies substantially on the success of one group of miticides, the organotin based compounds. The ability of phytophagous mites of economic importance to develop resistance to chemicals to which they are exposed makes the introduction of a new compound of a different structure and mode of action of value to the industry.

Chemical and physical properties

Trade name: Apollo 50W

Common name: bisclofentezin

Chemical name: 3, 6-bis (2'-chlorophenyl)-1, 2, 4, 5-tetrazine.

Empirical formula and molecular weight: $C_{14}H_8Cl_2N_4$, 303.

Structural formula:

Formulations

500 g/kg wettable powder

500 g/litre aqueous based suspension concentrate

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Toxicological properties

Active ingredients:	Acute oral	LD50 rat	>3200 mg/kg
	Acute dermal	LD50 rat	>1332 mg/kg
		LD50 bobwhite	
		quail	>7500 mg/kg
	Fish toxicity	LC50 (96 h)	
		rainbow trout	> 100 mg/litre

Mode of action

Bisclofentezin is a contact acaricide effective against the eggs and early motile stages of phytophagous mites. Activity against eggs of *Tetranychus spp* and summer eggs of *P. ulmi* is greater in the early stages of egg development with a reduction in susceptibility close to hatching. Against winter eggs of *P. ulmi* susceptibility is greater during diapause than during development.

Of the motile stages, direct activity is greatest against larvae and protonymphs. There is virtually no activity against adults but eggs laid by adults treated with bisclofentezin are affected.

No information is available on the biochemical mode of action of bisclofentezin.

Biological activity in field trials

Bisclofentezin has undergone four seasons of testing in field trials on apples in both the northern and southern hemispheres where the major effort has been concentrated on the control of European red mite (ERM). FBC unpublished data reports bisclofentezin to be selective of the phytoseiid mites, *Typhlodromus pyri* and *T. occidentalis*, *Amblyseius fallacis* and *Phytoseiulus persimilis*. Selectivity of *T. pyri* has been confirmed in Nelson field trials (Wearing and Ashley pers comm) over two seasons.

This paper reports on trial work in New Zealand for the control of ERM and two spotted mite (TSM) conducted in Hawkes Bay, Nelson and Canterbury.

METHOD

All trials were carried out in commercial apple orchards on single tree plots in randomised block layouts. There were five replicates of 6 year old Gala in Hawkes Bay, six replicates of 5 year old Oregon Red (a Delicious type) in Nelson and three replicates of dense 30 year old Sturmer trees at the Canterbury site.

Miticides were applied to the trees by a tractor mounted vertical boom sprayer in Hawkes Bay and by motorised hydraulic knapsack sprayer in Nelson and Canterbury, spraying to run off on each occasion. The greentip applications were made at first bud break, and post-blossom at 95% petal fall. The standard, azocyclotin (Peropal) was applied after the hatch of the first and the second generations of ERM summer eggs. The control trees were left untreated. All other chemicals in the normal grower programme were applied by standard airblast sprayer. Counts of mite numbers were made at regular intervals; 19 occasions at the Hawkes Bay site; 15 at Nelson and 18 at Canterbury. Ten leaves per tree were picked and mites removed using a leaf brushing machine. Eggs and all active stages of mites and predators were recorded. Details of timing and rates of chemical applications are given in Table 1.

RESULTS AND DISCUSSION**Hawkes Bay**

During the 1981-82 season bisclofentezin (80% WP) was tested on two sites in Havelock North to identify optimum application timing and rate for control of ERM and TSM in pipfruit. Results from these first season's trials confirmed the potent ovicidal activity of bisclofentezin and clearly indicated that effective mite control would be achieved from early season application at greentip and at early post-blossom.

In two 1982/83 trials bisclofentezin (50% WP) (25 g ai/100 litres) with intermediate oil at greentip gave a highly significant reduction of ERM numbers (Table 1).

TSM populations became established in one trial. A follow-up application of bisclofentezin at post-blossom reduced TSM numbers but because of high variation in numbers between replicates there were no significant differences.

TABLE 1: Effect of treatments on peak mite numbers (mites per 10 leaves) 1982/83 trials.

Treatment	Rate ai/100 lts	Hawkes Bay		Nelson		Canterbury	
		ERM	TSM	ERM	TSM	ERM	TSM
1 untreated		16.0 a	81	117 a	24 abc	235 a	221 a
Greentip (application dates)		14/9/82		9/9/82		16/9/82	
2 intermediate oil	2425 ml	5.6 ab	106	106 a	67 a	86 ab	281 a
3 bisclofentezin	25 g	7.6 ab	85	18 b	30 ab	53 bc	207 a
4 bisclofentezin	25 g	0.8 b	108	13 bc	18 ef	16 bc	265 a
+ oil	2425 ml						
Post Blossom (application dates)		5/11/82		27/10/82		18/10/82	
5 trt 2 + bisclofentezin	25 g	—	—	2 bc	2 f	11 c	26 c
6 trt 4 + bisclofentezin	25 g	1.6 b	21	2 bc	4 ef	1 c	23 c
Standard (application dates)		5/11/82	&	9/11/82 & 8/12/82		8/11/82 & 10/12/82	
		4/12/82					
7 azocyclotin	12.5 g	0.8 b	45	1 bc	12 bcdef	7c	204 ab

Original data shown but Duncan's Multiple Range Test carried out on log transformed data.

Nelson

Predators were already established on the trial trees and the overwintering population of ERM was low. Intermediate oil applied at greentip for control of San José scale (*Quadraspidiotus perniciosus*) had a similar miticidal effect to that reported by Collyer (1976) where oil delayed ERM build-up by about a month, but numbers were similar to those on untreated trees at harvest.

All bisclofentezin applications gave acceptable season-long control of ERM as did two timed applications of azocyclotin (Table 1).

T. pyri was recorded throughout the trial from November and *P. persimilis* from early February. By harvest predatory mites were found wherever there were aggregations of prey. Low phytoseiid numbers were recorded on miticide plots where there were few prey. Thomas and Chapman (1978) stated that it is essential for IMC that low levels of prey are maintained to ensure survival of the predators. The place of bisclofentezin in IMC is being investigated.

Canterbury

Control of ERM at the Canterbury site was similar to that for other trials. Addition of oil to bisclofentezin at greentip gave an improved result. All post-blossom applications gave excellent control including the two timed applications of azocyclotin (Table 1).

Although ERM is the major mite pest in Canterbury orchards TSM is also a problem. Under heavy infestations this pest can cause defoliation, reduced plant vigour and downgrading of fruit. Adequate control of TSM with miticide applications against ERM is a chance effect dependent on the time of movement of overwintering adult TSM, from ground cover and hibernating sites on the tree, onto the foliage. Miticide applications at greentip failed to control TSM. The early November application of azocyclotin controlled the first generation of TSM but failed to prevent the population reaching damaging levels in February. Both post-blossom applications of bisclofentezin significantly reduced TSM numbers (Table 1) which remained low for the whole season. This good control may have been assisted by warm north-west winds in the early spring which prompted the TSM overwintering population to move up onto the trees 'en masse' earlier than in other seasons.

Because of a late season build-up of TSM on those trees that did not receive bisclofentezin post-blossom a late season knock-down spray was required. Six trees with high mite numbers were selected and the eradicator properties of bisclofentezin and cyhexatin (Plictran) compared. Two applications each of bisclofentezin 50 g ai/100 litres and cyhexatin 20 g ai/100 litres, 12 days apart achieved good control of TSM and ERM.

Leaf examinations made 10 days after the first application showed the following TSM stages present:

TSM stages per leaf (Mean of five leaves):

	Adults	Deutonymph	Protonymph	Eggs	Phytoseiid mites
bisclofentezin	16	0	2	91*	4
cyhexatin	5	19	17	44	5

* Approximately 55% of eggs appeared discoloured and collapsed in the bisclofentezin treatment.

T. pyri, which feeds preferentially on ERM but will eat TSM if the ERM is not present, was found in moderate numbers throughout the trial. *T. occidentalis*, a principal TSM predator was also present. It is a highly mobile mite feeding on all stages. At the time of knockdown treatments these phytoseiid mites were well established on the untreated controls but variable in numbers on the miticide plots.

Phytotoxicity

No phytotoxicity has been observed on fruit or foliage in any field trial. These findings are fully supported by overseas investigations (FBC Ltd 1981 unpublished reports.)

CONCLUSIONS

Bisclofentezin is a novel, highly active mite ovicide, with some contact activity on the juvenile stages. In the field trials discussed it has given season long control of ERM on apples when applied at greentip prior to the hatch of winter eggs, and has given good control of both ERM and TSM when applied early post-blossom. The very specific biological activity of bisclofentezin and its selectivity to the phytoseiid mite species and predator insects should make it of particular interest in the design of future integrated pest management programmes. Timing and rates of application of bisclofentezin are being investigated for optimum use in IMC.

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