Biology of red-legged earth mite

A report prepared for
The New Zealand Asparagus Council

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1 EXECUTIVE SUMMARY

At all five study sites in Hawkes Bay red-legged earth mite populations continued to decline in 1993/94. With three years' reliable data it is clear that the distribution of the pest is becoming more restricted. Explanations for this phenomenon are based on extrapolation of Australian information and are linked to the cool, wet summer in 1992/93 when field observations showed that even as late as 29 December, mite populations were still active.

The population decline offers growers the opportunity to develop strategies to ensure that the return of weather patterns more favourable to red-legged earth mite will not lead to it re-establishing the wide distribution seen in 1991/92.

The decline in populations has shown that in adverse conditions ragwort is a key host plant. The use of apple baits has made mite detection more efficient and has shown that they associate with key species in a crop (e.g. ragwort, clover, twin cress) even when other known hosts are present.

Our three years' research on this pest have clearly identified the key factors that must be understood if it is to be contained in its current reduced range

1. sampling
2. chemical control
3. reduction in risk of spread

Continued research on these topics is needed.

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2 INTRODUCTION

Red-legged earth mite is a pest of South African origin that is widespread in Australia and localised in New Zealand. It is adapted to Mediterranean climates - hot dry summers and mild wet winters; such areas are isolated in New Zealand but provide a significant proportion of export vegetables. The impact of red-legged earth mite on Australian lucerne and clover crops, and its periodic damage to vegetables in New Zealand, have led USDA-APHIS (United States Department of Agriculture-Animal and Plant Health Inspection Service) to determine that it is a quarantine pest of importance. If it became established in the Central Valley of California, one of the most productive cropping areas in the world, it would seriously impact on existing production systems.

No disinfestation treatments exist for red-legged earth mite. We had intended to do some preliminary research in this last season but the collapse of the mite populations prevented us getting experimental material. The only option is to certify pest-free status of the land the crop was grown on. This is problematic as when mite numbers are low, intensive searching may locate some, but the quarantine risk posed by low density populations is low, if it exists at all.

The key to managing risk of infestation with red-legged earth mite is to understand its biology and to then be able to develop risk models with USDA-APHIS that meet their needs and facilitate the export of fresh vegetables from New Zealand to the Californian market (and to the eastern seaboard for some speciality crops such as herbs that will justify the freight costs). To achieve changes in the approach of the USDA to red-legged earth mite risk, we need to ensure we have high quality data that answer the needs of the agency.

After three years' work on this complex pest it is clear that key factors are the interaction between weather and population dynamics, vegetation management, crop hygiene, and efficient sampling systems. A quarantine treatment would be useful but may not be cost-effective to develop unless it was also effective against thrips and aphids.

3 SAMPLING SYSTEMS

Intense hand searching was previously shown to be the most effective way of determining the presence of red-legged earth mite (Carpenter & van Epenhuijsen 1993a). This is laborious and requires some expertise to distinguish between red-legged earth mite, blue oat mite and various lodellid mites.

Information from Australia suggested that peel from Granny Smith apples was an efficient way of sampling for red-legged earth mite. To simplify the process, thin slices of apple were used, with a complete circle of peel present.

3.1 Methods

1. Population sites were monitored in late July, early October and late November. Baits were left out for 2 - 20 hours. Baits were either laid on known host plants or every two metres.

2. Sampling pattern. At Pakipaki in a lucerne crop with a wide variety of other plants, baits were laid systematically (every two metres), on plants, or randomly.

   There were 20 baits per treatment and all sites were hand-searched to check bait efficiency

3.2 Results and discussion

Apple baits attracted a wide variety of mites and insects, including red-legged earth mite and blue-oat mite (Table 1). If left for more than four hours bird damage reduced their usefulness. If mites were present they would be found on the baits within two to four hours.

Baits did not attract mites unless placed on a plant (Table 2); even two to three cm from a plant was too far for a mite to move. Mites were detected at one site using apple baits when hand searching was unsuccessful.

The information collected in this trial is extremely useful.

The efficacy of the baits was very good, and was more effective than hand-searching. The mites did not move off their host plants and did not live on bare ground. The most important difficulty, apart from interference from birds, was in separating the various mite species present. It seems likely that the attractiveness of Granny Smith peel is due to β-farnesene which is known to be attractive to many insects and is present in Granny Smith apples.

Table 1: Evaluation of apple baits

Site	Late July		Early October		Mid November	
	Duration	Mites*	Duration	Mites	Duration	Mites
Maraekakaho	20 h	RLEM	6 h	RLEM	6 h	RLEM
Ngatarawa 1	20 h	BOM	4 h	RLEM	4 h	-
Ngatarawa 2	20 h	-	4 h	-	4 h	-
Pakipaki 1	20 h	BOM	3 h	-	3 h	-
Pakipaki 2	20 h	Not visited	2 h	-	2 h	-
Pakipaki 3*	20 h	Not visited	2 h	RLEM	3 h	-

* RLEM - Red-legged earth mite
BOM - Blue oat mite
- No mites

** Various patterns for laying out the baits were tested - random regular and on potential host plants. Only the latter was effective.

Table 2: Plant associations of RLEM at Maraekakaho and Pakipaki 3 in early October 1993. The total number of RLEM attracted to apples baits placed on 20 plants is given.

Maraekakaho			Pakipaki 3	
Plant	Asparagus	Adjacent Pasture	Plant	Pasture
Ragwort	40	*	Lucerne	1
Dandelion	0	0	White clover	4
Buttercup	0	0	Red clover	1
Amaranthus	0	0	Twin cress	4
Couch grass	0	*	Dandelion	2
Summer grass	0	0	Bare ground	0
White clover	0	0		
Bare ground	0	0		

* Plant species not present in pasture

4 PLANT ASSOCIATIONS

In 1992/93 it was found that red-legged earth mite was associated with a wide range of broadleaf plants.

This year the apple baits make it possible to investigate plant associations in a more quantitative manner.

4.1 Methods

At Maraekokaho 20 baits were placed on each of ragwort, buttercup, summergrass, amaranthus, Californian thistle, dandelion and bare ground in the asparagus bed, and 10 m away 10 baits were laid on clover pasture, on grass meadow and woolly verbascum associations. Six hours later the baits were assessed.

At Pakipaki 10 baits were laid on lucerne, white and red clover, dandelion and twin cress, and checked after three hours. At Mangaroa baits were laid on lucerne, twin cress and bare ground.

4.2 Results

Red-legged earth mites were recovered only from ragwort at Maraekokaho, but from several plant species at Pakipaki (Table 2). At Mangaroa only blue-oat mite was recovered. At no site were mites found on bare ground.

Parallel hand searches supported the ragwort association. No red-legged earth mites were found by hand searching at Pakipaki.

5 MAF MONITORING

Review of the MAF data for Hawke's Bay and Rangitikei areas for the last few seasons supports the findings from our population monitoring. A low proportion of properties are infested, and the overall trend has been downwards.

The MAF sampling showed a peak of infested properties and mites recovered in 1990. The effect of sampling date on the surveys is unknown and will be evaluated in the 1994/95 season. In bad mite years, the mites were noticeable during early winter before harvest begins, according to observations made by local growers.

6 WEATHER PATTERNS

The summer of 1992/93 was cool and wet, and last year (Carpenter & van Epenhuijsen 1993) we postulated that these mild conditions affected red-legged earth mite's ability to enter diapause. It seemed likely that soil moisture deficit would be the best indicator of conditions as they would affect the mite.

In Table 3 soil deficits for December, January and February for 1991, 1992, 1993 and 1994 are given. Maximum soil water deficit in Hawkes Bay is 115 mm.

In 1992/93 the soil water deficits in December were one third to one half of the preceding years and the year after. January figures were a little lower in 1992/93 and November values were moderate and variable in all years.

For the years with reliable population estimates - mid 1991 onwards, the disappearance of the mite is correlated with soil moisture deficit. In 1991 mites disappeared in December. In 1992 they were still active in late December, and in 1993 they had all gone by mid-November, a November when soil moisture deficit was very high earlier than other years.

Two sites on Table 3 are mite locations - Ngatarawa and Napier. The data indicate that the soil at the other sites was dry enough to allow mites to enter diapause, indicating that strenuous efforts need to be made to restrict the spread of the pest.

7 POPULATION DATA

Since late 1991 red-legged earth mites have been monitored at Ngatarawa (2 sites) Maraekokako and Mangaroa. In 1993 two sites at Pakipaki were added (Table 4).

With population densities falling continually, and the mites going from very common to rare.

In 1991 mites were present throughout the year, but after 1992 winter activity was greatly reduced and populations had completely disappeared by summer 1993.

8 DISCUSSION

We were unable to carry out a chemical control trial and work on postharvest disinfestation because of a lack of red-legged earth mites. We hope to carry this out in 1994, possibly in the Whakatane district where mite populations appear to have held up better.

Our hypothesis last year that conditions would have not allowed the mites to enter diapause (Carpenter & van Epenhuijsen 1993a, b) has been supported by the continued decline in numbers in 1993. As populations have declined, so have the plants used as hosts. Ragwort is confirmed as a key weed to rogue in high risk areas.

The pattern of factors leading to risk is now reasonably clear. Soil type has been already defined as crucial (Carpenter & van Epenhuijsen 1993a, b). This needs to be coupled with appropriate weather patterns, and there has to be appropriate, broad-leaved host plants.

We can now move towards integrating this data and predicting the areas in Hawke's Bay at risk to infestation with this mite. This will allow growers and exporters to manage risk more effectively.

The new baiting system can be used by growers to test for their own mites, once they can tell the difference between red-legged earth mite and blue-oat mite.

Three problems still exist. Because of the population crash we could not determine how far the mites will move - will they cross a road, a fence line, a bare headland? How can you control mite population in the field, and can you control the pest with postharvest treatments? .

Areas prone to mite attack show up on aerial photographs quite distinctly (Fig. 1). It may be possible to use aerial photography to determine risk areas.

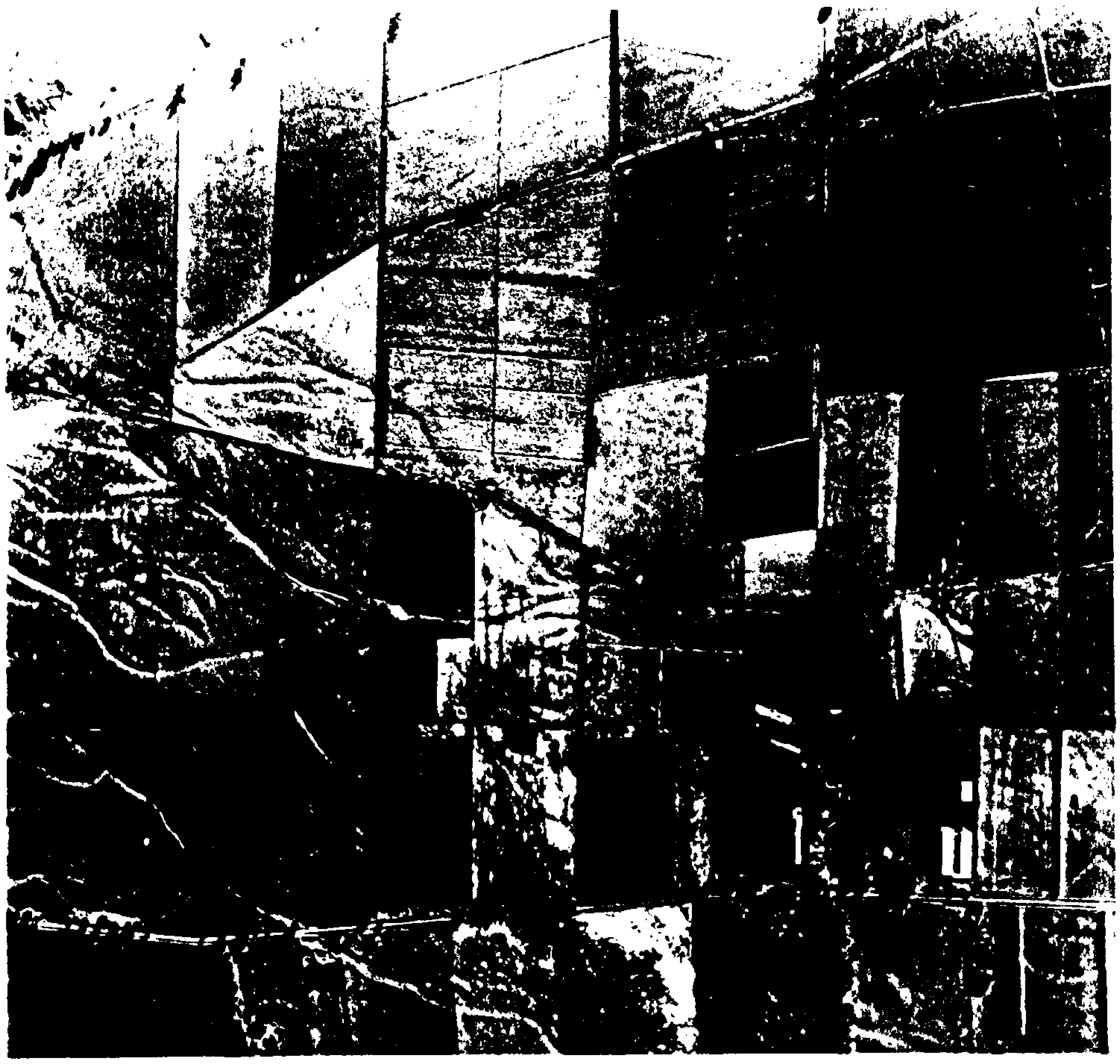

Figure 1: Aerial photograph of inland Hawkes Bay. The areas marked with quaternary water channels seem susceptible to mite infestation.

9 REFERENCES

Carpenter, A. & van Epenhuijsen, K. 1993a. Red-legged earth mite - a quarantine pest of asparagus. CropSeed Confidential Report No. 69. Report to the New Zealand Asparagus Council.

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10 ACKNOWLEDGEMENTS

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Table 3: Summer soil moisture deficits (mm), last week of each month.

Location	1990		1991				1992				1993				1994	
	N	D	J	F	N	D	J	F	N	D	J	F	N	D	J	F
Napier (airport)	115	115	115	115	63	115	115	115	18	26	101	103	108	115	115	108
Eskdale	70	115	115	115	92	111	115	105	21	43	59	115	115	115	115	97
Omaranui	115	115	115	115	55	115	115	115	39	55	106	115	115	115	111	115
Rose Hill	86	115	115	115	56	115	102	115	21	43	102	115	115	99	112	115
Ngatarawa	115	115	115	115	98	115	115	103	55	84	115	115	115	115	115	115
Gwavas	67	115	115	115	71	115	90	109	21	33	78	115	115	115	102	101
Pukehou	62	115	115	115	57	115	115	115	34	67	115	115	95	115	115	115

Table 4: Mite occurrence.

Location	1991			1992			1993		
	Winter	Spring	Summer	Winter	Spring	Summer	Winter	Spring	Summer
Ngatarawa 1	***	***	***	**	**	*	+	*	+
Ngatarawa 2	***	***	***	**	**	*	+	+	+
Mangaroa	***	***	***	**	**	*	+	+	+
Maraekokaho	***	***	***	***	***	***	**	*	+
Pakipaki 1	-	-	-	-	-	-	-	*	+
Pakipaki 2	-	-	-	-	-	-	-	+	+

Key *** very easy to find ** found after 2-5 minutes search * 1-3 mites found after intensive 10-20 minute search + not found after intensive search - not included in study