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Hardy nursery stock: Efficacy and persistence of suSCon Green against vine weevil in different growing media

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CONTRACT REPORT

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More growers are trying out peat-free media for nursery stock, and the performance of suSCon Green in these media needed to be evaluated. For this reason, a 3-year trial series was set up to check both efficacy and persistence of suscon in a range of media, such as woodfibre, coir and bark. The results showed that the type of media influenced vine weevil survival as well as affecting the efficacy of suSCon Green. Growers planning to use media such as woodfibre or woodfibre mixes will need to use slightly higher rates of suSCon to achieve the high levels of control given in normal peat or 75% peat/25% bark media.

Summary

Trials were carried out at 3 ADAS sites: Leeds, Reading and Wolverhampton. The growing media used in the work were all mixed at HRI Efford, and therefore were identical with the media used in the phytotoxicity work carried out by M Scott.

The following media were used:

a) Camlands woodfibre/vermiculite/pine bark mix (30%, 15%, 55% by volume respectively).
b) Mixed conifer bark and peat 50/50%.
c) Peat/pine bark 75/25%.
d) 100% coir.

In addition, a further range of media mixes were used at ADAS Wolverhampton, including various combinations of coir and peat. The test plants (*Thuja plicata*) were potted into 1 litre pots in year one of the trial, and then into 3 litre pots for the remaining 2 years. The following rates of suSCon Green were used:

a) 0)
b) 750) gm/m^3 media
c) 1000)
d) 1250)

Thorough mixing was carried out at HRI Efford and the bare root *Thuja plicata* potted direct into the various media types.

Vine weevil eggs were added (30 per pot) to the plants at various intervals of from 1-3 seasons after potting, to test the persistence and efficacy of suSCon.

Counts of surviving weevil larvae showed that media containing 100% coir, or a large percentage of coir, tended to have more larvae than other media, when no suSCon was present.

Control of vine weevil in the woodfibre medium was reduced in each year of the trial; on average the control varied from 60% in year 1 to 59% in year 3. By comparison, the percentage control in a standard peat/bark 75/25% mix (at the same rate of suSCon) was from 70% in year 1 to 95% in year 3.

The reduction in efficacy of suSCon in woodfibre was fairly constant; it did not increase dramatically by the last year of the trial. The reasons for this reduction in control are not known, but it is possible that the physical constituents of the woodfibre blocked diffusion of the active ingredient of suSCon Green (chlorpyrifos) from the microgranules.

Coir media on the whole gave good results with suSCon at all 3 ADAS sites; although the percentage control was slightly less than that in the standard peat/bark mix. However, because coir favours vine weevil survival, perhaps by allowing more fibrous roots to develop, it is recommended that at least 1000 gm of suSCon per m^3 is used in coir media.

Other media, such as the 50/50 peat/bark mixture, and various combinations of coir and peat, had no obvious effect on the efficacy and persistence of suSCon, and levels of control were acceptable.

Root weights of the test plants (*Thuja plicata*) tended to be heaviest when grown in coir, and usually lowest when grown in the woodfibre medium.

INTRODUCTION

Previous work funded by the HDC (HONS 15a) has evaluated the performance of suSCon Green in peat and peat/bark growing media, and determined the optimum rates of 750 and 1000 gm/m³ for each media respectively. It was noticed that the survival of vine weevil larvae tended to be greater when bark (at 25% by volume) was present in the media.

Because of the continuing development of peat substitutes, such as coir, wood fibre, etc, it was decided to initiate trials to evaluate the performance of suSCon Green in these new growing media.

The trial had two main objectives:

a. To assess the effect of new growing media on vine weevil survival.

b. To assess the effect of these media on the efficacy and persistence of suSCon Green.

The effect of growing media on the potential phytotoxicity of suSCon Green is being evaluated in a separate trial at HRI Efford (HNS 15b).

MATERIALS AND METHODS

The trial was scheduled to last for 3 years (1992-1995) and at 3 sites. (ADAS Leeds, Reading and Wolverhampton). Exactly the same experiment techniques were used at each site, and the growing media used were mixed at HRI Efford for both the efficacy work and the phytotoxicity work, thus ensuring standardisation.

The growing media used in the trial were:

a. Camlands woodfibre/vermiculite/pine bark mix (ready to use mix); in proportions of 30, 15, 55% respectively.

b. Mixed conifer bark and peat 50/50%*.

c. Peat/pine bark 75/25%.

d. 100% Sri Lankan coir (Wessex)

e. 75% coir/25% peat.

f. 50% coir/50% peat.

g. 25% coir/75% peat.

h. 100% Shamrock peat.

The full range of media was evaluated at Wolverhampton, but only the core media (a-d) were used at Reading and Leeds.

* In year 1 of the trial (1992-93), 100% mixed conifer bark was used, but this mix was not commercially practical. In year 2 (1993-94) plants were potted up in the mix b) as shown, and this mix was also used for the year 3 trials.

Bare-root *Thuja plicata* plants were potted up into 1 litre pots in year one of the trial. Some pots were inoculated with vine weevil eggs in year 1, while others were not treated, but potted on into 3 litre pots in year 2, using freshly treated compost. These plants in 3 litre pots were used in years 2 and 3 of the trial.

Ten replicates of each treatment were used, each pot being one replicate. Each type of growing media was tested at the following rates of suSCon Green.

a. Untreated
b. 750 gm/m^3
c. 1000 gm/m^3
d. 1250 gm/m^3

The suSCon Green was thoroughly and evenly incorporated into the growing media using the mixer at HRI Efford. Osmocote 12-14 months spring fertiliser was added to all the mixes at the rate of 6 kg/m^3.

The ADAS Centres involved in the trial each maintained a vine weevil colony. Mature (ie brown and fully turgid) eggs were obtained from the colonies normally between July and August, and 30 eggs were inoculated into each pot. The eggs were placed in a 1 cm deep, 5 cm long depression in the compost, and then carefully covered over.

Eggs were not placed in a pile on top of one another as this would have reduced the survival of the larvae. Treated plants were brought into a cool greenhouse until December or January, when surviving weevil larvae were large enough to be found easily.

Vine weevil numbers were then counted, either by carefully sorting through the compost in the laboratory, or by sieving and then floating off the larvae in a saturated solution of magnesium sulphate.

At intervals, plants were checked for signs of any phytotoxicity, such as leaf browning or lack of vigour. In the final year of the trial, root damage indices (RDIs) were calculated for weevil feeding damage, and then the dry root weights were calculated at some sites.

RESULTS

The calendar of events for the 3 years of the trial is shown in Table 1.

Table 1

Year	Site	Potting date	Date of egg inoculation#	Date of assessment
1992	Reading	1 May	24 July	5- 7 January 1993
	Wolverhampton	5 May	23 June - 14 August	3- 5 January 1993
	Leeds	29 May	19 August	11-13 January 1993
1993	Reading	16 April	13 August (20)*	13-17 December
			18 August (10)	
	Wolverhampton	5 April	27 July - 10 August	6-10 February 1994
	Leeds	7 May	18 August - 28 September	6-10 January 1994
1994	Reading	16 April	12 August	17-25 January 1995
	Wolverhampton	5 April	23 May - 10 June	21 December 1994 - 8 January 1995
	Leeds	7 May	20 July - 26 July	March 1995

* 20 eggs inoculated on 13 August; followed by 10 on 18 August.

\# Where eggs were inoculated over a period of several weeks, all the replicates in one block were treated with the same egg batch, to reduce experimental variation.

The survival of vine weevil larvae in untreated compost at each site is shown in Table 2.

Table 2

Type of growing media	Total vine weevil larvae per 10 pots											
	Year 1			Mean	Year 2*			Mean	Year 3			Mean
	Reading	Leeds	Wolves		Reading	Leeds	Wolves		Reading	Leeds	Wolves	
Hortifibre	113	11	17	47	103	0	49	76	162	7	47	72
100% mixed# bark	36	11	39	29	131	2	40	86	54	5	45	35
Peat/bark 75/25%	118	37	14	56	142	10	45	97	63	11	65	46.3
Coir 100%	115	28	58	67	186	23	76	131	72	30	119	73.7
Overall means	95.5	21.8	32.0	49.8	132.5	8.8	52.5	92.5	86.5	13.3	69	60.8

\# In year 2 this media changed from 100% bark to 50/50 peat/bark.

* Survival of vine weevil larvae at the Leeds site in Year 2 was very poor; these results are not included in the means for year 2.

Mean larval survival was better in year 2 than in year 1 of the trials (except at the Leeds site); this was presumably because the plants had been potted into 3 litre pots by year 2 and thus had a stronger and bigger fibrous root system; allowing more weevils larvae to successfully feed and mature. However, the plants remained in 3 litre pots for the third year of the trial, and larval survival actually decreased compared to year 2. (Table 2).

Recovery of mature larvae was always greatest at the Reading site, in all 3 years of the trial. In fact, there was a known "wild" weevil infestation at this site and there was certainly oviposition by these weevils in addition to the 30 eggs per pot inoculated each year. Survival of larvae was adequate at the Wolverhampton site, but at the Leeds site it was poor in each year. Considering that the environmental conditions in which the plants were kept were roughly similar, this discrepancy is surprising and disappointing. However, it underlines the importance of replicating vine weevil trials at more than one site if resources allow, in order to achieve an acceptable result.

The overall means for each growing media (Table 2) show that in all 3 years, the coir media allowed greater larval survival than any other media tested. In year 3, the Leeds site results, although overall survival was poor, show clearly the increased survival in 100% coir media. Since there is a trend towards the use of coir in propagation mixes, and in some liner mixes, this fact could be important for growers and means that vine weevil control in this media is an important priority.

The Hortifibre proprietary mix from Camlands (now Melcourt plc), containing vermiculite, bark, and a high percentage of wood fibres, supported fewer weevil larvae than the coir at all sites and in all years, although in year 3 the differences were minimal. Therefore, any reduction in effect of suSCon Green in the Hortifibre media would be unlikely to be due to increased larval survival.

Table 3 shows the mean number of vine weevil larvae per pot from each of the rates of suSCon and growing media tested. Statistical analysis of the results was not appropriate, because of the numbers of pots with zero larvae, even in the untreated pots.

Oviposition by the "wild" population tends to be random, with some pots having larger numbers of eggs laid on them than others. This may be the reason for the very high count (162 larvae from 10 pots) in the Hortifibre media in year 3 at Reading. Because this figure is so much higher than all the other media at this site, it is probably an aberration due to concentrated "wild" oviposition on these plants.

Table 3

Media type	Rate of suSCon Green	Mean larvae/pot Year 1				Mean larvae/pot Year 2*				Mean larvae/pot Year 3			
		Reading	Leeds	Wolves	Mean	Reading	Leeds#	Wolves	Mean	Reading	Leeds	Wolves	Mean
Woodfibre mix	0	11.3	1.1	1.7	4.7	10.3	0	4.9	7.6	18.0	0.7	4.7	7.2
	750	1.4	3.4	0.8	1.9	5.5	0.1	0.6	3.0	13.1	0.4	1.5	5.0
	1000	3.2	1.6	0.4	1.7	4.7	0.2	0.6	2.7	6.0	0.5	1.7	2.7
	1250	2.0	1.6	0.5	1.4	2.1	0.1	0.5	1.3	2.1	0.0	1.8	1.3
Mixed bark (Melcourt)*	0	3.6	1.1	3.9	2.9	13.1	0.2	4.0	8.6	5.4	0.5	4.5	3.5
	750	0.5	1.1	0.4	0.7	0.7	0.1	0.2	0.5	0.3	0	0.2	0.2
	1000	0.2	1.5	0.4	0.7	0	0	0.1	0	0.1	0	0.1	0.1
	1250	0.5	2.8	0.7	1.3	0	0.1	0	0	0.1	0	0.1	0.1
Peat/bark 75/25%	0	11.8	3.7	1.4	5.6	14.9	1.0	4.5	9.7	6.3	1.1	6.5	4.6
	750	0.2	0.8	0	0.3	0.4	0.1	0	0.2	0.4	0.2	0.4	0.3
	1000	0.5	0.1	0	0.2	0.2	0	0.2	0.1	0.7	0	0	0.2
	1250	0	0.1	0	0.03	0	0	0.1	0	0.1	0	0.1	0.1
Coir 100%	0	11.5	2.8	5.8	6.7	18.6	2.3	7.6	13.1	7.2	3.0	11.9	7.4
	750	4.6	1.3	0.1	2.0	11.7	0.1	0.8	6.3	1.5	0.1	0.7	0.8
	1000	1.1	0.9	0.1	0.7	3.3	0.1	0.7	2.0	3.2	0	0.5	1.2
	1250	0.5	0.5	0.1	0.4	4.7	0	0.1	2.4	1.3	0	0.5	0.6

\# Leeds results for year 2 not included, in the mean figure as survival was poor.
* Mean of 10 pots per treatment.

Table 4 shows the mean percentage control from each rate of suSCon Green.

Table 4

Media type	Rate of suSCon (gm/m^3)	Mean % control of vine weevil		
		Year 1	Year 2	Year 3
Hortifibre	750	60	72	59
	1000	64	74	73
	1250	70	85	85
Mixed bark 100% (year 1) Bark/peat 50/50 (year 2)	750	76	95	95
	1000	76	100	97
	1250	55	100	97
Peat/pine bark 75/25	750	95	98	94
	1000	96	100	96
	1250	99	100	96
Coir 100%	750	70	68	90
	1000	90	87	86
	1250	94	84	92

The results in Tables 3 and 4 show that all rates of suScon Green were still maintaining control of vine weevil after 3 seasons. By the time of the last assessments, the one litre "core" of the pots contained suSCon that was 3 years old, while the remaining compost had 2 year old residues of suSCon. Overall means (Table 4) show that the Hortifibre (Woodfibre mix) media did reduce the effectiveness of suSCon, especially at the lowest rate (750 gm/m^3) when only 59% control was given in year 3. Even at the highest rate, which is 25% greater than the highest label rate of 1000 gm/m^3, only 85% control was achieved. This confirms the trend shown by the previous year's results, and indicate that the woodfibre reduces the efficacy of suSCon in some way. At the Reading site, where pressure from vine weevil was high due to a "wild" population ovipositing on the plants, the reduction in effectiveness of suSCon in Hortifibre was most marked (Table 3). The 750 gm/m^3 rate only gave 58% control in this media in year 3 at Reading. However, the persistence of insecticidal effect was not reduced overall in year 3; the reduction in effect (compared to other media) was fairly consistent.

Other media did not have as marked an effect on the persistence or efficacy of suSCon Green, and levels of control were good in year 3 with all the other media (Table 4), although as previously mentioned, coir tends to favour the survival of vine weevil to a higher degree than other growing media when no insecticide is present.

At the time of larval assessments, the roots of each *Thuja plicata* plant were washed clean of compost and then scored for weevil feeding damage on a 0-3 scale as follows:

0 = No sign of larval feeding

1 = Slight: a few small areas of damage to the main stem with no obvious reduction in the lateral root system.

2 = Moderate: discrete areas of damage on the main stem and a slight reduction in the size of the lateral root system.

3 = Severe: extensive feeding damage girdling the main stem and a significant reduction in the lateral root system.

The mean scores for 2 sites in year 3 are shown in Table 5.

Table 5

Growing media	Rate of suSCon (gm/m^3)	Mean root damage index		Overall mean
		Leeds	Wolves	
Hortifibre	0	3.0	2.2	2.6
	750	1.8	0.6	1.2
	1000	1.0	1.2	1.1
	1250	0.7	1.4	1.1
Conifer bark	0	2.8	2.2	2.5
	750	1.0	0.3	0.7
	1000	1.2	0.2	0.7
	1250	1.0	0.3	0.7
Peat/bark	0	3.0	1.9	2.5
	750	1.0	0.6	0.8
	1000	1.2	0.0	0.6
	1250	1.5	0.1	0.8
Coir	0	2.1	1.5	1.8
	750	1.6	0.7	1.2
	1000	0.8	1.2	1.0
	1250	1.0	1.0	1.0

The results from scores were somewhat variable, but overall means show that the root damage score tended to be higher in the Hortifibre media and the coir media than mixed bark or peat/bark media, at all rates of suSCon used. In some cases, even though no vine weevil larvae were found at assessment, there was still obvious root damage from larval feeding. The time between egg inoculation and assessment was not long enough to allow larvae to pupate, so the likely cause of larval death was waterlogging. When many of the fibrous roots have been eaten, the compost may stay wet for long periods, yet the *Thuja plicata* test plants show no obvious symptoms of distress. Weevil larvae then die and rot away, leaving no trace except for damaged roots.

At the Leeds site, the dry weight of roots in year 2 was calculated by cutting off the roots at compost level and drying for 16 hours at 102°C. The results are shown on Table 6.

Table 6

Mean dry root weights (g) of *Thuja plicata*

Growing media	Rate of SuSCon Green				Mean +
	0	750	1000	1250	
Woodfibre	1.03	0.55	1.57	2.67	1.46 a*
Conifer bark	0.61	3.30	2.73	3.33	2.49 b
Peat/bark	1.26	2.93	2.23	2.43	2.21 b
Coir	0.62	3.45	3.82	4.26	3.04 b
Mean	0.88a	2.56b	2.59b	3.17b	-

\+ All means are expressed as weight of roots in grams. Data were transformed to the form $\log_{10}(x^{+1})$ before statistical analysis.

* Means followed by the same letter are not statistically signficant (Duncan's Multiple Range test; P = 0.05).

Incorporation of suSCon Green gave a significant increase in root dry weights; compared to untreated media. The plants grown in woodfibre media were significantly lighter than plants grown in any of the other media. Coir grown plants had the heaviest roots on average, but the differences between coir and peat/bark or conifer bark media were not significant.

The increase in numbers of vine weevil larvae recovered from coir may be directly due to the larger root mass; this would agree with the conclusion of Blackshaw and Thompson (1993), who found that incorporation of bark into the growing media increased root weights and led to higher numbers of weevil larvae surviving.

Table 7

Results of dry root weight determinations at the Reading site in year 3 are shown in Table 7.

Growing media	Rate of suSCon (gm/m^a)	Mean dry weight of roots (in grams)*
Hortifibre	0	48.2
	750	30.5
	1000	38.9
	1250	31.6
Mean		37.3
Conifer bark	0	22.8
	750	43.1
	1000	35.1
	1250	52.9
Mean		38.5
Peat/bark	0	17.0
	750	71.1
	1000	53.4
	1250	51.6
Mean		48.3
Coir	0	27.6
	750	50.6
	1000	51.5
	1250	66.5
Mean		49.1

* Data were transformed to the form $\log_{10}$ before analysis.

Statistical analysis of these results showed that there were significant differences (P = 0.01) between the dry weight of roots from different growing media. There were also significant differences (P = 0.001) between root weights from the different rates of SuSCon Green. The interaction between rate of SuSCon and type of growing media was also highly significant (P <0.001). Standard errors of the mean values (SEMs) for both media type and rate of suSCon were 0.0309. (119 residual degrees of freedom).

The results show that, for most of the media tested, the incorporation of suSCon Green led to a significant increase in root dry weights, compared to the untreated plants. However, root dry weights in the Hortifibre medium decreased when suSCon Green was incorporated (Table 7) although the differences were not significant. This may also indicate that the product does not control vine weevil feeding as well in this media as in 'normal' media, such as peat/bark. Root dry weights were again highest in the coir media.

At some ADAS sites, vine weevils were graded by size into either small, medium or large larvae when the counts were made. The stage of development of larvae obviously depends on the time interval between egg inoculation and assessment, and the ambient temperatures.

Table 1 showed the relevant dates at each site. Analysis of the larval size from year 3 counts at Reading are shown in Table 8; eggs were inoculated at this site in August 1995. Counts from untreated pots only.

Table 8

% of larvae in each category	Woodfibre	Conifer bark	Peat/bark	Coir
Small	56	2	32	9
Medium	14	16	18	11
Large	30	82	50	80

In year 2 of the trial, the same analysis of larval size was made. The results from the Leeds site are shown in Table 9.

Table 9

% of larvae in each category	Woodfibre	Conifer bark 50/50	Peat/bark 75/25	Coir
Small	6	26	27	11
Medium	68	62	67	49
Large	26	12	6	40

The results from Table 8 and 9 are not directly comparable, because they cover different years and different sites. However, the counts at Leeds indicate that the coir media had a greater percentage of larger larvae present, than the peat/bark media. Statistical analysis of this aspect was not possible, again because of the number of pots with zero counts of large larvae. Coir also favours greater survival of the weevil compared to other media (see Table 2). Both these aspects need further detailed investigation, as the mechanism underlying these differences is not known.

OTHER GROWING MEDIA

The full range of media, as opposed to the 'core' media, were tested at Wolverhampton. Table 10 shows the mean numbers of weevil larvae per pot for each media at this site.

Table 10

Media type	Rate of suSCon (gm/m³)	Mean No of larvae per pot			Mean	Mean % control
		Year 1	Year 2	Year 3		
Woodfibre	0	1.7	4.9	4.7	3.8	-
	750	0.8	0.6	1.5	1.0	79
	1000	0.4	0.6	1.7	0.9	80
	1250	0.5	0.5	1.8	0.9	80
100% bark +	0	3.9	4.0	4.5	4.1	-
	750	0.4	0.2	2.0	0.9	82
50/50 peat/bark	1000	0.4	0.1	1.0	0.5	89
	1250	0.7	0	1.0	0.6	88
Peat/bark	0	1.4	4.5	6.5	4.1	-
75/25	750	0	0	0.7	0.2	95
	1000	0	0.2	0.5	0.2	95
	1250	0	0.1	0.5	0.2	95
Coir 100%	0	5.8	7.6	11.9	8.4	-
	750	0.1	0.8	0.4	0.4	95
	1000	0.1	0.7	0	0.3	97
	1250	0.1	0.1	0.1	0.1	99
Coir/peat	0	2.6	9.1	8.6	6.8	-
75/25	750	0	0.8	0.2	0.3	96
	1000	0	0.3	0.2	0.2	97
	1250	0	0.8	0.3	0.4	95
Coir/peat	0	2.0	5.2	6.7	4.6	-
50/50	750	0	0.2	0.1	0.1	98
	1000	0	0	0.1	0.0	100
	1250	0	0	0	0	100
Coir/peat	0	1.0	8.2	5.3	4.8	-
25/75	750	0	0.1	0.4	0.2	96
	1000	0	0	0.1	0	100
	1250	0	0.2	0.1	0.1	98
Peat 100%	0	4.1	3.6	9.4	5.7	-
	750	0	0.1	0.2	0.1	98
	1000	0	0	0	0	100
	1250	0	0	0.2	0.1	98

100% bark media used in year 1; in year 2 plants were potted on using a 50/50 bark/peat mixture.

The means for the 3 years of the trial show that, at the Wolverhampton site, the coir media gave the highest survival of vine weevil larvae on untreated pots (mean of 28% survival from 30 eggs inoculated per pot.) This confirms the data from the Leeds and Reading sites. Percentage control of vine weevil was very good from all rates of suSCon Green in most media, even in the final trial year when the 'core' of compost was 3 seasons old. However, there was an obvious reduction in control in the Woodfibre media. All other media, including coir and all the coir/peat combinations used, gave good results with suSCon Green when incorporated before potting up.

The analysis of each growing media is shown in Table 11.

Table 11

Analysis of media used in the trial

Lab sample No and identification	pH	% organic matter	Phosphorus mg/l (index)	Potassium mg/l (index)	Magnesium mg/l (index)	Conduct µS (index)	Nitrate mg/l N (index)	Ammonium mg/l N (index)
95101510 T1-4 Wood Fibre	4.3	53.6	162 (9)	593 (6)	185 (8)	1019 (7)	432 (7)	125 (3)
95101509 T5-8 Conifer Bark	4.0	53.2	184 (9)	528 (6)	117 (7)	964 (7)	318 (7)	197 (4)
95101511 T9-12 Peat/Bark	4.0	53.0	270 (9)	799 (7)	186 (8)	1429 (9)	458 (7)	291 (5)
95101512 T13-16 Coir	4.1	44.1	246 (9)	578 (6)	150 (7)	1008 (7)	335 (7)	163 (4)

Analysis of the media used in the trial showed only minor differences in aspects such as pH, conductivity, etc. The wood fibre medium had the highest percentage of organic matter, and coir the lowest; but this is unlikely to explain the effect of woodfibre on the performance of suSCon Green, as conifer bark and peat/bark had only slightly lower levels of organic matter.

DISCUSSION

The different growing media can affect the end result of these trials in one or two ways: either by influencing the survival of larvae, or by affecting the performance of the incorporated insecticide. Both of these factors appear to be involved in these results.

In this work, a range of media were used, including wood fibre, bark, peat and coir, and various combinations of each. The most marked reductions in effectiveness of suSCon Green were found in the media based on woodfibre. The percentage control of vine weevil using rates of suSCon Green of 750 and 1000 gm/m³ varied from 59 to 74% whereas in a peat or peat/25% bark media, 95% control or greater was normally obtained.

Although the woodfibre decreased the % control of vine weevil larvae, the persistence of suSCon did not appear to be significantly reduced. The results in year 3 showed a level of control roughly the same as the previous year, so there was no dramatic reduction in effect.

Nielsen and Roth (1985) found that the type of growing media had a significant effect on mortality of larval vine weevil even when no insecticide was present. Also, growing media containing hardwood (form not specified) tended to reduce the effectiveness of bendiocarb when compared to certain peat media.

The constituents of the Hortifibre mix were listed on page 1, and one of the major constituents by volume is woodfibre; believed to be shredded soft woodfibres. More recent work in the USA has confirmed that media with a high percentage of mixed wood fibres can significantly reduce the effectiveness of suSCon Green (Nielsen, personal communication). Why these media have this effect is not known, but it may well be a physical effect, with the woodfibres preventing or reducing the movement of chlorpyrifos (the active ingredient in suSCon Green) in the pore spaces.

Nielsen and Boggs (1985) found that a range of insecticides were less effective against vine weevil larvae in a 'muck' soil, containing 25% organic matter, than in a loam or sandy soil. The age, or state of decomposition, or organic matter may also have an effect, as Harris (1966) found that well decomposed (old) peat deactivated insecticides more rapidly than young peats. The word "peat" of course is used to cover a range of materials that are not identical in composition (Bragg, personal communication).

Moorhouse *et al* (1993) confirmed that peat based media allowed significantly greater survival of vine weevil larvae than field soil, and the performance of the pathogenic fungus *Metarhizium anisopliae* was significantly reduced in peat.

All these results do not, however, indicate exactly which mechanisms are causing the observed effects. Our results in this trial show that the woodfibre media reduces the performance of suSCon Green in some way, either by adsorption, or by a physical affect of shielding larvae from the insecticide diffusing out from the microgranules. Similarly, more weevil larvae were recovered from coir media than the others. This may be due to the physical constituents of this medium. Total pore space of coir is quoted as 96.1% (Anon, 1992) whereas for peat the figure is 92-95%. It is possible that the young vine weevil larvae can move more easily through the coir medium to find the fibrous roots; however this is purely speculative at present. In previous trial work, plants in coir media had significantly heavier roots, and this may support more vine weevil larvae.

Growing media with bark at up to 25% by volume have been shown in previous ADAS trials to increase vine weevil survival compared to purely peat based media. Blackshaw and Thompson (1993) also reported that the numbers of weevil larvae recovered increased with higher ratios of bark to peat in growing media. Interestingly, Blackshaw found that the smaller bark fractions were most effective; large (4.75 to 9 mm) bark particles supported significantly fewer larvae. The results of the present trial show that, even in 100% bark media (year 1), suSCon Green can give acceptable control of vine weevil. An analysis of the particle size of the media is not available (Melcourt proprietary mix) but it did consist of a mix of sizes from small to large. This media proved exceptionally difficult to manage, as it dried out very quickly after being watered, and plant growth was poor. This is why a 50/50 peat/bark mix was used when the plant were potted on in year 2. Results in Table 4 show that vine weevil control in this media with suSCon Green was acceptable.

Trials at HRI Efford have shown that woodfibre mixes can give excellent results for a range of HNS subjects; with plant quality almost as good as the standard peat/bark mix. Therefore it is likely that the industry will take up these mixes on an increasing scale in the future. As vine weevil control continues to be a priority for the industry, then the reduction in effectiveness of suSCon Green in Hortifibre must be borne in mind. Whether other woodfibre-type mixes would have the same effect as the Camlands mix used in this trial series is not known, but such a reduction is likely. Because the level of vine weevil control demanded by the industry is so high, (even one larva can kill an evergreen azalea!), it is suggested that 1000 gm of suSCon Green per cubic metre is the minimum rate needed in woodfibre mixes, and possibly up to 1250 gm per cubic metre.

Coir is more expensive than peat; its quality and continuity of supply is not guaranteed, and its main use in the future seems to be as a mix with bark in propagation of HNS subjects, especially in modules. The effectiveness of suSCon Green in this situation has been evaluated in a separate trial jointly funded by the HDC and Crop Care/Fargro Ltd.

Apart from the media already mentioned, all the other media or media combinations, such as peat/bark, bark alone, or coir/peat mixes gave satisfactory results with suSCon Green.

The results in the final year of the trial series confirmed that suSCon Green at all rates give over 90% control of vine weevil after 3 seasons, except in the Hortifibre media where a reduction in effect was observed.

CONCLUSIONS

1. Coir has an effect on vine weevil survival; it allows more larvae to survive and mature than many other media. Therefore, growers using coir should ensure they have a sound vine weevil control strategy in place.

2. Hortifibre, (and probably other wood fibre - based mixes) reduce the effectiveness of suSCon Green. A minimum of 1 kg and probably 1.25 kg of suSCon per m^3 of media is needed for acceptable control.

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