Project HNS 15a
HARDY ORNAMENTAL NURSERY STOCK: CHEMICAL CONTROL OF VINE WEEVIL

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HNS15a

CHEMICAL CONTROL OF VINE WEEVIL

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ABSTRACT

The effectiveness and persistence over 3 seasons of 5 rates of Suscon Green was tested at 3 ADAS sites (Leeds, Reading and Wolverhampton) in two different types of composts. In year one of the trial, all rates of Suscon Green gave excellent control of vine weevil, but by years 2 and 3, differences were shown at several sites.

The lowest rate used, 37.5g a.i./m³ compost was still reasonably effective at Leeds after 3 seasons, but at the Reading site, the lower rates of 37.5 and 50g a.i./m³ were not as effective after this time. Rates of 75g a.i./m³ or above gave excellent control at all sites for the 3 seasons of the trial. Fonofos M.S. (Cudgel) worked well at Leeds and Wolverhampton, but gave poor results in each year at Reading. At the Wolverhampton site, untreated liners were potted into one litre pots for year 1 of the trial. Survival of vine weevil larvae was noted in all rates of Suscon Green, even as high as 150g a.i./m³. This is attributed to larval survival in the untreated core of compost, despite being potted up in treated compost. The result emphasises how important it is for vine weevil control to start right at the propagation stage in hardy nursery stock.

No phytotoxicity was seen at any time during these experiments.

There were indications that the presence of bark (at 25% by volume) in the compost increased the level of survival of vine weevil, but further work is needed to prove this.

INTRODUCTION

Vine weevil is a major pest of horticultural crops and, in the absence of control measures, losses of hardy ornamental plants are often considerable.

Until recently, excellent preventative control of the pest was achieved by routine incorporation of aldrin into the compost before use. This treatment was effective and virtually eliminated vine weevil from commercial nurseries, at very low cost. However, for environmental reasons, aldrin has now been withdrawn from the UK and throughout Europe.

For this reason, there was an urgent need for alternative insecticides to be evaluated for vine weevil control. Existing products such as slow-release fonofos (Cudgel) or carbofuran (Yaltox) can give control of vine weevil, but both have disadvantages. Fonofos is subject to the Poisons Rules and is classified as a Part II poison; and requires gloves to be worn when handling treated compost. This is a major obstacle to its commercial use. Yaltox granules can be applied as a surface treatment, but not to stock grown under protection. This is a disadvantage when the area of stock under protection is increasing rapidly in the UK.

The slow-release formulation of chlorpyrifos developed as a micro-granule by Incitec Limited (suSCon Green) appeared from previous MAFF-funded work to have great potential for use as a compost admixture against vine weevil. The formulation was designed to release active ingredient over a period of one or more years.

Therefore, a three year trial was set up with joint funding from HDC and Incitec Limited, to evaluate suSCon Green as an incorporated treatment for hardy nursery stock at three ADAS Centres.

The results of the three years of the study are reported here.

METHODS

Experiments were carried out at three ADAS Centres: Leeds, Reading and Wolverhampton. Host plants were *Cotoneaster horizontalis* at Leeds, *Euonymus alatus* at Wolverhampton and *Thuja plicata* at Reading. Bare-root plants were used at Leeds and Reading, while liner plants were used at Wolverhampton. One litre rigid plastic pots were used throughout for the first year of the experiment, except at Leeds, where the exceptional vigour of the *Cotoneaster* test plants meant that they had to be potted direct into 2 litre pots. Two different compost mixes were used at each site. Compost A consisted of peat and grit in the proportion 90:10, while Compost B consisted of peat/bark/grit in the proportion 65:25:10. Osmocote 12-14 month slow release fertiliser was incorporated into both composts at the rate of $4kg/m^3$. Insecticidal treatments applied at each site are detailed in Table 1. There were ten replicate pots per treatment.

Table 1 Insecticide treatments incorporated into compost May-June 1990

Treatment	Active Ingredient	Dose Rate ($g\ a.i./m^3$)
suSCon Green	100 g/kg chlorpyrifos	37.5
suSCon Green	100 g/kg chlorpyrifos	50
suSCon Green	100 g/kg chlorpyrifos	75
suSCon Green	100 g/kg chlorpyrifos	100
suSCon Green	100 g/kg chlorpyrifos	150
Cudgel	433/g/litre fonofos	43.3
Untreated	-	-

Insecticides were incorporated into the compost immediately before potting at all sites. Experiments were situated in open sided shelters with overhead irrigation at Leeds, in the open on irrigated sand beds at Reading, and in an open protected area with overhead irrigation at Wolverhampton. After inoculation with vine weevil eggs, plants were brought into the greenhouse, except at Leeds, where they remained outside in a protected area.

All plants were repotted into 3 litre pots (using freshly treated compost) at Leeds and Reading, between April and June 1991. However, at the Wolverhampton site, because the original liner plants had to be scrapped, the trial was restarted using bare-root *Chamaecyparis* plants(all remaining soil was washed off the plants before potting), potted direct into 3 litre pots in May 1991.

Table 2 shows the relevant dates of treatment, potting, egg inoculation and assessment at all sites.

Site	Year 1			Year 2			Year 3	
	Date of Potting	Eggs Inoculated	Assessment Date	Date of Potting	Eggs Inoculated	Assessment Date	Eggs Inoculated	Assessment date
Leeds	19/29 June 1990	27 Sept 1990 (30/pot)	April 1991	11 June 1991	6 Sept 1991 (30/pot)	10-14 Feb 1992	20 Aug 1992 30/pot	25-26 January 1993
Reading	4-8 May 1990	22 Aug (20/pot) + 17 Sept 1990 (20/pot)	Dec 1990-Jan 1991	April 1991	22 Aug (20/pot) + 29 Aug (20/pot) + 11 Oct 1991 (40/pot)	January 1992	14 July 1992 30/pot	17-22 Feb 1993
W'ton	25 June 1990	3-24 Aug 1990 (30/pot)	Nov-Dec 1990	13-14* May 1991	30 July - 14 August 1991 (30/pot)	Dec 1991-Jan 1992	6-18 May 1992 30/pot	26 August-10 September 1992

*New trial started at this site

Each plant was artificially infested with vine weevil eggs obtained from laboratory cultures. Vine weevil eggs were stored in small glass tubes containing a little moist compost. A shallow depression was scraped in the compost surface around each plant, the eggs were placed carefully in, and covered over to prevent desiccation. Only fully turgid, pale brown eggs were used. White eggs, or 'dimpled' eggs that may not have been viable were rejected.

In the first year of the trial, 30 eggs per pot were inoculated at Leeds and Wolverhampton, but at Reading 20 eggs per pot were inoculated on each of two occasions.

In the second year of the trial, again 30 eggs per pot were inoculated at Leeds and Wolverhampton, but at the Reading site there was some doubt about the viability of the eggs used initially. Therefore, all pots were inoculated with 20 eggs per pot on two dates in August, and another 40 eggs per pot in October 1991. In the third year, all sites used 30 eggs per pot applied during summer 1992. Table 2 shows the relevant dates for all three sites.

Assessments for surviving vine weevil larvae were carried out the following winter after inoculation (Table 2); at Leeds and Reading the compost was washed through a sieve and larvae then floated off in a saturated solution of Epsom Salts. At Wolverhampton, plants and compost were removed from the pots, compost carefully broken away and placed on a tray, where it was searched for vine weevil larvae.

RESULTS

The full records of assessment of individual plants are stored at Wolverhampton. Analysis of variance of the larval counts was not appropriate, firstly because many of the treatments were completely effective, and secondly because of the occurrence of zero values for individual replicates on some occasions even on untreated pots.

Mean larval counts for each treatment for the first year of the trial are shown in Table 3. At all three sites, survival of vine weevil larvae in untreated pots was greater when bark was present in the rates of 25% by volume. Survival of larvae in untreated pots as a percentage of the original number of eggs inoculated varied from a low of 7% to a high of 37%, which illustrates the difficulty of working with vine weevil in trials. Even using recently laid, turgid eggs, it is unusual to obtain survival rates of higher than 50% in this type of trial.

The suSCon green treatments were completely or almost completely effective at Leeds and Reading at rates at or above 75gm ai/m^3 compost. Fonofos slow-release (Cudgel) worked well at Leeds, but gave poor control at the Reading site.

The results from the Wolverhampton site in the first year of the trial showed little relationship to the dose of chlorpyrifos in the compost. This is almost certainly due to the fact that the *Euonymus* plants used at this site were liners grown in untreated compost. Even though the compost they were potted into was treated, vine weevil larvae survived in this 'reservoir' of untreated compost. At this site, the plants were scrapped and the trial started again with bare root plants of *Chamaecyparis*. The results do confirm however that good vine weevil control is impossible unless the liner compost is also treated with insecticides, as well as the final pot. Conversely, if the liner compost was treated, and plants were potted up in untreated compost, it is likely that weevil control would also be poor. However, this hypothesis has not been fully tested.

The suSCon green granule proved easy to use and its bright green colour was readily seen in the treated compost, enabling the grower to note whether it was evenly mixed or not. The commercially available formulation is a darker green, but it is still possible to tell whether it is evenly mixed into compost.

The microgranules (1,200 per gramme) active ingredient (chlorpyrifos) has a low water solubility but can be adsorbed onto organic matter. The weevil larva is killed either by direct contact with the pesticide residue, or by eating roots containing residues. Therefore even, thorough mixing of microgranules into the compost is vital for good control, because areas with no or poor granule distribution may allow weevil larvae to survive. The chlorpyrifos is released from the micro granules gradually, and as it degrades in the compost, new active ingredient is released to replenish its activity.

Results from the second year of the trial are shown in Table 4. At the Leeds site, all rates of suSCon green, and Cudgel, gave excellent control of vine weevil, and survival in untreated pots was up to 32% in a peat/bark mix, but only 9% in a peat/grit mix. The total, or almost total control even at the lower rates of suSCon (37.5gm and 50gm/m³) and Cudgel were surprising because, although freshly treated compost was used when potting up, the original 2 litre root ball contained insecticide that was over 12 months old.

Results from the Wolverhampton site also showed total control from all rates of suSCon, and excellent control from Cudgel, but this was not surprising as the trial was restarted at this site in 1991, and so the insecticide deposits were only 10-12 weeks old when eggs were put on. Survival of larvae was about 30% on untreated pots, and the type of compost had little effect on this percentage.

At the Reading site, the fact that eggs were inoculated on three occasions, making a total of 80 eggs per pot, seemed to have a major effect on the survival of weevil larvae. Rates of suSCon green at or above 75gm ai/m³ compost gave good control, but there was some survival. The two lowest rates of suSCon green (37.5 and 50gm ai/m³) gave only moderate control, and results were worst in the peat/grit rather than the peat/bark compost. The original insecticide residue (from the initial potting up in 1 litre pots) was 66-72 weeks old at the time of egg inoculation (Table 2). Cudgel gave very poor results in both types of compost at this site and appeared to have no persistence left after two seasons.

Results from assessments after the final season (year 3) are shown in Table 5. The plants used for these assessments had been originally repotted into treated compost between May and June 1991, and were inoculated with vine weevil eggs between May and August 1992. However, the original 1 litre root ball was by this time more than two years old.

All rates of suSCon Green still gave excellent control at the Leeds site, as did Cudgel. Results were similar at the Wolverhampton site, although here the trial was only in its second year (see Table 2). It was noticeable that Cudgel did not give as good results when bark was present in the compost.

At the Reading site, although only 30 vine weevil eggs per pot were inoculated, a mean of 46 larvae were recovered from untreated pots containing bark. This is due to contamination by "wild" vine weevil, at the experimental site, laying extra eggs on the pots. The "wild" population must have laid many eggs to cause this level of larvae, and therefore this represents a severe test for the insecticide treatments. There were generally higher numbers of weevil larvae where bark was present in the compost; but larvae survived in all rates of suSCon green in both composts at this site. However, control was still good at rates of suSCon green above 100 g a.i./m^3. Cudgel gave poor control in both composts, as it did the previous year at this site.

The Regional variation in results (Tables 3-5) was quite striking, with Leeds and Wolves giving similar levels of control but not at Reading. However, this is almost certainly not due to any climatic factor, but is due to the number of weevil eggs applied. Leeds and Wolves ADAS always used 30 eggs per pot, whereas at Reading, between 40 and 80 eggs were used, and in the final year 'wild' weevils laid extra eggs in the Reading trial.

CONCLUSIONS

1. SuSCon Green has been clearly shown to give excellent control of vine weevil for over two years providing the rate is at least 75 gm a.i./m³ of compost.

2. Cudgel gave good control for the first season at two sites, but results after this time were variable, and control at the Reading site was consistently poor.

3. Three seasons experience with suSCon green has shown no signs of phytotoxicity at the rates used (up to 150 gm. a.i./m³ compost) and has confirmed that the granules were easy to use and can be readily seen when incorporated into the compost.

4. Results from the trial at Wolverhampton showed that if untreated liners are potted into treated compost, large numbers of vine weevil larvae can survive in the original liner compost. Treatment of liners is therefore essential to good control of vine weevil in hardy ornamental nursery stock.

SUGGESTIONS FOR FURTHER RESEARCH

1. There is evidence from previous MAFF funded trials that if treated liners are potted up in untreated compost, vine weevil control is poor. However this should be evaluated further, as a means of reducing the cost of routine vine weevil control with suSCon green. The effect of using full rate of SuSCon in liners, but potting-on with reduced rates of product should also be checked. This work should include susceptible species of plant (eg Parthenocissus) and weevil resistant species (eg Pieris).

2. The effect of bark in the compost at rates of up to 25% by volume, and the effect of 'alternative' composts such as coir, on weevil survival and efficacy of suSCon green, should be investigated in a new series of trials. This work is now under way at the same three ADAS sites, with joint funding from HDC and Incitec Limited.

3. The effect of inert materials (such as rockwool) as compost admixtures on the effectiveness of suSCon green should be evaluated in further trials.

4. Work should also be done to evaluate the safety of SuSCon Green to seedlings and direct stuck cuttings, as well as checking its efficacy in modules.

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PUBLICATIONS ARISING FROM THIS PROJECT

BUXTON, J.H. (1992) Vine weevil control in nursery stock: development of suSCon Green. HDC Project News, Summer 1992, No.16, p.1

BUXTON, J.H. et al (1992) Control of vine weevil in containerised nursery stock with controlled release chlorpyrifos granules. Brighton Crop Protection Conference: Pest and Diseases - 1992, Vol.3 pp. 1229-1334.

FIRST YEAR'S RESULTS 1990-1991

Table 3 Mean number of larvae recorded per pot after artificial infestation with vine weevil eggs

Treatment	Leeds *Cotoneaster bullatus*		Wolverhampton *Euonymus alatus*		Reading *Thuja plicata*	
	A peat/grit	B peat/bark/grit	A peat/grit	B peat/bark/grit	A peat/grit	B peat/bark/grit
Interval (weeks) #	10		5-7		13-14	
No.of eggs inoculated per pot	30		30		20+20	
1. suSCon green (37.5g)*	0.3	0.5	2.7	2.9	0.5	0.9
2. suSCon green (50g)	1.2	0	0.2	2.4	0.2	0.6
3. suSCon green (75g)	0	0	0.5	2.6	0	0.3
4. suSCon green (100g)	0	0	0.4	1.6	0	0
5. suSCon green (150g)	0	0	0.6	0.6	0	0.1
6. Fonofos (43.3g)	0	0.1	0.9	1.7	3.0	1.2
7. Untreated -	8.9	11.1	2.1	9.7	4.4	5.4

interval between potting up and egg inoculation

* all rates in gm - a.i. per m^3 compost

SECOND YEAR'S RESULTS 1991-1992

Table 4 Mean number of vine weevil larvae recorded per pot after artificial infestation with vine weevil eggs*

Treatment	Leeds *Contoneaster bullatus*		Wolverhampton *Chamaecyparis*		Reading *Thuja plicata*	
	A peat/grit	B peat/bark/grit	A peat/grit	B peat/bark/grit	A peat/grit	B peat/bark/grit
Interval (weeks) #	61		11-13		66-72	
No.of eggs inoculated per pot	30		30		80	
1. suSCon green (37.5g)	0	0	0	0	6.1	2.6
2. suSCon green (50g)	0.1	0	0	0	3.4	1.8
3. suSCon green (75g)	0	0	0	0	0.4	1.0
4. suSCon green (100g)	0	0	0	0	2.1	0.6
5. suSCon green (150g)	0	0	0	0	0.0	0.4
6. Fonofos (43.3g)	0	0	0	0.1	16.8	15.3
7. Untreated -	2.8	9.5	9.7	10.3	21.6	16.3

* all plants repotted into freshly treated compost, except at Wolverhampton, where original 1990 plants were scrapped and the trial restarted using bare-root plants - see Table 2.

\# Interval between original potting and egg inoculation

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THIRD YEAR'S RESULTS 1992- 1993

Table 5 Mean number of vine weevil larvae recorded per pot after artificial infestation with vine weevil eggs

Treatment	**Leeds** *Contoneaster bullatus*		**Wolverhampton** *Chamaecyparis*		**Reading** *Thuja plicata*	
	A peat/grit	B peat/bark/grit	A peat/grit	B peat/bark/grit	A peat/grit	B peat/bark/grit
Interval (weeks) *	110		51-52		113	
No.of eggs inoculated per pot	30		30		30	
1. suSCon green (37.5g)	0	0	0	0	14.5	6.0
2. suSCon green (50g)	0.3	0	0	0	2.5	5.4
3. suSCon green (75g)	0	0	0	0	0.4	3.5
4. suSCon green (100g)	0	0.1	0	0	1.8	1.7
5. suSCon green (150g)	0	0	0	0	0.4	0.7
6. Fonofos (43.3g)	0	0.1	0.1	3.3	16.7	19.5
7. Untreated -	19.1	12.5	14.5	11.9	32.3	46.0

* interval between original potting up and egg inoculation

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