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CONTRACT REPORT

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# Pot Chrysanthemums: Western Flower Thrips Biology and Control

Undertaken for the Horticultural Development Council

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# POT CHRYSANTHEMUMS: WESTERN FLOWER THRIPS BIOLOGY AND CONTROL

**Summary**

Western Flower Thrips (WFT), (Frankliniella occidentalis) a non-indigenous pest in the UK, is potentially a major problem to growers of ornamentals, because of unsightly feeding damage, and because it is a vector of Tomato Spotted Wilt Virus.

The opportunity was taken, on an infested nursery in Hampshire growing pot chrysanthemums, to assess the effectiveness against WFT of the predatory mite Amblyseius cucumeris and to make other studies on the biology and control of the pest. Observations and trials were done to assess the relative susceptibility to attack of different cultivars, the value of sticky traps for detecting the pest, a comparison of the insecticides currently recommended for control of this pest, and an investigation to determine where WFT pupated.

When A.cucumeris was added to pots of chrysanthemums three, four, five or six weeks after 'sticking', at rates increasing from 0.5 - 23.0 mites per pot it did not control WFT adequately and the plants had to be sprayed with an insecticide before they could be sold. The numbers of WFT on 14 cultivars of chrysanthemums, assessed as they came into flower, varied from 0.7 - 22.3 thrips per pot. There were generally fewer thrips on the 'Anne' series of cultivars than there were on the Yoder cultivars or cultivars with single flowers. However there were also big differences between cultivars within all three groups. Yellow Garland was the most and Marsala the least heavily infested of the single cultivars.

White and yellow sticky traps caught roughly equal numbers of WFT, but both colours attracted more males than females. The traps caught WFT in parts of the glasshouse where the numbers of the pest on the crop were below the (practical) detection level. One or two sprays of dichlorvos (Darmycel Dichlorvos) applied to run-off at 1 ml/litre reduced the numbers of thrips present by up to 60 and 74 per cent respectively. In contrast two sprays of either deltamethrin (Decis) at 0.7 ml/litre, or endosulfan (Thiodan 35 EC) at 10 ml/litre reduced numbers by 9 and 6 per cent respectively. Endosulfan, but not dichlorvos, when

applied by the grower, with a motorised sprayer at 80 p.s.i., was appreciably more effective than the same insecticide applied with a knapsack sprayer at 40 p.s.i.

Investigations showed that more thrips pupated on the plant, mainly in flowers, than in the compost of the pots or in the soil under the benches.

**Introduction**

Western flower thrips (WFT) was recorded for the first time in England in May 1986 infesting natural season chrysanthemums, although it is now very widespread. The pest is subject to statutory control and intensive insecticide programmes are recommended by the Plant Health and Seeds Inspectorate (PHSI) to control it and to try to prevent its spread. However, little is known about the biology of WFT in the UK or about the efficacy of predatory mites relative to insecticides.

In May 1987, WFT was recorded on pot chrysanthemums on a nursery in Hampshire, where biological control was being used to control other pests. On such nurseries, the PHSI Schedule permits growers to use the predatory mites Amblyseius barkeri (mackensii) or A. cucumeris to control WFT instead of insecticides, provided ADAS monitors their effectiveness. The opportunity was therefore taken at this site to gather more information about the effectiveness of Amblyseius spp., and to study the biology and control of WFT.

**Materials and Methods**

Site
Shelley Nursery, Ower, Hampshire

Crop
Observations were made on pot chrysanthemums grown in a glasshouse approximately 2,000 square metres in area. The plants were grown in 452 cm x 10 cm aluminium channels (12 to each bed) supported approximately 0.8 m above the bare soil. Each channel held approximately 18 pots, depending on the maturity of the plants, and each pot consisted of five cuttings.

**Assessments**

The numbers of adults and immature WFT on plants were assessed by beating separately five randomly-chosen pots per bed over a large white tray (43 cm x 33 cm).

## (i) Observations to assess the effectiveness of A.cucumeris in controlling WFT

### Materials and Methods

The predatory mites that the grower was using commercially to control WFT were delivered weekly in plastic bottles, each containing approximately 1000 A. cucumeris in bran. The bran was gently shaken over the plants by the grower within a day of their arrival. The rates used and the age of the plants treated is shown in Table 1.

**Table 1 Rates of introduction of A.cucumeris**

| Dates and (Week Nos.) | Age of plants when Amblyseius introduced (weeks) | Numbers of A. cucumeris per pot (5 plants per pot) |
|---|---|---|
| 25 May - 21 June (22-25) | 3 to 7 | 0.5 |
| 22 June- 12 July (26-28) | 6 | 1.0 |
| 13 July- 23 August (29-34) | 4 to 5 | 7.5 |
| 24 August-30 August (35) | 5 to 6 | 11.5 |
| 31 August (36) | 5 to 6 | 23.0 |

Occasional insecticide treatments of endosulfan or dichlorvos were applied by the grower to plants shortly before the buds began to show colour (approximately 6 weeks old) if WFT were numerous. The numbers of thrips present on pots of Yellow Garland, the cultivar found to be most susceptible to WFT, were assessed weekly from Week 24 (14 June) to Week 29 (13 July) to determine how well A.cucumeris had controlled WFT.

### Results

A. cucumeris did not control WFT effectively. Mites were not seen during assessments until the rates of introduction were increased to 23 mites per pot. The numbers of WFT increased from none detected three weeks after sticking, to 1.4 thrips per pot two weeks later, and to 20.3 per pot eight weeks after sticking (Table 2 and Appendix 1). The plants had therefore to be sprayed (usually twice with either deltamethrin, dichlorvos or endosulfan) before they were sold. Dichlorvos scorched the petals of plants showing bud colour.

**Table 2 Total numbers of live WFT recovered from plants (cv Yellow Garland) between three and eight weeks after sticking.**

| Week of sticking \ Age of plants after sticking | Mean numbers thrips/pot | | | | | |
|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 | 8 |
| 24*[1] | - | - | 2.0 | 4.2 | 16.2 | 31.6 |
| 25 | - | - | - | - | 7.2 | 17.6 |
| 26 | 0 | 0.8 | 1.6 | 3.4 | 6.8 | 23.4 |
| 27 | - | - | 1.6 | 4.6 | 11.2 | 27.6 |
| 28 | 0 | 0 | 1.0 | 4.0 | 14.6 | 1.4 |
| 29 | 0.4 | - | 0.8 | 4.4 | 0*[2] | 0*[2] |

*[1]: week 24 = 14 June

*[2]: chemical treatments applied to these pots

**(ii) Comparison of attractiveness of different cultivars of chrysanthemum to WFT**

**Method**

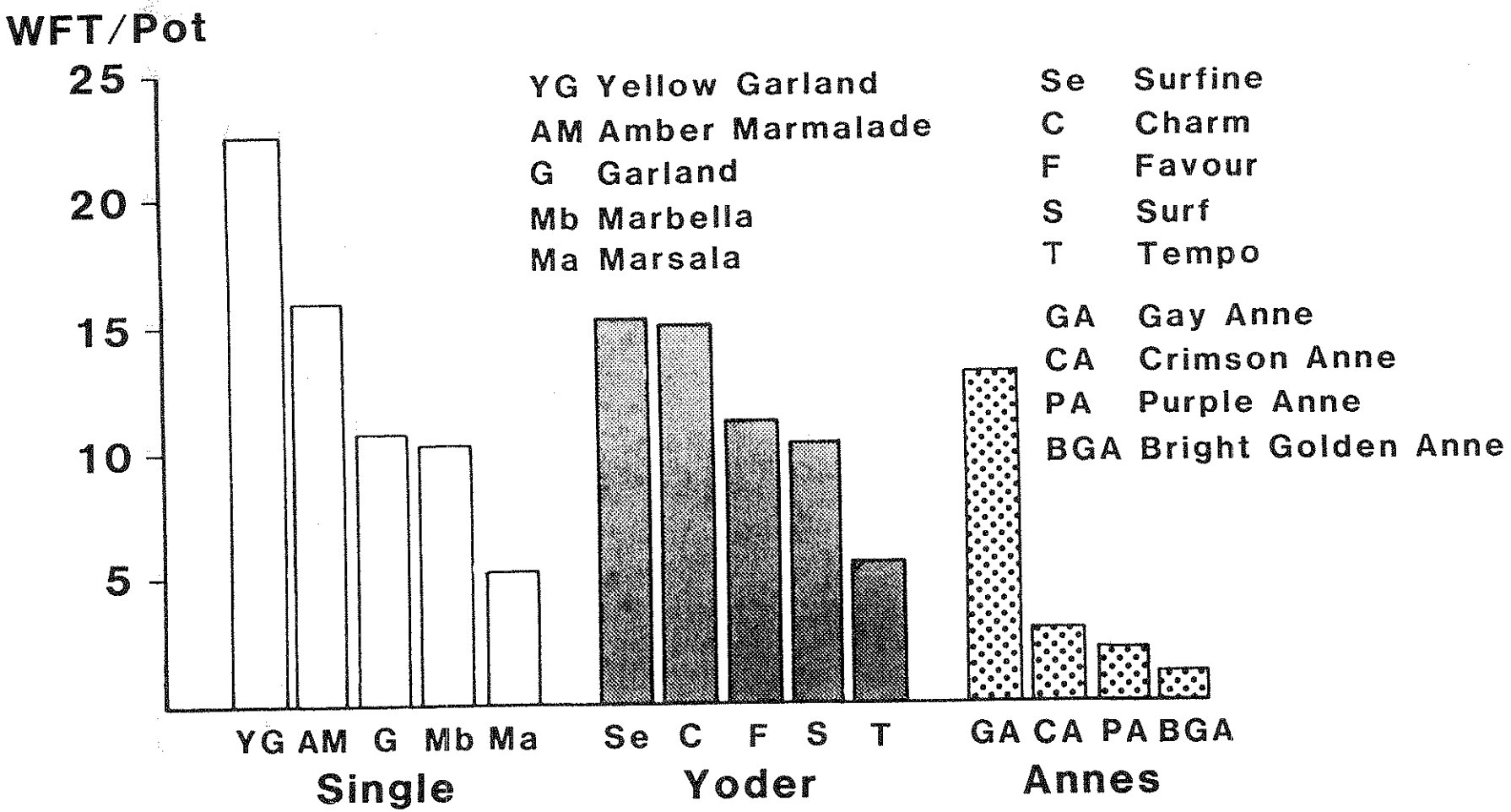
On 7 July, 12 and 26 August the numbers of WFT on fourteen cultivars were assessed.

**Results**

There were large differences between cultivars (Fig. 1 and Appendix 2). Generally, fewer thrips were present on the 'Anne' series, than on the 'Yoder' series, or cultivars with single flowers, but big differences also occurred within the three groups. Of the single cultivars, Yellow Garland was the most and Marsala the least heavily infested. Surfine was the most and Tempo the least heavily infested of the Yoder varieties.

The numbers of thrips present on plants were not necessarily a guide to the amount of damage that they caused. The least infested variety, Bright Golden Anne, suffered damage to its petals, but this was not easily seen. Crimson Anne also had few thrips, but the damage showed clearly on the dark petals. Conversely, damage was not easily seen on the most infested variety Yellow Garland.

Fig 1 **NUMBERS OF WFT ON POT CHRYSANTHEMUMS**



### (iii) Comparison of attractiveness of yellow and white sticky traps and assessment of their value in detecting low numbers of WFT

Sticky traps are used extensively to detect various pests (whitefly, aphids and leaf miners) including thrips. Work abroad (Yudin, Mitchell and Cho, 1987) suggested that WFT was attracted more to white than to yellow traps but the reverse was found in 1987 on a HDC - sponsored trial done on cucumbers. Further observations were therefore made to compare yellow and white traps and to see how the numbers of thrips caught on these traps compared with the numbers present on the crop. [WFT was first detected on this nursery on a yellow sticky trap being used to monitor whitefly].

**Materials and Methods**

Each trap* (250 x 95 mm), attached to a cane, was stuck into a pot of chrysanthemums located about 1 metre from the end of each bench.

In the two observations done in the summer, on 26 June and 3 July, one trap of each colour (randomised) was put on each of six benches containing plants from three to eight weeks old. The traps were left in position for one week.

In the autumn when the numbers of WFT on white traps and on the crop were compared, the traps were left in position for two weeks (15-30 October). Observations were made on six batches of plants from three to eight weeks old.

The numbers of thrips on randomly selected plants was assessed in the usual way by shaking the pots over a white tray at the start and end of the two-week trapping period. The total numbers of thrips on the traps were counted in the glasshouse, but their identidy and sex (summer assessments only) was determined by colleagues at the Harpenden Laboratory.

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* Yellow or white Aeroxon sticky traps coated with polystyrol glue obtained from R A Davies & Partners, Ty Mawr, Llysfaen, Colwyn Bay, Clwyd LL29 8UE.

**Results**

Although results varied somewhat between benches roughly similar numbers of WFT were caught on yellow and white traps (Table 3). However the traps caught almost five times as many males as females.

**Table 3. Mean numbers of male and female WFT caught on yellow and white sticky trap**

| Trapping Period 26 June - 10 July | Mean numbers of WFT per trap per week | | Mean |
|---|---|---|---|
| | Yellow | White | |
| | SED ± 3.62 | | |
| Males | 18.0 | 20.0 | 19.02 SED ± 2.39*** |
| Females | 3.1 | 4.7 | 3.93 |
| Mean | 10.57 SED ± 2.778 | 12.39 | |

*** Significantly different at P = 0.01

In October between 24-122 (mean 58.5) WFT per trap were caught compared with a mean of 0.15 WFT recovered from individual pots of chrysanthemums (Table 4)

**Table 4 Numbers of WFT caught on sticky traps or found on potted chrysanthemums**

| Age of plants (Weeks after sticking) | WFT per pot 15 Oct | 30 Oct | WFT per trap 15-30 Oct |
|---|---|---|---|
| 3 | 0 | 0 | 29 |
| 4 | 0 | 0 | 49 |
| 5 | 0 | 0 | 72 |
| 6 | 0 | 0.2 | 122 |
| 7 | 0 | 1.0 | 55 |
| 8 | 0.4 | - | 24 |

**(iv) Comparison of insecticides Approved for the control of WFT**

**Introduction**

Deltamethrin, dichlorvos, and endosulfan have Off-Label Approval for the control of WFT and they are recommended by PHSI for its control. However, there is little critical data on the relative efficacy of these insecticides. Soaps (eg. Savona) are used to control whitefly on various crops under glass particularly where biological control is being used, because they have little effect on parasites and predators. Little is known about their effects on WFT either.

**Materials and Methods**

The insecticides tested (endosulfan, deltamethrin, dichlorvos, "soap" (Savona)) were applied on 27 July and/or 3 August to plants that were to be harvested two weeks after the first sprays were applied. Half a bench of pots was sprayed on each occasion, such that a quarter of the plants were sprayed on 27 July, a quarter on 3 August, a quarter on both dates and a quarter received no insecticide (sprayed with water only on both occasions).

Sprays were applied to run-off at 40 p.s.i. with a Drake and Fletcher knapsack sprayer fitted with a 2 m boom. The rates used are shown in Table 5.

The numbers of adult and immature WFT present on five pots selected at random from each bench were assessed immediately before treatment and two days later.

**Results**

Dichlorvos was the most effective treatment. One or two sprays reduced the total numbers of thrips present 48 hours after treatment by up to 60 and 74 per cent respectively. Deltamethrin was generally more effective than endosulfan, but the results were not consistent. Poor results were obtained with Savona (Table 5). The control obtained in

**Table 5 Chemical control of WFT with insecticides**

| Treatment | Rate | Percentage control of WFT 48 hours after treatment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | One spray - Early | | | One spray - Late | | | Two sprays | | |
| | (ml product/l) | Adults | Immatures | Total | Adults | Immatures | Total | Adults | Immatures | Total |
| Dichlorvos 50% e.c. (Darmycel Dichlorvos) | 1.0 | 27.6 | 48.6 | 42.4 | 67.6 | 30.4 | 59.8 | 77.5 | 58.7 | 73.5 |
| Deltamethrin 0.25% e.c (Decis) | 0.7 | 42.9 | 13.3 | 22.7 | 38.4 | -23.1 | 17.2 | 1.0 | 25.0 | 9.3 |
| Endosulfan 35% e.c. (Thiodan 35 EC) | 2.0 | 33.3 | -6.5 | 5.6 | -5.2 | 65.1 | 14.5 | -36.4 | 39.5 | 6.6 |
| Fatty acids (Savona) | 10 ml* | 8.7 | -71.1 | -44.1 | -43.1 | 15.8 | -19.8 | -6.9 | 7.9 | -1.0 |
| No treatment | - | - | - | - | - | - | - | - | - | - |

NB: Minus number represents an increase in thrips numbers

* Recommended rate 20 ml/l; not applied in soft water as suggested by the manufacturers.



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the trial using a knapsack sprayer was compared on two occasions with that obtained by the grower, using his electronically-driven sprayer at 80 p.s.i. Endosulfan gave 74 per cent control (compared with 7 per cent control with two sprays in the trial), but there was little difference in the control obtained by either method with dichlorvos. (Table 6).

**Table 6 Control of WFT with sprays applied on different occasions with a commercial sprayer.**

| Cultivar | Percentage control of WFT (48 hours after treatment) | |
|---|---|---|
| | Dichlorvos*[1] | Endosulfan*[2] |
| Amber Marmalade | - | 75 |
| Charm | 59 | 59 |
| Marbella | 41 | 78 |
| Surfine | 60 | - |
| Yellow Garland | 67 | 82 |
| Mean | 56.6 | 74 |

*[1] Applied 22 July

*[2] Applied 26 August

**(v) To determine where WFT pupates in pot chrysanthemums**

WFT is generally considered to pupate in the soil, but recent observations suggested that significant numbers pupated on plants. Observations were therefore made to see where most WFT infesting pot chrysanthemums pupated.

**Materials and methods**

Laboratory observations were made in September on ten pots (half nine and half ten weeks old) of heavily infested chrysanthemums (cv. Yellow Garland). The top growth was cut off level with the compost and placed in separate, insect-proof cages. A white sticky trap was placed in each cage to catch any adults that emerged and these were examined daily for 4 days and then every 2-10 days for a further 30 days.

The experiment was repeated in November using the cultivar Bright Golden Anne.

At the same time observations were made in the glasshouse in Hampshire to see whether and how many WFT pupated in the soil beneath the benches supporting the pots of chrysanthemums. Ten sticky "emergence cages", were made from tomato boxes. The bottoms of the boxes were removed and replaced with polythene sheet coated on the inside with "Thripstick" (polybutene plus deltamethrin). These were placed on the soil in the glasshouse under the benches that held the oldest (and most heavily infested) chrysanthemums. Half the cages were put in areas where the soil was wet and half where it was usually dry. The traps were in position for ten days.

The exercise was repeated in November. In both cases the numbers of WFT trapped in the Thripstick were recorded.

**Results**

No thrips were caught in the emergence cages on the floor of the commercial glasshouse.

Over 70 per cent of the adult thrips recovered from the pot chrysanthemums came from plants (Table 7). Some of the thrips caught, particularly in the first few days may have been present as adults before the experiment begun, but it was almost certain that many of the insects pupated on the plants and not in the soil.

Some (at least 29 per cent) WFT pupated in the compost and these might be controlled if an effective soil-acting insecticide was incorporated in the compost.

**Table 7 Numbers of adult WFT recovered from two cultivars of pot chrysanthemum and from the compost**

| Cultivar | Age of plants (weeks) | Numbers of WFT caught on sticky traps | |
|---|---|---|---|
| | | Compost | Foliage |
| Yellow Garland | 9 | 4 | 16 |
| | 10 | 4 | 13 |
| | Mean | 4 (22%) | 14.5 (78%) |
| Bright Golden Anne | 9 | 6 | 4 |
| | 10 | 5 | 13 |
| | Mean | 5.5 (39%) | 8.5 (61%) |
| Both cultivars | Mean | 4.75 (29%) | 11.5 (71%) |

**Conclusions**

The predatory mite, A. cucumeris, did not establish successfully on pot chrysanthemums, even though large numbers (up to 23 per pot) were introduced; nor did it control WFT effectively. Plants inoculated with the predators when they were between three and six weeks old became heavily infested with WFT and they had to be sprayed with an insecticide (usually twice, with dichlorvos or endosulfan) or fogged with deltamethrin. Until more information is available about how and when to use A. cucumeris on pot chrysanthemums its use is not advocated.

The numbers of WFT on different cuttings of chrysanthemus varied greatly. Single cultivars tended to be more heavily infested than Yoder cultivars or the Anne series, although there were big differences in the numbers present within each group. Whether the thrips preferred certain cultivars or whether they multiplied more quickly on some than on others was not established.

The numbers of WFT on the crop increased dramatically in the last 2-3 weeks before the plants were sold. The numbers of thrips present at this stage did not necessarily reflect the amount of damage visible on the flowers. Damage was more noticeable on red and bronze cvs. eg Crimson Anne, than on yellow cultivars eg. Yellow Garland, on which the largest numbers were found. Information about both the host status and the susceptibility of the commonly grown cultivars of spray and pot chrysanthemums would be of considerable value to growers.

Large numbers of WFT were present on the oldest plants, but they were often almost undetectable on plants up to four weeks old (Table 2). However appreciable numbers of thrips were caught on sticky traps positioned in part of the glasshouse where the numbers of WFT on the plants were barely detectable. Such traps are therefore valuable aids to glasshouse growers who wish to check whether WFT is present in the glasshouses before crops become heavily infested.

In the tests done on this nursery yellow and white traps caught roughly equal numbers of thrips, but in other trials sponsored by the HDC yellow traps were appreciably more effective than white ones. Yellow traps

have the added advantage of being more attractive than white ones too to pests such as aphids, leafminers and whiteflies.

In the trial sprays of dichlorvos were appreciably more effective than ones of deltamethrin, endosulfan, or of the soap 'Savona', in line with results from many other trials. When checking the effectiveness of dichlorvos and an electric sprayer at high pressure (80 psi), endosulfan appeared to be more effective than when applied by a knapsack sprayer at 40 psi in the trial. This indicates that method of application is important, but since the methods were not compared at the same time, the results are not directly comparable.

Unfortunately Savona was applied at half rate in (hard) tap water rather than in soft water as the manufacturers recommend. The product should therefore be tested again.

Limited observations in the laboratory suggested that some WFT pupate on the crop, by passing the subterranean stage but others pupated conventionally in the compost. Soil - applied insecticides might therefore be of some,but limited value in the control of WFT on pot chrysanthemums. None however appeared to pupate in the compacted soil beneath the benches.

**Acknowledgements**

The co-operation of Mr P Wills, the owner of the nursery and his staff is gratefully acknowledged. Thanks are also due to Mr R A Davies of R A Davies and Partners who provided the white and yellow sticky traps, to Miss Helen Roberts, Harpenden Laboratory, for identifying the thrips, especially those caught on the sticky traps.

**References**

Yudin, L S, Mitchell, W C, Cho J. J. 1987. Color preference of thrips (Thysanoptera:Thripidae) with reference to Aphids (Homoptera:Aphididae) and Leafminers in Hawaiian Lettuce Farms. J. Econ. Entomol. 80: 31-55 (1987)

**Storage of Data**

The raw data will be stored by the ADAS Regional Entomologist, Block A, Government Offices, Coley Park, Reading RG1 6DT for a period of ten years. The Horticultural Development Council will be consulted before disposal.

Appendix 1.

Number of adults, immatures and total live thrips recovered from plants (cv Yellow Garland) between 3 and 8 weeks after sticking.

| Week of sticking \ Age of plants after sticking | Mean numbers thrips/pot | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | | | 4 | | | 5 | | | 6 | | | 7 | | | 8 | | |
| | A | I | TOTAL | A | I | TOTAL | A | I | TOTAL | A | I | TOTAL | A | I | TOTAL | A | I | TOTAL |
| 24* | - | - | - | - | - | - | 2.0 | 0 | 2.0 | 4.0 | 0.2 | 4.2 | 5.4 | 10.8 | 16.2 | 18.4 | 13.2 | 31.6 |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | 5.2 | 2.0 | 7.2 | 10.8 | 6.8 | 17.6 |
| 26 | 0 | 0 | 0 | 0.8 | 0 | 0.8 | 1.4 | 0.2 | 1.6 | 2.2 | 1.2 | 3.4 | 5.8 | 1.0 | 6.8 | 9.4 | 14.0 | 23.4 |
| 27 | - | - | - | - | - | - | 1.0 | 0.6 | 1.6 | 2.6 | 2.0 | 4.6 | 7.2 | 4.0 | 11.2 | 10.6 | 17.0 | 27.6 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0.8 | 0.2 | 1.0 | 2.0 | 2.0 | 4.0 | 5.8 | 8.8 | 14.6 | 1.0 | 0.4 | 1.4 |
| 29 | 0.4 | 0 | 0.4 | - | - | - | 0.6 | 0.2 | 0.8 | 3.8 | 0.6 | 4.4 | 0*[2] | 0*[2] | 0*[2] | 0*[2] | 0*[2] | 0*[2] |

* Week 24 = 14 June

A = adult thrips
I = immature thrips
- = no data
* = chemical treatments applied to these pots

Appendix 2.

Numbers of live thrips recorded on different varieties of pot chrysanthemums on three sampling occasions

| Variety | Type | Mean number thrips/pot 7 July Total | 12 Aug Total | 26 Aug Total | Grand Mean Total |
|---|---|---|---|---|---|
| Bright Golden Anne | Annes | 0.6 | 1.0 | 1.2 | 0.7 |
| Crimson Anne | " | 1.2 | - | 4.2 | 2.7 |
| Purple Anne | " | 0.8 | 3.0 | 1.2 | 1.7 |
| Amber Marmalade | Single | 12.4 | - | 20.0 | 16.2 |
| Garland | " | 7.8 | 14.0 | - | 10.8 |
| Marbella | " | 16.0 | 10.4 | 4.6 | 10.3 |
| Marsala | " | 3.4 | 7.0 | - | 5.2 |
| Yellow Garland | " | 21.8 | 17.6 | 27.6 | 22.3 |
| Charm | Yoder | 14.4 | 10.4 | 20.6 | 15.1 |
| Favour | " | 3.6 | 19.4 | - | 11.5 |
| Gay Anne | " | 13.0 | - | - | 13.0 |
| Surf | " | 10.2 | 10.6 | - | 10.4 |
| Surfine | " | 15.8 | 14.8 | - | 15.3 |
| Tempo | " | 2.6 | 9.2 | - | 5.9 |

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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

.....Michael Saynor..... M Saynor B.Sc. Ph.D

Contract Manager

Date .....9 January 1989

Report authorised by .....Jan Cermak.....

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