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| **PROJECT NO:** | PC70 |
| **PROJECT TITLE:** | TOBACCO WHITEFLY : USE OF INSECTICIDAL DIPS ON POINSETTIA CUTTINGS |
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| **LOCATION OF PROJECT:** | ADAS TRAWSGOED |
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CONTENTS

## PC70: RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

### Application

Control of tobacco whitefly is difficult and time consuming, due to the strong insecticide resistance shown by this pest and the problem of spray coverage of leaf undersides.

This project was designed to test dip treatments for poinsettia cuttings, in order to maximise coverage of leaf undersides with the insecticide.

Petroleum spraying oil at 0.5 or 1.0% as a dip gave outstanding control of eggs, scales and pupae of tobacco whitefly. No other treatment was as effective against the eggs, which are the commonest method of spread of this pest.

Growers can now dip poinsettia cuttings on receipt from abroad, giving maximum effect with minimum amounts of pesticide.

### Summary

This project was designed to test a range of insecticides as dips for poinsettia cuttings. The importation of cuttings from certain European Countries carries with it the risk of tobacco whitefly infestation. Because this is a statutory pest in the UK an eradication policy is followed which involves the grower in many insecticide applications and much extra cost.

By dipping the cuttings, minimal amounts of pesticide would be used, with maximum coverage of leaf undersides, which is where the eggs and scales of tobacco whitefly are present.

Results showed that petroleum spraying oil (hortichem) at 0.5% or 1.0% gave good control of eggs, scales and pupae. No phytotoxicty was seen but cuttings dipped in oil solution had a glossy sheen on the leaves. However, tests on all varieties of poinsettias should be carried out to ensure crop safety.

Savona (horticultural soap) at 1% also gave good control of scales and pupae but was ineffective against the eggs. Also phytotoxic effects were seen on treated cuttings.

Applaud as a single dip was poor on eggs, excellent on scales and good on pupae. Nemolt gave poor results generally, and it is concluded that a programme of applications of this product is needed for best effect.

All these products are IPM compatible, ie. growers can follow the dips with the use of biological controls, with no harmful residual effects, eg. on Encarsia parasites.

## Action points for growers

1. Providing large scale dipping can be carried out efficiently, then oil at 0.5% will give excellent control of any tobacco whitefly at an early stage, often before the grower detects any infestation.

2. This will save time and money later on.

3. Growers importing cuttings from abroad should consider this technique as a routine part of growing the crop.

4. Further testing on all the major varieties of poinsettias should be done to confirm crop safety.

## Practical benefits

1. Control of tobacco whitefly at this early stage will save time, money, and possible crop damage from frequent high volume insecticide sprays.

# HDC FUNDED R & D : EXPERIMENT REPORT
# PC70 : TOBACCO WHITEFLY :
# USE OF INSECTICIDE DIPS ON POINSETTIA CUTTINGS


## SUMMARY

Work at ADAS Trawsgoed using the 'B' strain of tobacco whitefly (the most virulent strain) showed that a single dip of petroleum spraying oil (Hortichem) at 0.5 or 1.0% gave excellent control of eggs, scales and pupae of *Bemisia tabaci*. After dipping, the poinsettia cuttings (variety Lilo) had a glossy or shiny effect on the leaves, but this was soon outgrown and no phytotoxicity resulted.

Savona (horticultural fatty acids) at 1% also gave good control but caused phytotoxicity (brown markings on the leaves) which would probably not be acceptable to growers.

The Insect Growth Regulator (IGR) Applaud (buprofezin) plus Agral at 0.3 + 0.3% gave good control of the scales, but was less effective on eggs and pupae.

Nemolt (teflubenzuron) was the least effective treatment in these trials.

No phytotoxicity was seen from the Applaud or the Nemolt treatments.

Further work with a range of rates of petroleum oil on the main varieties of poinsettia is needed to confirm the lack of phytotoxicity.

# 1. INTRODUCTION

The tobacco whitefly *Bemisia tabaci*, is a non-indigenous pest in the UK and has been eradicated whenever outbreaks occurred. However, it continues to arrive on imported poinsettia cuttings every year. The level of infestation has varied from year to year, but 1993, over 30 outbreaks were recorded, all on poinsettias, and all on imports from Europe and certain other countries.

Often the level of infestation on the cuttings is very low because the major propagators have an active control programme in place. Obvious contamination of cuttings, especially with adult whiteflies, is rare, but it is common to find low levels of eggs or first instar scales. These stages are very small and impossible to see unless a microscope or hand lens is used. When the cuttings are potted up and grown on in a warm environment, the infestation soon develops on the growers holding.

The level of insecticide resistance shown by *Bemisia* is very high, as has been confirmed by numerous studies in Europe and America. Control at later stages can therefore be difficult. (Denholm, 1991, Prabhaker, 1992).

The aim of the present work was to find an effective, safe insecticide which could be applied early to the cuttings and eradicate eggs and scales of *Bemisia* that may be present. As well as being safe to the cuttings, the treatment should also be safe to operators as anyone carrying out dip treatments is bound to come into close contact with the insecticide solution.

By using insecticides as a dip, the amount of product used would be minimal, so costs would be low. In addition, a thorough dip of poinsettia cuttings is most likely to give good coverage of the leaf undersides, which is exactly where the whitefly is found.

## 2. MATERIALS AND METHODS

Well rooted poinsettia cuttings (variety Lilo) in Jiffy sevens (net pots made of compressed peat) were used in all the experiments.

The cuttings were selected for uniformity, and all but two leaves removed. Each cutting was labelled with plot number and treatment number, and placed in the *Bemisia* culture cage for oviposition to take place.

Cuttings were removed after one day, and adult whiteflies removed using a pooter and blasts of compressed air. This ensured poinsettia cuttings with a cohort of freshly laid eggs. Because only two leaves had been left on the cuttings, eggs were concentrated on these leaves, which helped to reduce sampling variability.

All treatments were replicated 6 times, in a randomised block design. The cuttings were stood out on capillary ,matting in a separate chamber in the glasshouse. Temperatures were recorded hourly using a squirrel data logger. Mean temperatures during the experimental work averaged 24°C (test on eggs) 22°C (test on scales) and 21.8°C (test on pupae).

Work in Denmark (Enkegaard, 1992) has clearly shown that natural mortality of *Bemisia* scale stages is much reduced at temperatures above 20°C, compared to 15°C. Therefore the temperatures maintained during the experiments were favourable for development of *Bemisia tabaci*.

By leaving batches of cuttings for set periods after oviposition, evenly aged populations of either eggs, scales, or pupae were allowed to develop.. Each of these stages was treated separately in the trials.

Pre-treatment counts were carried out to determine the mean number of eggs or other stages per leaf.

**Insecticidal treatments**

| | Product | Rate mls/100 litres | |
|---|---|---|---|
| 1. | Untreated | - | |
| 2. | Spraying oil | 500 | (0.5%) |
| 3. | Spraying oil | 1000 | (1.0%) |
| 4. | Nemolt | 100 | (0.1%) |
| 5. | Applaud + Agral | 30 + 30 | (0.03%) |
| 6. | Savona | 1000 | (1.0%) |

Each cutting was immersed individually into the insecticide solution, taking care that the jiffy pot did not come into contact with the liquid. Once submerged, the cutting was twisted (90° clockwise and then 90° anti-clockwise) twice. Dipped cuttings were then placed back onto moist capillary matting.

Untreated cuttings were dipped in plain water. A record of phytotoxicity was kept by assessing the treated cuttings on a 0-3 scale, where

0 = no effect
1 = slight damage to leaves
2 = moderate damage to leaves
3 = severe damage to leaves.

Counts of surviving whitefly stages were made, normally 7 days after treatment. Live scales were yellow in colour and fully turgid. Dead scales tended to turn pale brown in colour and lose turgidity or shrivel up. By examining the scales under a microscope and using these criteria, stages were classified as live or dead.

In the case of the test against *Bemisia* pupae, the number of successfully emerged pupal cases was counted, to determine the effect of treatments on pupae. Any mortality on control plants was corrected for on treated plants using Abbotts (1925) formula.

## 3. RESULTS

### 3.1 Effect of insecticides on eggs of *Bemisia tabaci*

| | |
|---|---|
| Cuttings infested | 5/9/93 |
| Pre-treatment count | 11/9/93 |
| Dips carried out | 11/9/93 |
| Post-treatment count | 17/9/93 |

**Table 1 The control of *Bemisia* eggs on poinsettias**

| Treatment | Rate | Mean number of *Bemisia* per leaf | | % Control |
|---|---|---|---|---|
| | | Pre-treatment eggs | Post-treatment (scales) | |
| Untreated | | 27.0 | 27.0 b | 0.00 a |
| Spraying oil | 0.5% | 25.3 | 3.7 a | 86.8 d |
| Spraying oil | 1.0% | 16.6 | 3.4 a | 79.9 c |
| Nemolt | 0.1% | 33.2 | 31.6 b | 7.3 b |
| Applaud | 0.03% | 22.8 | 22.8 b | 0.0 a |
| Savona | 1.0% | 36.7 | 35.5 b | 3.1 ab |
| SED | | 7.32 | 6.89 | 3.16 |
| % CV | | 47.1 | 57.7 | 18.5 |
| F Ratio | | NS | <0.001 | <0.001 |

Means followed by the same letter are not significantly different. (Duncan's multiple range test).

In this experiment, only spraying oil at both concentrations gave good control of eggs, which were 6 days old when treated. Eggs of *Bemisia* normally take about 10 days to hatch at the mean temperatures used in the experiment (24°C), so the eggs were well developed when treated.

### 3.2 Phytotoxicity

Poinsettias (variety Lilo) that were dipped in spraying oil showed a glossy sheen on the upper leaf surface (see Plate 1). Assessments were made 3, 7, and 14 days after treatment but no other symptoms from oil treatment were seen, and the new growth emerging from the cuttings was unaffected.

There was no damage from the Nemolt or Applaud treatments, but the Savona 1% dip treatment caused some phytotoxicity. This appeared as a bronzing or browning of the interveinal areas on the underside of oldest leaves. There was also some yellowing of the upper leaf surface (see Plates 2 and 3).

The mean phytotoxicity score across all replicates on Day 7 was 1.5. However, on some cuttings the "bronzing" reaction covered up to 75% of the leaf area. It is considered that this damage may reduce subsequent cutting growth, and would probably be unacceptable to growers.

### 3.3 Effect of insecticides on scales of *Bemisia tabaci*

| | |
|---|---|
| Cuttings infested | 21/9/93 |
| Pre-treatment count | 7/10/93 |
| Dips carried out | 7/10/93 |
| Post-treatment count | 14/10/93 |

**Table 2** **The control of *Bemisia* scales on poinsettias**

| Treatment | Rate | Mean number of *Bemisia* per leaf | | *% Control |
|---|---|---|---|---|
| | | Pre-treatment | Post-treatment | |
| Untreated | - | 30.6 | 25.2 a | 17.2 a |
| Spraying oil | 0.5% | 19.1 | 0.5 c | 98.3 d |
| Spraying oil | 1.0% | 33.8 | 0.1 c | 99.7 d |
| Nemolt | 0.1% | 36.0 | 18.1 b | 32.5 b |
| Applaud | 0.03% | 24.2 | 2.8 c | 84.4 c |
| Savona | 1.0% | 34.5 | 2.1 c | 92.8 cd |
| SED | - | 9.8 | 3.2 | 6.3 |
| % CV | - | 56.9 | 69.4 | 16.1 |
| F Ratio | | NS | <0.001 | <0.001 |

*% control figures are corrected for mortality on untreated plants (Abbott 1925)

Means followed by the same letter are not significantly different (Duncans multiple range test).

In this experiment the scales were 18 days old when treated and the majority were in the 1st or 2nd instar. All the treatments except Nemolt gave excellent control of scale stages of *Bemisia tabaci*. Nemolt gave over 32% control and was more effective on scale stages than it was against eggs. Tobacco whitefly scales have a very waxy outer layer, which is hard to wet and makes spray penetration difficult. The dip treatments obviously gave good coverage of leaf undersides so that scales were contacted by all treatments. The best treatments were spraying oil (at both concentrations) giving over 95% control, and Applaud which gave over 84% scale control from one application. Normally, insect growth regulator (IGR) materials such as Applaud and Nemolt need several applications in a programme for best results. Savona at 1% also worked well, but the obvious phototoxicity from one dip is a major disadvantage with this product.

## 3.4 Phytotoxicity

As in the dip test for *Bemisia* eggs, plants (variety Lilo) used in the scale trial with petroleum oil showed a glossy sheen on the upper leaf surface. No other symptoms were observed. Applaud and Nemolt were again safe, while Savona at 1% caused the same brown lesions as before. (See Plate 2). The mean phytotoxicity score 7 days after treatment was 1.5.

## 3.5 Effect of insecticides on pupae of *Bemisia tabaci*

| | |
|---|---|
| Cuttings infested | 22/9/93 |
| Pre-treatment count | 20/10/93 |
| Dips carried out | 20/10/93 |
| Post-treatment count | 1/11/93 |

Table 3 **The control of *Bemisia* pupae on poinsettias**

| Treatment | Rate | Mean number of *Bemisia* per leaf Pre-treatment | Post-treatment | *% Control |
|---|---|---|---|---|
| Untreated | - | 16.3 | 14.9 b | 9.2 a |
| Spraying oil | 0.5% | 13.8 | 0.3 a | 95.8 c |
| Spraying oil | 1.0% | 13.3 | 1.1 a | 94.8 c |
| Nemolt | 0.1% | 17.9 | 12.3 b | 17.0 ab |
| Applaud | 0.03% | 8.2 | 5.7 a | 23.1 b |
| Savona | 1.0% | 10.6 | 1.8 a | 82.3 c |
| SED | - | 4.9 | 2.5 | 9.8 |
| % CV | - | 63.6 | 72.3 | 32.4 |
| F Ratio | | NS | <0.001 | <0.001 |

*% control figures are corrected for mortality on untreated plants (Abbott, 1925)

Both rates of spraying oil gave very good control of pupae of *Bemisia*; this stage of the whitefly is difficult to kill with conventional contact insecticides. Savona also worked well, but control was not as good as from the oil. Dead pupal cases from both Savona and spraying oil were wafer thin, brown and shrivelled, so were easily recognisable. Pupae affected by the IGR Applaud were 'fatter' but also brown, and sometimes a dead adult could be seen inside the half emerged pupae.

## 3.6 Phytotoxicity

As in previous trials, no phytotoxicity was seen from any treatment except Savona. At 1% this product again caused the bronzing on leaf undersides but in this test the damage to leaf uppersides (white spotting) was more marked. The mean score for Savona treated plants on 24/10/93 was 2.2 (4 days after treatment) and on 1/11/93 was 1.9 (11 days after treatment). Young leaves appeared to be less affected by the damage; which was always most marked on the fully expanded leaves.

## 4. DISCUSSION

These results have shown clearly that petroleum oil (Hortichem spraying oil, containing 79.8% w/w white petroleum oil) gives excellent control of the three main stages of *Bemisia tabaci* which are likely to be present on poinsettia cuttings (ie eggs, scales and pupae). The product was not tested on adults, which are rarely found on imported cuttings except in cases of severe infestation, but workers in Canada have found a strong repellent effect on adult tobacco whiteflies (Matteoni and Steiner, 1991). Moreover, by controlling the whitefly at this early stage, application is economical in terms of amount of pesticides used. Once the poinsettias have developed a strong leaf canopy, coverage of the undersides of leaves with insecticides is much more difficult.

Dipping techniques used in these trials were, however, fairly labour intensive as each cutting had to be handled individually. Before widespread commercial usage of dipping, a method of mechanisation would need to be developed, to speed the process up.

The trials showed no obvious phytotoxicity from oil at 0.5 or 1.0%, but only one pesticide dip was carried out. Oils can be phytotoxic if too high a concentration is used, or if frequent applications are made (Martin, 1964). There was little difference in effectiveness between the two rates of oil, so to increase the safety margin it is recommended that the 0.5% rate is used.

These oils should not be tank mixed with any other pesticide, as this may increase the risk of phytotoxicity. In particular, products containing sulphur, or Rovral w.p (iprodione) should not be applied within 28 days of a spraying oil application. No damage was seen at 0.5% or 1.0% on the variety of poinsettia variety used (Lilo) but before widespread usage by growers it is recommended that a screening test with all the commercially available varieties is carried out to check for any adverse reactions. The variety Steffi is particularly prone to react badly to pesticide applications (Krebs, 1989).

One important feature of spraying oils is their moderate effect on *Encarsia* parasites. This means that, following dipping to reduce the *Bemisia* population, a biological control programme using *Encarsia* can be followed successfully. With the recent withdrawal of the recommendation for aldicarb

(Temik) for glasshouse ornamentals, successful biological control will become even more important.

Petroleum oils appear to act on insect pests by "stifling" the eggs or larval stages, ie depriving them of oxygen. There may also be some direct toxic action when oils penetrate the insect cuticle (Martin, 1964). Eggs and pupae of whiteflies are particularly difficult to kill with most contact pesticides, but the oils give good results. Moreover, there appears to be no documented resistance as yet to petroleum oils.

The two IGR (insect growth regulator) materials used in these tests differed widely in their effectiveness against *Bemisia*. Nemolt (teflubenzuron) generally gave poor results, while Applaud (buprofezin) was effective on scales and gave some control of pupae, but was ineffective against the egg stage. The mode of action of these materials is to disrupt chitin synthesis, so only stages that are actively growing (ie shedding their skins) are normally affected. Tests in Japan have shown that Applaud is only effective against very young (1 day old) eggs (Yasui, 1985), a result confirmed by this work using eggs 5-6 days old.

The IGR's are best therefore used in a programme of two or three sprays, at least a week apart, to cover the susceptible life cycle stages.

The insecticidal soap (Savona) product tested was effective against scales and pupae, but less so against the egg stage. At 1% concentration, however, the phytotoxicity seen probably precludes its widespread usage on young cuttings. This type of damage to poinsettias has been seen with similar products in the USA and Canada (Matteoni and Steiner, 1991).

## 5. CONCLUSIONS

1. Petroleum oil at 0.5% concentration as a single dip gives excellent control of eggs, scales and pupae of *Bemisia tabaci*. This treatment could be of great value to growers to reduce any infestation on imported cuttings at an early stage.

2. Only one variety of poinsettia (Lilo) was tested. Before widespread commercial usage can be recommended, the product should be thoroughly tested on all the commercially available varieties of poinsettia.

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## PLATE 1

The Effect of dipping poinsettia cuttings

(variety Lilo) once in petroleum spraying

oil solution at 1.0%

## PLATE 2

"Bronzing" effect on leaf undersides of poinsettia

cuttings following one dip in Savona at 1%