CropSeed Confidential Report No. 105

Decision support system for asparagus growers

A report prepared for
New Zealand Asparagus Council

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May 1994

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CONTENTS

1 SUMMARY

Insects and mites were counted in spears collected from 10 properties in Levin, Ohau, Poroutawhao, Marton and Bulls once a week between 18 October and 6 December 1993. Of all the insects and mites found, 69.5% were thrips and 28% were aphids. The total number of insects and mites per property varied between 186 and 378 in the 672 spears which were dissected. Only one harmful blue oat mite was found in the spears. Different methods of expelling insects from spears were compared with the MAFQual "tapping" method. The methods used in the three experiments were dehydration, heat and dipping or showering with chemical solutions at different concentrations.

Tapping removed less than 10% of the thrips.

The best results overall were obtained by dehydration, which expelled 74.3% of the thrips. Malathion was effective in the first dipping experiment. However, when the concentrations were reduced, no significant difference between soap, Malathion and Pulse was found. Showering spears with different chemicals expelled between 49.0 to 60.3% of the insects present. The results for aphids in two experiments were the same as for thrips.

Asparagus were also fumigated according to NZIG instructions. Some 96% of the thrips and aphids were killed, but only 33% of the mites.

All the 10 samples (each containing 84 spears) collected weekly contained more than one thrips.

Keywords: asparagus, aphids, thrips, detection, expulsion.

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2 INTRODUCTION

Major importing countries set thresholds for insect infestation levels on imported produce. The difficulty for the asparagus growers and the exporters is to establish the actual number of insects present in spears. This information is needed so that growers can decide whether or not to fumigate their produce prior to an export inspection.

Inefficient expulsion of small insects from fresh vegetation can lead to inaccurate estimates of a population (Teulon and Penman 1988). Tapping out insects was found to be an unreliable method for estimating populations of insects in asparagus spears (van Epenhuijsen 1993). It was also found, in preliminary tests with flower thrips in flowers from the *Caeanothus* shrub (Californian lilac), that it was far more difficult to expel the insects from the flowers when the insects were still alive. For this reason, methods using camphor and ethylacetate were abandoned.

This report describes experiments designed to expel insects and mites from asparagus spears after harvest. Results from the fumigation of spears with Hortigas are also presented.

3 METHODS

Samples of 14 spears were collected from 10 properties in 1993 on October 18, 25; November 1, 8, 15, 22, 29; and December 6. Spears were kept cold in chilly bins during transport to the laboratory. They were then washed, cut to 180 mm lengths and kept overnight at 4°C.

To test a physical expulsion method, bundles of 2-3 spears were firmly tapped 3-4 times over a plate to knock loose insects out.

Chemicals tested for their ability to expel insects were; Malathion (organophosphate), Defender soap (a saponified fatty acid), Pulse (an organo-silicone copolymer penetrant and surface active agent) and a vegetable oil (containing Canola, unsaturated fatty acids (60%) and the antioxidant E320). To extract insects from asparagus spears, samples were bagged in organza netting and submerged for 30 minutes in the chemical solutions at 17-20°C without agitation. The spears were then removed and the bags and spears rinsed under running water. The expelled insects were collected in a sieve (250 microns), poured into a petri-dish and counted. The spears were placed in plastic bags and kept at 8°C until they were examined for residual insects.

In another set of experiments, continuous showering of spears (Fig. 1) was tested. Spears were packed in mesh cylinders (described below) and placed in a funnel to which an organza collecting bag was attached. The funnel was then placed in a piece of pipe standing on a rack on top of a fish bin containing 30 litres of solution. An FP1 Onga submersible pump with an output of 13 litres per minute was placed in the fish bin. A plastic garden rose (diam. 100 mm) was fixed above the spears. Chemical solutions were allowed to shower the spears for 8 minutes, after which the spears were washed and stored at 4°C in a plastic bag for later dissections.

To test a heat method of expulsion, the spears were packed vertically in an incubator set at 50°C, in wire mesh cylinders 80 mm diameter and 180 mm long with a mesh size of 12 x 12 mm.

The cylinders were placed in a plastic 1 litre flask of which the bottom part was cut off and covered with organza netting. The flask was inverted over a 100 ml jar which contained water and a few drops of Sunlight detergent. Spears were rinsed in water after the treatments and checked for residual insects the same day, along with the liquid in the collecting jar and the water used for rinsing.

To test dehydration as an expulsion method, asparagus were bagged in organza and placed in a Harvest Maid dehydrator at 50°C for 14 hours. When dry, the spears were tapped lightly over a white plate. Insects on the plate and those remaining in the dried asparagus were counted.

After the extraction methods spears were dissected with a scalpel under a stereo microscope and remaining insects counted. Bracts were removed and tips very thinly sliced parallel to main axis of the spear to enable thorough examination.

A daylight fluorescent colour, Sunset Orange A-9 pigment (2 gram per litre), was added to Pulse to trace the penetration of the solution under the bracts. Spears were dipped and checked under ultra violet light after the bracts were removed. Many areas under the bracts and in the tip were not reached by the solution (Fig. 8).
Fumigation
Samples of 14 spears per property were fumigated with Hortigas in a fumigation tent made of horticultural plastic placed over a wooden frame. Spears and insects were checked after 2 days.

Sampling sites

Ohau on Foxton sand plain surrounded by grassland, a small block of young pine trees and some macrocarpa trees. Varieties supplied; Lucullus and Limbras.

Levin Sth (4.4 ha) on silty loam and surrounded by a willow shelterbelt. Adjacent to the plot are vegetable plots and grassland. Varieties supplied; Larac and Cito.

Poroutawhao (6 ha) on a Foxton sand plain, surrounded by grassland, young pine trees and some macrocarpa trees. Variety supplied; Jersey Giant.

Marton Erd (10 ha) on sandy loam surrounded by a willow shelterbelt and grassland. Variety supplied; Jersey Giant.

Bulls Prd on riversilt (8.8 ha) surrounded by rough grass and pine trees. Variety supplied; Rutgers Beacon.

Marton Trd (2 ha) on Kiwitea silt loam surrounded by pine trees and grassland. Variety supplied; Jersey Giant.

Marton Krd (7 ha) on silty river loam surrounded by grain crops, grassland and native trees. Varieties supplied; Limbras, Larac, and Rutgers Beacon.

Levin LRC (0.8 ha) on silty loam and partly surrounded by a willow and poplar shelterbelt. The side is surrounded by organic kiwifruit and pipfruit orchards, a vegetable plot and grasslands. Variety supplied; Limbras 10.

Bulls Trd (52 ha) on sandy loam and partly surrounded by a poplar shelterbelt, pastures, willows and macrocarpa trees. Variety supplied; Mary Washington.

4 RESULTS

4.1 Thrips populations

Only two major species of thrips were found in the spears from the asparagus blocks at Levin Sth, Poroutawhao, Levin LRC and Ohau between 7 October and 17 December 1992. (Wong Siu Kai pers. comm.). These were winged onion thrips and the unwinged thrips occurring in tufted grasses, referred to in this report as the "tufted grass thrips".

A New Zealand flower thrips was found in only one spear after 17 December, when harvesting had ceased. Another five species were caught in separate water traps and yellow sticky traps, but were not found on the spears. Most thrips found belonged to the Sub-Order of the Terebrantia; only 6% belonged to the Tubulifera, which do not attack horticultural crops. The percentage of thrips-infested spears varied between 25% (18 October) and 32% (6 December).

In the 180 mm spears, 61% of the thrips were found in the top 40 mm of 500 spears which were dissected.

A total of 1911 thrips were found in all samples (Table 2). Apart from one weekly sample, all had more than one thrips in each of the 84 spears. The total number of thrips showed a sharp increase from 22 November onward (Fig. 2). A total of 132 nymphs were found over the whole experiment, with an increase in numbers after 8 November.

At one of the properties, the number of thrips exceeded 300 in the weekly samples over the season (Fig. 3). The very dark tufted grass thrips was more easily seen, but the percentage of this thrips was low in comparison to the total number of thrips (Table 2).

The percentage of thrips unwinged ranged from 12-26% on seven properties but reached over 40% on three properties.

The highest number of aphids was found at Levin LRC (Fig. 4), and were found there on the spears from 13 October onwards. This is most probably due to the presence of willow shelterbelts which provide overwintering sites. Interestingly, when 5 cm long spears were covered in netting in the field, it was found at harvest, that thrips and aphids were already present on the spears so the insects entered the spears at a very early stage. Although not identified to genus level (Table 6), both winged and unwinged (nymphs) thrips were found on the spears.

The non-pest mites found belonged to the Anystidae (whirlygig mite), Bdellidae (predator mites) and Tydaeidae (harmless mites). Only one blue oat mite was found on the spears.

Very few other insects were found. They included leafrollers, spiders, and springtails (Fig. 5).

Numbers of aphids, mites and other insects per asparagus block are shown in Fig. 6 and 7.

4.2 Expulsion experiments

In the first dipping experiment (Table 3) Malathion and heat removed respectively 59.4 and 68.1% of the thrips (total winged, unwinged and immature stages of nymphs).

Phytotoxicity was not checked in detail and although some damage in the first experiment was noticed. This was not found in the second experiment where lower concentrations were used.

In the second dipping experiment (Table 4) the lower concentration of Malathion, Pulse and soap expelled between 53% and 57% of the thrips. These treatments were significantly better than tapping.

In the third experiment (Table 5) showering, as used in the USA (E. Nigh pers. comm.), was tested. The effectiveness of Pulse 0.01% was not different from oil and the other three treatments were better than oil. More aphids were expelled than in the first two experiments, with no significant difference between Malathion, Pulse and soap.

Tapping seems to be a very inaccurate method. A single thrip may be tapped out whether the spears contain very few or many.

Dehydration was the best method of expelling thrips and aphids, however dissection revealed that 26% of the thrips still remained in the spears.

The percentage of thrips, aphids and other insects killed was over 95%. Only four of the 12 mites in this experiment were killed (Table 6). The total number of mites was only 3% of all insects and mites found.

5 DISCUSSION

Before MAFQual allows asparagus to be exported, a trained Quality Assessor will pay a visit to the exporter to carry out a quality assessment.

Normally, 100 spears are taken in bundles of 4-5 which are then tapped against a hand over a white plate. All expelled insects and mites are recorded on a quality assessment sheet. This tapping is not standardised and the size of the spears, the number of times the sample is tapped and the time it takes place, may vary. Growers may tap spears shortly after the harvest or after overnight cooling. Both methods may give different results. All samples in our experiments were cooled overnight at 4°C before tapping and dissecting.

During our experiments, nearly 7% of the thrips were in the first stage of development after hatching from the eggs (first instar or nymphs). They would probably not be noticed and not be counted by a quality assessor, since they are hardly visible as they are small, yellowish and transparent.

Chemicals, like the penetrant Pulse, are often referred to as giving a "flooding" effect (Rohitha et al. 1992; Waller 1990) under the bracts. In our test, although many bracts were flooded, many still remained dry (Fig. 8). A visual search (dissection) of spears is the best method, but this is very labour intensive and destroys the produce as with some other methods used.

Some difficulties were discovered during the course of this research. Expulsion of unwinged thrips seems to be unreliable when spears are tapped. Showering spears with soap, and to a lesser extent with Pulse, produced an enormous amount of foam. Assessment of insects and mites after dehydration is difficult for growers to do since the insects shrivel up and are difficult to identify. Treatment for a shorter period may solve this problem. Heating spears in an incubator for a long period makes spears very slimy and spears have to be rinsed to remove the adhering thrips. Checking petri-dishes with parts of spear-tissue in them makes counting insects without the proper equipment impractical.

Several different species of thrips are found in spears. The onion thrips occurs on a wide range of garden and horticultural crops, especially onions, but have also been recorded on pine seedlings, pastures, and lucerne. The colour varies from yellow to pale brown. Eggs are laid in plant tissue and the last two instars burrow into the soil from which the adults later emerge. This species is known to be spread by the wind to other properties. The unwinged "tufted grass" thrips is more noticeable by its dark brown colour and is often found on lucerne, clover, sedges, rushes, and tussock grass. Its frequent occurrence on other plants suggests that it is exceptionally active, readily distributed by the wind (Mound and Walker 1982), or can be regarded as permanent (Watson and Townsend 1981). High numbers of thrips in certain properties may be explained by the surrounding crops, cover crops, lucerne etc. (van Epenhuijsen, 1993).

The original research with Hortigas (Carpenter A. 1987; Carpenter and Stocker 1992, 1993) concentrated on New Zealand flower thrips (*Thrips obscuratus*) which was regarded as the key quarantine pest present. These thrips appear to be more tolerant of the fumigant. It is now clear that this species occurs only sporadically in the crop, and the work should focus on other species which appear on asparagus more frequently.

However, as asparagus is exported as a gourmet food, it is essential that it be free of insects, regardless of the quarantine significance of the insects found on the crop. Effective detection methods will give exporters confidence in their product and an efficient means of decision support. The most effective methods developed here were destructive, and may be used on discards. These methods were more efficient than the present standard tapping method.

Further work needs to standardise some of the methods described here, and to investigate the behavioural responses of the insects to various stimuli to see whether more insects can be expelled.

6 RECOMMENDATIONS

The MAFQual standard tapping should only be used if other countries use the same method to allow the entry of fresh produce.

Growers have found that present hydro-cooling removes a lot of seeds, soil, insects, mosses etc. For this reason showering in combination with hydro-cooling might be a cost effective means of removing some insects. Salt solutions, showering, tapping before and after overnight cooling, should be included in further research.

7 ACKNOWLEDGEMENTS

The author would like to thank Peter Stevens, FTRI Rotorua for information on Pulse, Yates NZ Ltd. for supplying Defender, the growers who supplied the spears, the New Zealand Asparagus Council for its contribution towards the cost of the research, and Sandy Wright for Biometrics support.

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Table 1: Percentage of thrips found in asparagus spears on 4 properties in Horowhenua in 1992.

Thrips tabaci (onion thrips)	53%
Apterothrips secticornis (tufted grass thrips)	40%
Chirothrips manicatus	1%
Thrips (Tubulifera spp.)	6%
	100%

Table 2: Total number of thrips (unwinged, winged and nymphs) and percentage of total adult thrips in all experiments per property in 6720 spears.

	Total number				
Block/code	adults & nymphs	nymphs	winged adults	unwinged adults	% unwinged adults
1. Ohau1	138	7	99	32	24.4
2. Ohau2	171	10	138	23	14.3
3. Levin Sth	105	12	55	38	40.9
4. Levin LRC	255	9	189	57	23.2
5. Poroutawhao	184	8	93	83	47.2
6. Marton ERd	342	11	245	86	26.0
7. Marton TRd	196	15	138	43	23.8
8. Marton KRd	246	20	197	27	12.1
9. Bulls PRd	146	17	76	53	41.1
10. Bulls TRd	128	23	97	8	7.6
Total	1911	132	1327	450	25.0

Table 3: Mean percentage of thrips expelled from spears by tapping, dipping and heat*. First experiment.

Treatment/Solution	Mean % expelled
Tapping	9.9a
Pulse 0.05%	33.8b
Soap 1%	39.9b
Malathion 0.08%	59.4c
Heat	68.1c

* Means followed by the same letter are not significantly different from each other.

Table 4: Mean percentage of thrips expelled from spears by tapping, dipping and heat*. Second experiment.

Treatment/Solution	Mean % expelled
Tapping	8.8a
Soap 0.5%	53.0b
Pulse 0.08%	56.6b
Malathion 0.05%	48.2b
Dehydration	74.3c

* Means followed by the same letter are not significantly different from each other.

Table 5: Mean percentage of thrips expelled from spears by overhead showering*. Third experiment.

Treatment/Solution	Mean % expelled
Oil 0.1%	10.7a
Malathion 0.08%	60.3b
Pulse 0.05%	57.5b
Pulse 0.01%	62.8b
Soap 0.5%	49.0b

* Means followed by the same letter are not significantly different from each other.

Table 6: Number of insects and mites found in 1120 spears from 10 properties and the percentage killed by fumigation.

Total number of insects and mites		Percentage killed
Thrips 266		95.9
winged	161	
unwinged	74	
nymphs	31	
Aphids 84		96.4
winged	7	
unwinged	77	
Other insects 22		95.5
Mites 12		33.3

Fig 1: Shower experiment in laboratory

Fig 2: Total number of insects and mites in spears (18 October - 6 December 1993).

Fig 3: Total number of thrips in asparagus spears.

Fig 4: Total number of aphids in asparagus spears.

Fig 5: Percentage of insects and mites in asparagus spears.

Fig 6: Total number of mites in asparagus spears.

Fig 7: Total number of other insects in asparagus spears.

Fig 8: Fluorescent dye showing penetration of chemicals under removed bracts (above paper punches).

Fig 1: Shower experiment in laboratory.

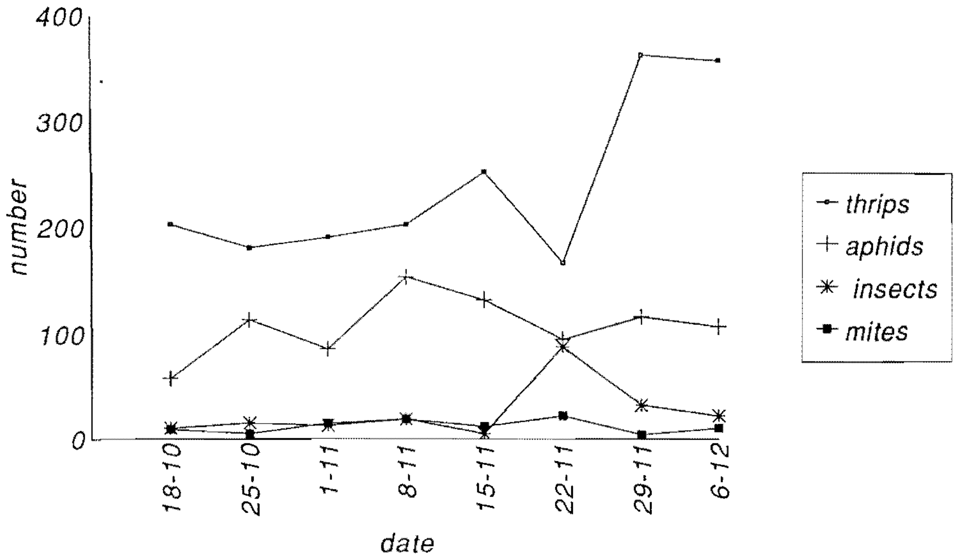

Fig 2: Total number of insects and mites in spears (18 October - 6 December 1993).

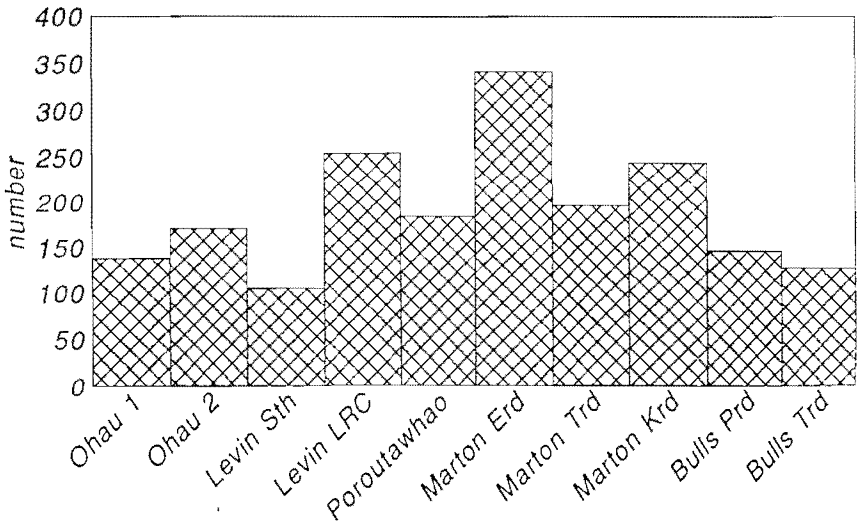

Fig 3: Total number of thrips in asparagus spears.

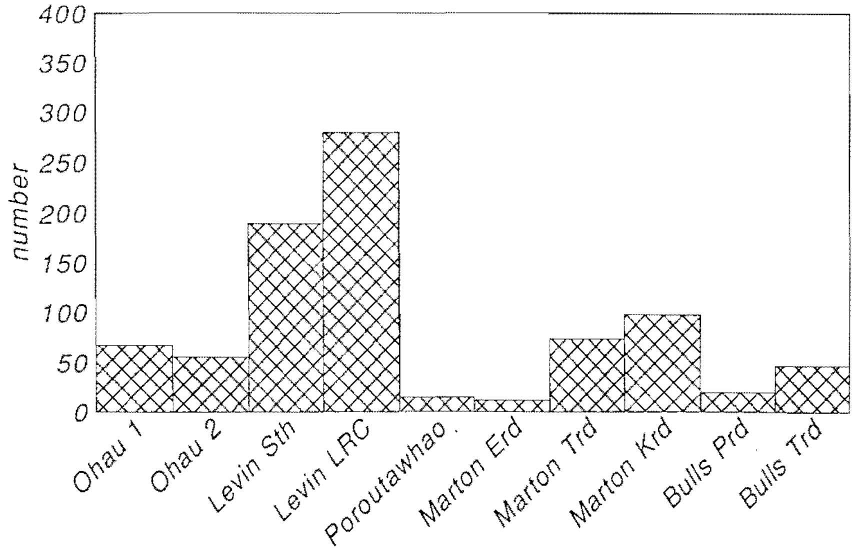

Fig 4: Total number of aphids in asparagus spears.

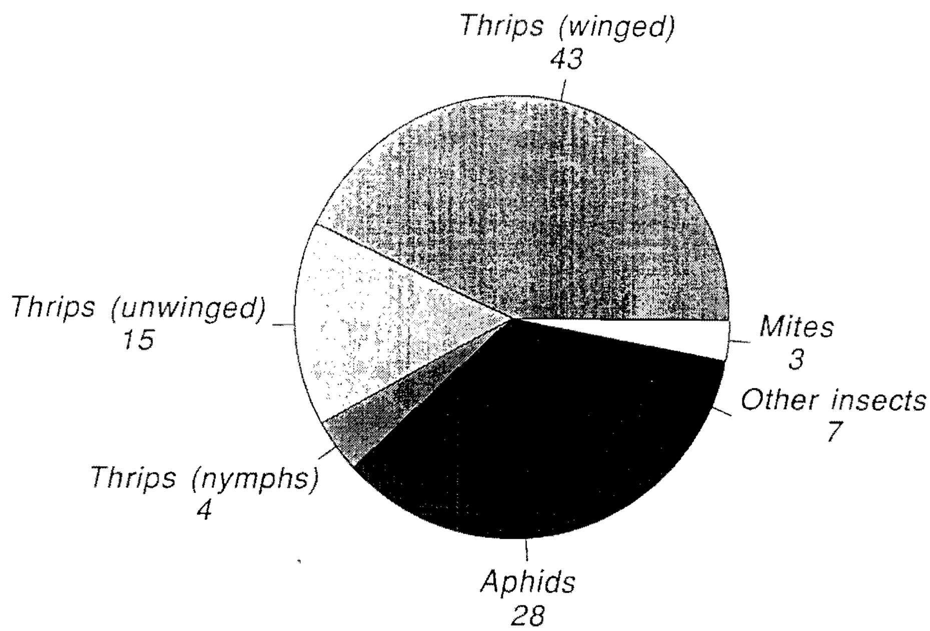

Fig 5: Percentage of insects and mites in asparagus spears.

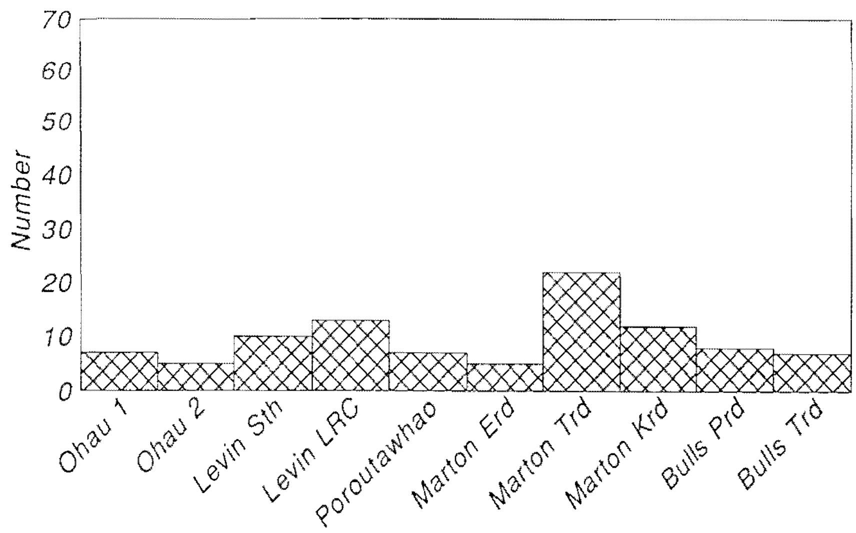

Fig 6: Total number of mites in asparagus spears.

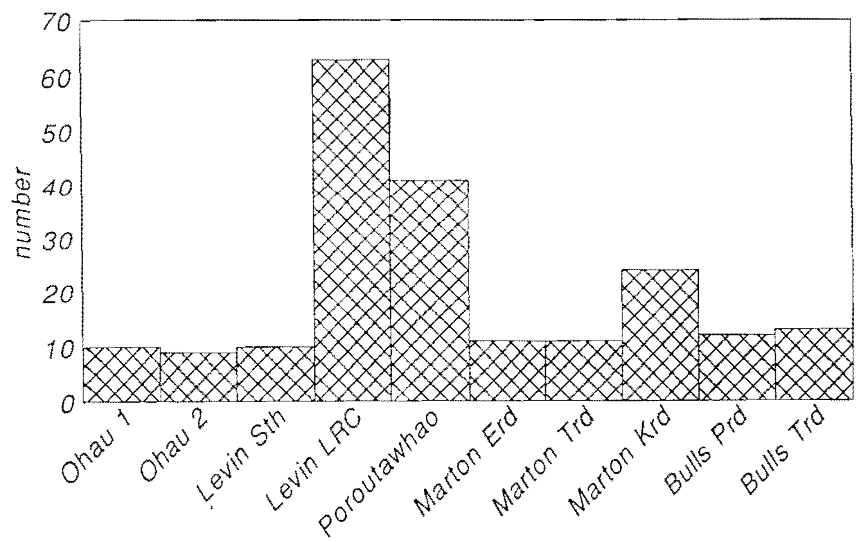

Fig 7: Total number of other insects in asparagus spears.

Fig 8: Fluorescent dye showing penetration of chemicals under removed bracts (above paper punches).