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Final Report on Rose, Salix and Acer Midge Trials in British Columbia 2004
CNLA IPM Research Project # 2004-05

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EXECUTIVE SUMMARY:

Rosa spp., *Acer circinatum* (vine maple) and *Salix lasiandra* (Pacific willow) flush out new flower and leaf buds on a continual basis throughout the growing season and the three midge species affecting these crops have multiple generations that cycle continuously throughout the growing season also. In 2003 and 2004, adult rose midge fly catches on yellow sticky traps peaked approximately every two weeks with major peaks in late July-early August and again in early-mid September. Adult *Acer* midge emergence peaked in mid-June and the *Salix* midge in mid-July.

Adult trap catch was not correlated with crop damage in untreated check plots. A small number of adult midges can cause high level of bud injury. Perhaps because one female midge may lay eggs in more than one bud and a single bud may be visited by more than one ovipositing female. None of the insecticide treatments demonstrated a commercially acceptable level of control. Imidacloprid (Intercept 60WP and Merit G) and the high rate of acetamiprid (Tristar 70 WSP at 0.16 g/L) suppressed maggot damage somewhat in all three crops. Two applications of Merit 0.5 G in May and August were more effective than bi-weekly drenches with Intercept 60WP. In *Acer circinatum*, both midge maggots and thrips were often found in the same damaged leaf. Thrips were also observed in *Rosa* buds affected by midge. This demonstrates the need for a combined management program for both midge and thrips in these crops.

It is recommended that combined treatments be assessed, such as alternating treatments with products like Merit G, Intercept 60WP and Tristar, which show some ability to reduce crop injury, perhaps with predatory nematodes such as *Heterorhabditis* sp. (Nemasys H) which may attack pupating larvae in the soil. Although spinosad was ineffective in 2003, there may be other products, such as Avid (abamectin) or newer "reduced-risk" insecticides not yet registered in Canada such as buprofezin (Talus), dinotefuran (Safari) or pyriproxyfen (Distance) that could be evaluated also. In hybrid roses, further work is also needed to identify resistant cultivars, some of which were found in 2003.

Adult midges of all three species were sent to the Biosystematics Laboratory in Ottawa for identification in 2003. Results are pending. The *Acer circinatum* (vine maple) midge appeared for the first time in BC nurseries in 2003 and has not previously been identified in the Pacific Northwest. Its ability to infest other maple species is not yet known.

Introduction:

Rose midge (*Dasineura rhodophaga*) has been an increasing pest of nursery grown roses in the BC Fraser Valley and Ontario in recent years. The maggots feed in developing shoot tips and flower buds, which turn black, shrivel and die. Rose midge is primarily a pest of outdoor-grown roses, where both soil-grown and container stock is affected, but has been known to do considerable damage to greenhouse plants also.

Affected plants produce few or no blooms and are unmarketable. The midge may be spread with infested plants as larvae or pupae in container soil. A similar midge causes severe damage to *Salix lasiandra* (Pacific willow), a nursery-grown ornamental plant native to the Pacific Northwest and is suspected to be a different genus or species. During the course of this trial, another midge was found to be affecting container-grown *Acer circinatum* (vine maple), a common ornamental plant also native to the Pacific Northwest. Other species of midges attack daylilies and highbush (cultivated) blueberries and cranberries in British Columbia (cranberry tipworm) and lupines in California.

The rose midge has several generations per year, from May to October. The tiny midge fly lays eggs in unopened flower and leaf buds, where maggots then hatch and feed for about one week before dropping to the soil to pupate. Buds infested with maggots become swollen and distorted, then turn black, shrivel and drop. Rose midge has several generations per year and overwinters as a pupa in the soil.

Each generation cycles every 5 to 10 days, with timing influenced by soil temperature. An earlier project in 2003 funded by the CNLA[1], suggests that larvae can pupate and be transmitted in container media in nursery-grown stock where containers are placed on ground cloth. The project found that while adult rose midges emerge in May and June in BC, maggot damage is not seen in roses until the peak emergence flight in July. Plant damage was then continuous in 2003, with a second peak adult emergence in early August. Emergence continued until the end of September in 2003.

The 2003 project found that midge damage to Pacific willow (*Salix lasiandra*) in BC occurs earlier, in early to mid-June, and is probably caused by a different species or

genus of midge. Both life cycle and morphological differences were observed between the rose and willow midge, which suggests these are different species, or genera. A third midge species or genus was found causing severe late summer damage to vine maple (*Acer circinatum*) in BC also.

There is a need for new management tools for these pests. The only insecticide specifically registered in Canada for rose midge is ORTHENE (acephate) but growers have been experiencing poor control with this product in recent years as midge has become more common and widespread. Diazinon and endosulfan are sometimes used also, but the level of control is uncertain with these products and these insecticides have a relatively highly mammalian toxicity and impact on beneficials. Diazinon may soon be unavailable for use in Canada. In the earlier 2003 project, imidacloprid (MERIT 0.5 G; ADMIRE 240 foliar and INTERCEPT liquid soil drench) and spinosad (SUCCESS) were evaluated in foliar and soil application and compared to an alternating spray program of endosulfan (THIODAN) and ORTHENE for reduction of maggot damage to buds. Only MERIT 0.5 G applied as a granular to the soil surface and watered-in when maggots were first observed in rose buds in early July, provided an acceptable level of control.[1] TRISTAR (acetamiprid) is registered for control of leafminers and some other insects on ornamentals and is a potential control product for midge, as is ACTARA (thiamethoxam). Some rose growers in the U.S. have reported good control with predatory nematodes also.

The 2003 project found that yellow sticky traps could be used for monitoring adult emergence in research studies, but were not practical for use by growers due to the large number of very similar insects caught on the traps. The project also found that the best method for evaluating crop damage and efficacy of treatments was counting the number of infested buds per plot. Infested buds were easily detected by the distortion and discolouration caused by maggot infestation. Since all of these crops produce new flower and leaf buds continuously throughout the growing season, infested buds were removed at each weekly count. Depending on the crop and varieties in the trial, the most practical method of measuring crop injury was either the percentage of infested buds versus total buds (where there were different varieties in each plot), or the total number of infested buds per plot area (for container stock of identical age and variety/species).

Objectives:

1. Evaluate the effectiveness of imidacloprid (Merit 0.5 G), acetamiprid (TRISTAR), ACTARA (thiamethoxam) and predatory soil nematodes (NEMASYS) for control of rose, willow and vine maple midge and develop integrated pest management program (IPM) recommendations for control of these midges.
2. Repeat trapping studies of adult emergence for a second year to establish the timing of peak adult emergence and relate to crop injury levels.
3. Develop an understanding of the life cycle and timing of vine maple midge in British Columbia.

Methodology:

Life Cycle and Emergence: Four yellow sticky card traps were placed 5 to 20 cm above the ground in container pot in check plots not treated with insecticide and the number of adult midges collected on traps was counted weekly from May to November.

Insecticide Trials: Four trials were conducted at two commercial nurseries in Langley, BC in susceptible crops where midge damage had been observed in previous years.

Trial 1: Nursery A: Crop = *Rosa* sp. hybrid mini-climber cv. 'Chew Pope' in one gallon (6 inch diameter) containers; completely randomized (CR) design with 8 pots per treatment.

Trial 2: Nursery B: *Rosa nutkana* (native wild rose) in one gallon (6 inch diameter) containers; completely randomized (CR) design with 8 pots per treatment.

Trial 3: Nursery B: *Salix lasiandra* (Pacific willow) in two gallon (9 inch diameter) containers; randomized complete block (RBC) design with four replicates per treatment and 12 pots per plot. Each plot was separated by a one metre fallow zone.

Trial 4: Nursery B: *Acer circinatum* (vine maple) in two gallon (9 inch diameter) containers; randomized complete block (RBC) design with four replicates per treatment and 12 pots per treatment. Each plot was separated by a one metre fallow zone.

Materials: Actara 25WG (25 % thiamethoxam); Intercept 60WP (60 % imidacloprid); Merit 0.5 G (0.5 % imidacloprid); Orthene T & O (75 % acephate); Tristar 70 WSP (70.35% acetamiprid). Predatory nematodes were unavailable at the time of the trial.

Foliar sprays and liquid soil drenches were applied with a CO_2 backpack sprayer at 320 kPa (40 psi) every 14 days in 500 mL water per plot (12 pots) in *Acer* and *Salix* and 250 mL water per treatment (8 pots) in *Rosa*. Intercept liquid soil drench was applied in 200 mL water per pot in *Acer* and *Rosa* and 300 mL water per pot in *Salix* (much larger plants). All treatments were begun on May 13; June 8 for hybrid *Rosa*. Merit 0.5 G was sprinkled on the pot surface with a hand-applicator and watered in after application once at the start of the trial (May 13; June 8 for hybrid *Rosa*) and a second time on August 3-4.

***ACER/SALIX*:**

Treatment	Application	Rate/1000 L/ha	Amt. Product/L
1. UTC			
2. MERIT 0.5 G	soil surface	670 g/100 m2	4.22 g/0.63 m^2 = 0.35 g/pot
3. ACTARA 25WG	foliar	200 g/ha	0.0126g/0.63m^2= 0.025 g/L
4. TRISTAR 70 WSP	foliar	3 pks x 16 g/pk	0.048 g/L
5. TRISTAR 70 WSP	foliar	5 pks x 16 g/pk	0.08 g/L
6. TRISTAR 70 WSP	foliar	10 pks x 16 g/pk	0.16 g/L
7. ORTHENE T & 0	foliar	850 g	0.85 g/L
8. INTERCEPT 60WP	soil drench	100g/2250 pots	0.533g/12 pots
			Apply in 200 mL water/pot (***Acer***)
			Apply in 300 mL water/pot (***Salix***)

***ROSA*:**

Treatment	Application	Rate/1000 L/ha	Amt. Product/Treatment

1. UTC			
2. MERIT 0.5 G	soil surface	670 g/100 m2	2.412 g/0.36 m^2 = 0.30 g/pot
3. ACTARA 25WG	foliar	200 g/ha	0.0072 g/0.36 m^2/250 mL
4. TRISTAR 70 WSP	foliar	3 pks x 16 g/pk	0.012 g/250 mL
5. TRISTAR 70 WSP	foliar	5 pks x 16 g/pk	0.02 g/250 mL
6. TRISTAR 70 WSP	foliar	10 pks x 16 g/pk	0.04 g/250 mL
7. ORTHENE T & 0	foliar	850 g	0.21 g/250 mL
8. INTERCEPT 60WP	soil drench	100g/3250 pots	0.25 g/8 pots in 1.6 L water

Evaluation:

Life Cycle and Emergence: The number of adult midge flies was counted on four yellow sticky traps in the check plots on a weekly basis and an average number of midges per trap week calculated. Peak emergence over time was compared in 2003 and 2004. Weekly adult midge trap counts in 2004 were compared to bi-weekly crop injury levels in untreated check plots (mean number of affected buds per plot).

Insecticide Trials: Treatment efficacy was evaluated bi-weekly by counting the number of midge-damaged buds per plot, before treatments were applied. Affected buds were removed at each evaluation. In *Rosa,* both vegetative and flower buds were counted. In *Acer* all buds with symptoms of midge injury such as swelling, distortion or discolouration were opened and the number of buds containing maggots was counted also. For *Acer* and *Salix,* Plant Quality was rated visually for each plot bi-weekly on a relative scale of 1 to 9, where 1 = best and 9 = worst, based on overall plant growth and the relative proportion of healthy new leaves and shoots. All treatments were evaluated for symptoms of phytotoxicity. Statistical analysis (ANOVA) was performed using CoStat Version 6.204, 2003, CoHort Software, Monterey, California, USA, Copyright © 1998-2003.

RESULTS:

Monitoring and Life Cycle: *Rosa* spp., *Acer circinatum* and *Salix lasiandra* flush out new flower and leaf buds continuously throughout the growing season and the three midge species affecting these crops have multiple generations that cycle continuously throughout the growing season also. Weather in spring/summer 2003 and 2004 in the BC Lower Mainland was unusually hot and dry. The number of adult rose midges trapped per calendar week in untreated check plants was variable from 2003 to 2004 (Figure 1). However, there was an overall pattern of small emergence peaks about every two weeks in mid-May, mid-June and mid-July followed by two major peaks: one in late July-early August and one in early-mid Sept. *Acer* and *Salix* midges demonstrated a more gradual pattern of adult emergence (data from 2004 only) with the *Acer* midge peaking in mid-June and the *Salix* midge in mid-July (Figures 3 and 4). Adult trap catches were not a good indicator of plant bud damage in untreated check plots (Figures 2-4). In *A. circinatum* there was little correlation between the number of buds containing maggots (biweekly count) and the number of damaged buds per plot in any treatment (Figure 6 and Table 7). Only about 20 % of damaged buds contained midge maggots. *A. circinatum* was also damaged by thrips. However, in each of the *Rosa* crops and *Salix* the number of buds containing maggots counted on at least two evaluation dates (data not shown) showed a similar average of 20% maggot-infested buds.

Figure 1: Mean No. of Adult Rose Midges Trapped in 2003 and 2004.

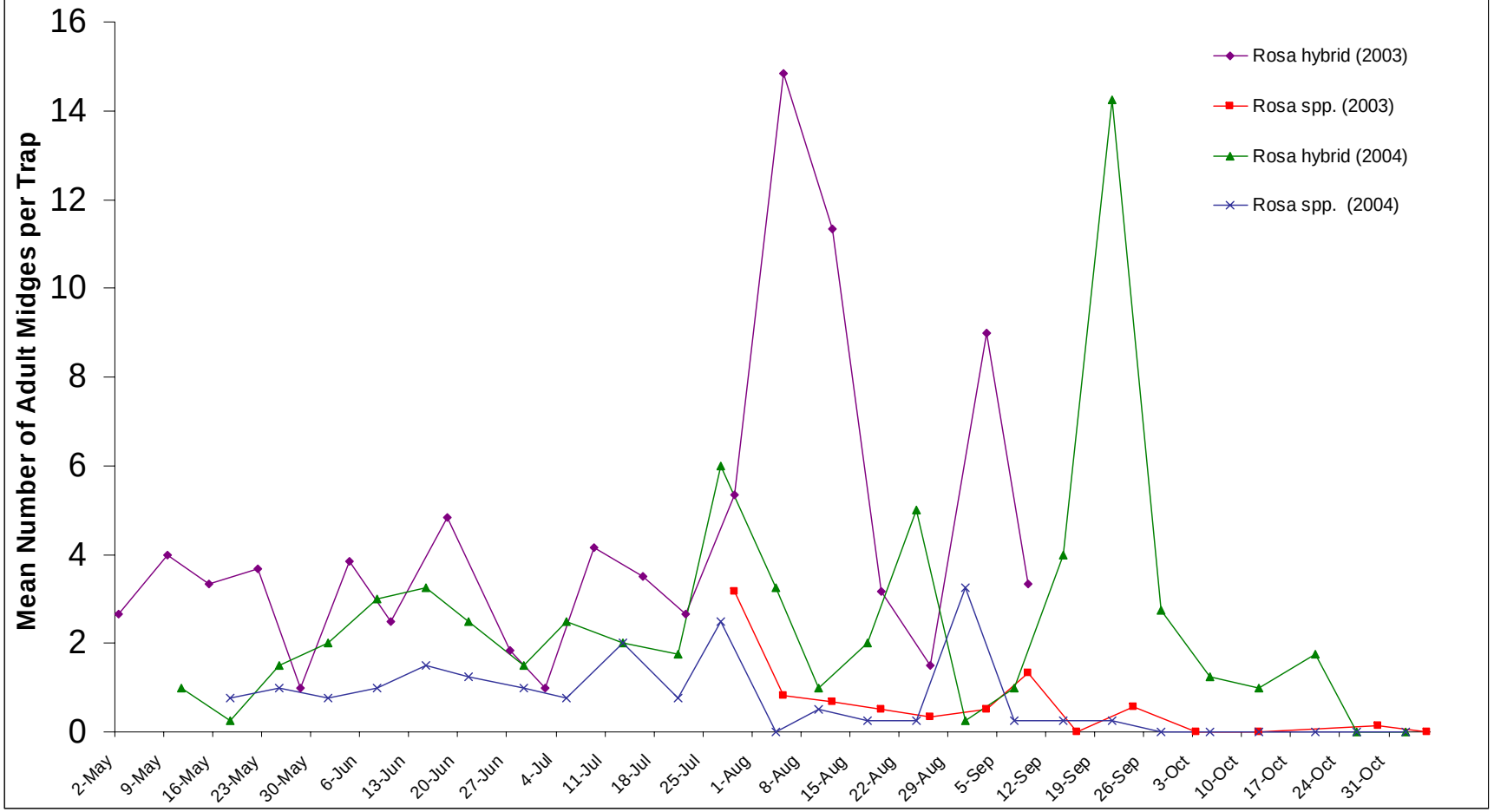


Fig. 2. *Rosa* hybrid: Mean No. Damaged Buds Bi-weekly vs. Mean No. of Adult Midges per Trap per Week

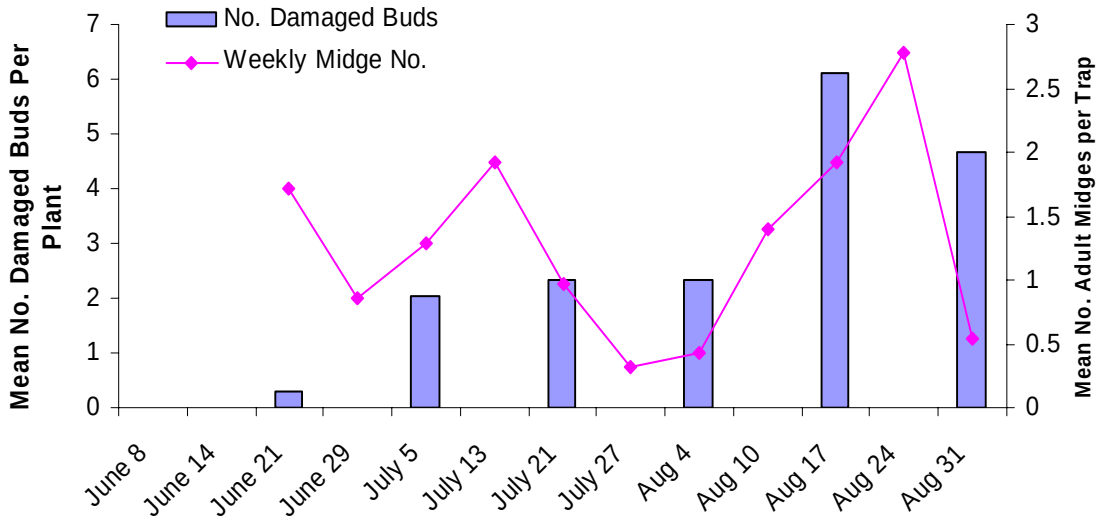
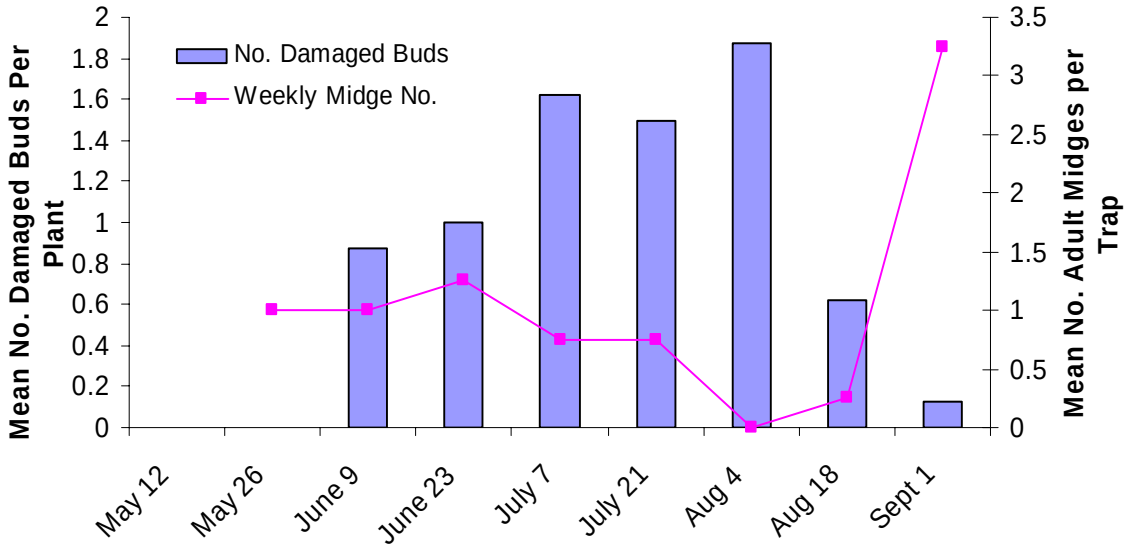


Fig. 3. *Rosa nutkana* : Mean No. Damaged Buds (Bi-weekly) vs. Mean No. of Adult Midges per Trap per Week



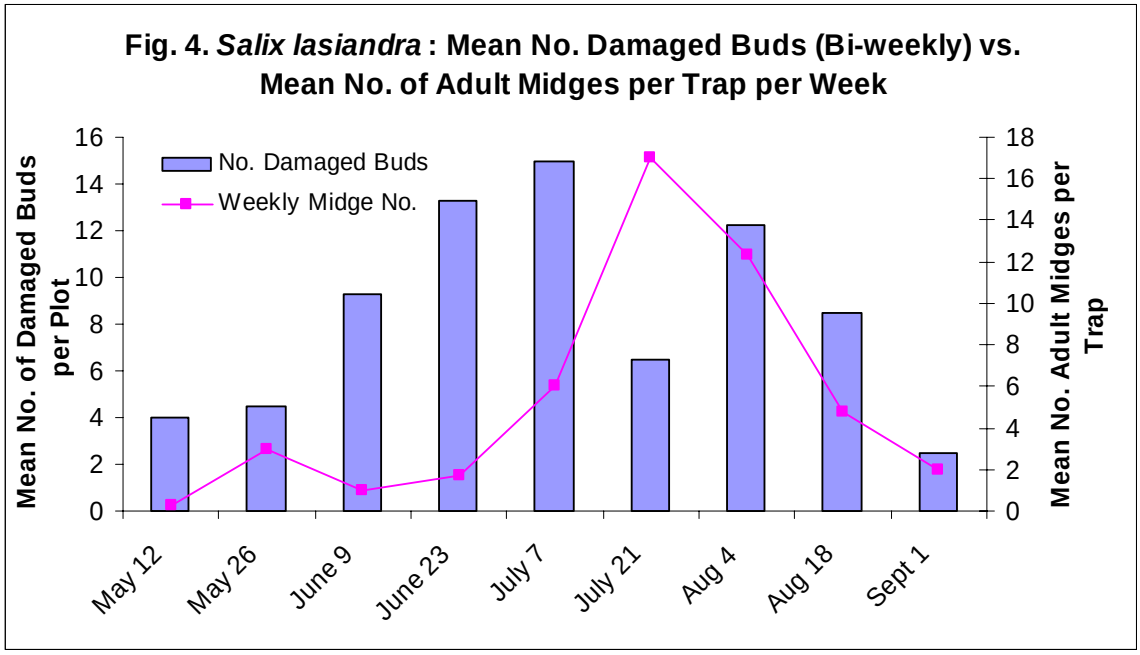


Fig. 4. *Salix lasiandra* : Mean No. Damaged Buds (Bi-weekly) vs. Mean No. of Adult Midges per Trap per Week
No. Damaged Buds
Weekly Midge No.
Mean No. of Damaged Buds per Plot
Mean No. Adult Midges per Trap
0
2
4
6
8
10
12
14
16
18
May 12
May 26
June 9
June 23
July 7
July 21
Aug 4
Aug 18
Sept 1

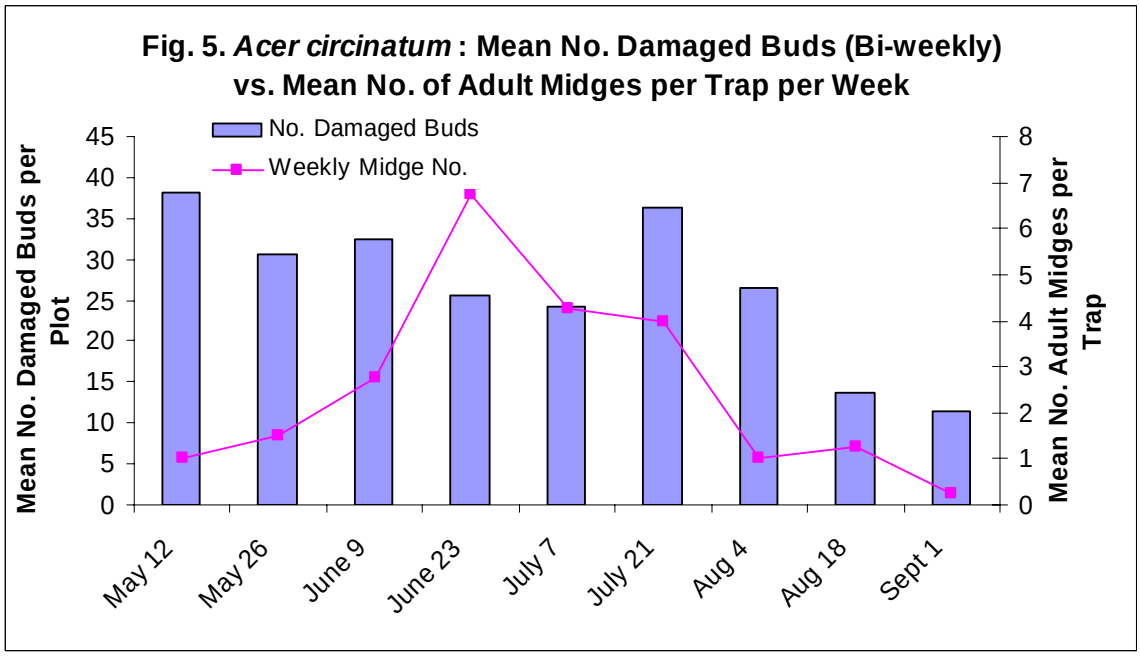


Fig. 5. *Acer circinatum* : Mean No. Damaged Buds (Bi-weekly) vs. Mean No. of Adult Midges per Trap per Week
No. Damaged Buds
Weekly Midge No.
Mean No. Damaged Buds per Plot
Mean No. Adult Midges per Trap
0
5
10
15
20
25
30
35
40
45
0
1
2
3
4
5
6
7
8
May 12
May 26
June 9
June 23
July 7
July 21
Aug 4
Aug 18
Sept 1

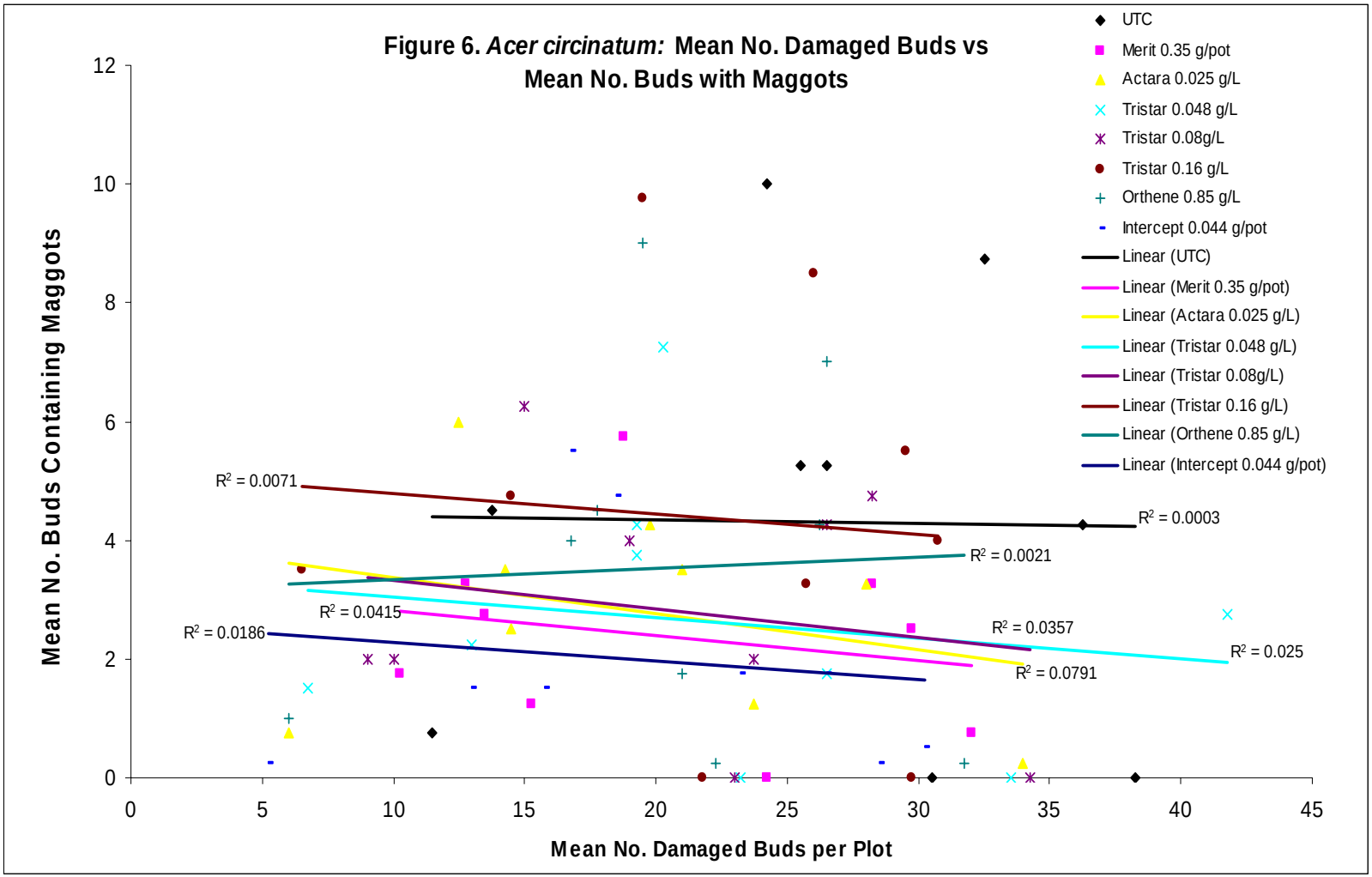
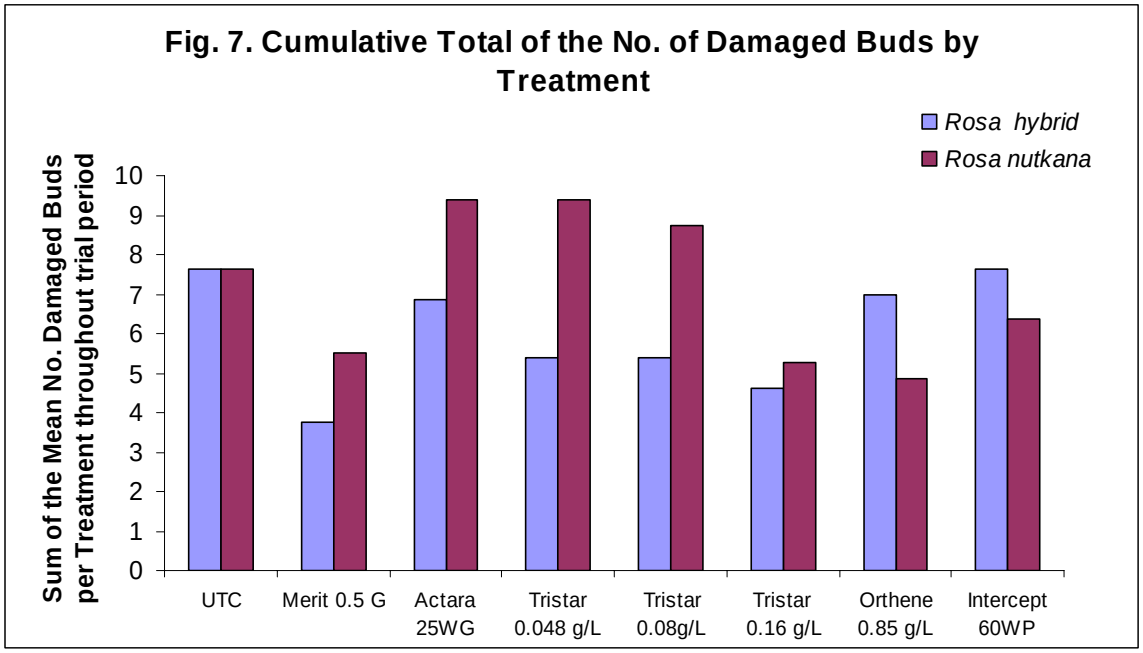


Figure 6. *Acer circinatum:* Mean No. Damaged Buds vs Mean No. Buds with Maggots
Mean No. Buds Containing Maggots
Mean No. Damaged Buds per Plot
0
2
4
6
8
10
12
0
5
10
15
20
25
30
35
40
45
UTC
Merit 0.35 g/pot
Actara 0.025 g/L
Tristar 0.048 g/L
Tristar 0.08g/L
Tristar 0.16 g/L
Orthene 0.85 g/L
Intercept 0.044 g/pot
Linear (UTC)
Linear (Merit 0.35 g/pot)
Linear (Actara 0.025 g/L)
Linear (Tristar 0.048 g/L)
Linear (Tristar 0.08g/L)
Linear (Tristar 0.16 g/L)
Linear (Orthene 0.85 g/L)
Linear (Intercept 0.044 g/pot)
R² = 0.0071
R² = 0.0003
R² = 0.0021
R² = 0.0415
R² = 0.0186
R² = 0.0357
R² = 0.025
R² = 0.0791

Insecticide Trials: In *Rosa,* Merit 0.5 G and the highest rate of Tristar 70 WSP (0.16 g/L) provided some reduction in plant injury but not a commercially acceptable level of control (Tables 1 and 2 and Figure 7). Two applications of Merit G, once on May 13 and again on Aug. 5 were more effective in roses than 14 day applications of Intercept 60WP liquid drench.



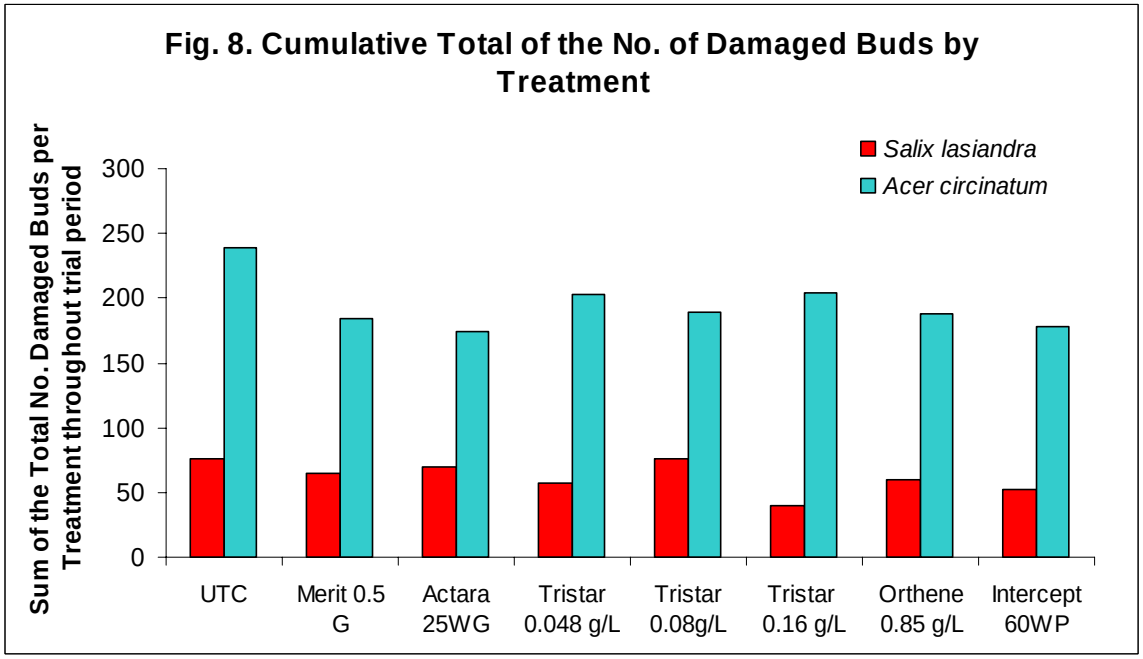


Table 1: *Rosa* sp. hybrid: Mean number of damaged buds per plant. [1]

Treatment	Rate g product	8-Jun	21-Jun	5-Jul	21-Jul	4-Aug	17-Aug	31-Aug	SUM
UTC	0	0	0.1a	0.9ab	1.0a	1.0ab	2.6a	2.0ab	7.6a
MERIT G	0.30/pot	0	0.1a	0.5bc	0.3bc	0.4b	1.6a	0.9b	3.8c
ACTARA	0.03/L	0	0.1a	0.6abc	0.5abc	1.1ab	2.5a	2.0ab	6.9ab
TRISTAR	0.048/L	0	0.1a	0c	0.4bc	0.8ab	2.8a	1.4b	5.4abc
TRISTAR	0.08/L	0	0a	0.5bc	0.1c	1.1ab	2.4a	1.3b	5.4abc
TRISTAR	0.16/L	0	0a	0.3bc	0.8ab	0.5ab	2.1a	1.0b	4.6bc
ORTHENE	0.85/L	0	0a	0.5bc	0.3bc	1.0ab	2.5a	2.8a	7.0ab
INTERCEPT	0.03/pot	0	0a	1.3a	0.1c	1.6a	3.0a	1.6ab	7.6a

[1]Mean of eight plants per treatment; completely randomized design. Treatments followed by the same letter within the same column are not significantly different in LSD at P = 0.05.

Table 2: *Rosa nutkana*: Mean no. of damaged buds per plot.[1]

Treatment	Rate g product	13-May	27-May	11-Jun	23-Jun	8-Jul	22-Jul	5-Aug	19-Aug	2-Sep	SUM
UTC	0	0	0b	0.9a	1.0a	1.6a	1.5ab	1.9ab	0.6ab	0.1a	7.6ab
MERIT G	0.30/pot	0	0b	0.4a	0.5a	1.1a	1.3ab	1.4ab	0.9ab	0a	5.5ab
ACTARA	0.03/L	0	0.3a	1.1a	1.1a	2.1a	1.0ab	2.8a	0.9ab	0.1a	9.4a
TRISTAR	0.048/L	0	0b	1.0a	1.3a	2.9a	1.1ab	1.4ab	1.6a	0.1a	9.4a
TRISTAR	0.08/L	0	0b	0.6a	1.1a	1.4a	2.3a	2.1ab	1.1ab	0.1a	8.8ab
TRISTAR	0.16/L	0	0.3a	0.5a	1.0a	1.1a	1.4ab	0.8b	0.3b	0a	5.3b
ORTHENE	0.85/L	0	0b	0.5a	0.3a	1.8a	0.4b	1.0b	1.0ab	0a	4.9b
INTERCEPT	0.03/pot	0	0b	0.8a	0.6a	0.9a	1.3ab	2.1ab	0.5b	0.3a	6.4ab

[1]Mean of eight plants per treatment; completely randomized design. Treatments followed by the same letter within the same column are not significantly different in LSD at P = 0.05.

No treatment provided a commercially acceptable level of control in *Salix* and *Acer* (Tables 3 and 4 and Figure 8). In *Salix*, Tristar at 0.16 g/L provided the greatest reduction in midge damage and the two formulations of imidacloprid provided some suppression. Tristar was not effective in *Acer.* In *Acer* the most effective treatments were the two formulations of imidacloprid and Actara.

Plant quality was rated bi-weekly for each plot on a scale of 1 to 9 where 1 = best and 9 = worst in *Salix* and *Acer* (Tables 5 and 6) but no significant difference in plant quality was observed among treatments due to the high level of bud damage in all treatments. Oddly, in *Acer* the Tristar treatments demonstrated the highest plant quality ratings overall, although this product was not effective on midge in this crop. This might have been due to an effect of Tristar on thrips which also infested the *Acer* crop heavily during the course of the trial. While the primary leaf bud injury was caused by midge maggots in this crop it was observed that thrips contributed to leaf injury also and the two pests were often present at the same time in young damaged leaves.

Table 3: *Salix lasiandra*: Mean number of damaged buds per plot. [1]

Treatment	Rate g product	13-May	28-May	11-Jun	23-Jun	08-Jul	22-Jul	05-Aug	18-Aug	02-Sep	Sum
UTC	0	4.0ab	4.5a	9.3ab	13.3a	15.0ab	6.5bc	12.3a	8.5a	2.5a	75.8a
MERIT G	0.35/pot	2.8ab	3.5a	11.5a	8.3bc	8.5cd	12.0a	10.0ab	7.8a	0.8a	65.0ab
ACTARA	0.025/L	5.0ab	4.3a	9.3ab	8.8bc	17.0a	10.8ab	5.5bc	8.3a	0.5a	69.3a
TRISTAR	0.048/L	3.3ab	3.5a	7.0ab	8.3bc	11.0abcd	10.3abc	7.0bc	4.3a	3.0a	57.5ab
TRISTAR	0.08/L	6.8a	4.5a	10.5ab	12.3ab	13.0abc	13.8a	7.0bc	5.8a	2.5a	76.0a
TRISTAR	0.16/L	2.3b	3.3a	4.0b	7.0c	5.3cd	5.8c	6.0bc	4.5a	1.8a	39.8b
ORTHENE	0.85/L	2.0b	4.0a	9.0ab	12.0ab	7.5cd	10.3abc	7.5abc	5.0a	3.0a	60.3ab
INTERCEPT	0.044/pot	2.0b	3.3a	10.5ab	12.5ab	9.5bcd	6.5bc	3.8c	4.0a	0.8a	52.8ab

[1]Mean of 12 plants per plot in a randomized complete block with four replicates per treatment. Treatments followed by the same letter within the same column are not significantly different in LSD at P=0.05.

Table 4: *Acer circinatum:* Mean number of damaged buds per plot. [1]

Treatment	Rate g product	13-May	27-May	11-Jun	23-Jun	8-Jul	22-Jul	5-Aug	19-Aug	2-Sep	Sum
UTC	0	38.3a	30.5a	32.5a	25.5a	24.3a	36.3abc	26.5a	13.8a	11.5a	239.0a
MERIT	0.35/pot	32.0a	24.3ab	15.3ab	29.8a	18.8a	28.3ab	13.5b	12.8a	10.3a	184.8b
ACTARA	0.025/L	34.0a	23.8ab	14.3b	28.0a	12.5a	19.8c	21.0ab	14.5a	6.0a	173.8b
TRISTAR	0.048/L	33.5a	23.3ab	19.3ab	26.5a	20.3a	41.8a	19.3ab	13.0a	6.8a	203.5ab
TRISTAR	0.08/L	34.3a	23.0ab	23.8ab	26.5a	15.0a	38.0ab	19.0ab	10.0a	9.0a	198.5ab
TRISTAR	0.16/L	29.8a	21.8b	30.8ab	25.8a	19.5a	29.5abc	26.0a	14.5a	6.5a	204.0ab
ORTHENE	0.85/L	31.8a	22.3b	16.8ab	21.0a	19.5a	26.3abc	26.5a	17.8a	6.0a	187.8ab
INTERCEPT	0.044/pot	30.3a	28.5ab	16.8ab	26.5a	18.5a	23.3bc	15.8b	13.0a	5.3a	177.8b

[1]Mean of 12 plants per plot in a randomized complete block with four replicates per treatment. Treatments followed by the same letter within the same column are not significantly different in LSD at P=0.05.

Table 5: *Salix lasiandra:* Mean plant quality rating on a scale of 1 to 9, 1= best, 9=worst. [1]

Treatment	Rate g product	13-May	28-May	11-Jun	23-Jun	8-Jul	22-Jul	5-Aug	18-Aug	2-Sep
UTC	0	1.5ab	1.8a	3.8a	5.0ab	4.3a	5.4ab	5.6a	5.1a	5.0a
MERIT G	0.35/pot	1.0b	2.3a	4.0a	5.3a	4.1a	5.6ab	5.1a	5.8a	5.5a
ACTARA	0.025/L	1.5ab	2.5a	3.8a	4.9ab	4.6a	5.0ab	5.3a	5.1a	4.6a
TRISTAR	0.048/L	1.3ab	1.5a	3.5a	4.9ab	4.5a	5.9a	5.5a	5.6a	5.4a
TRISTAR	0.08/L	2.0a	1.8a	3.3a	3.5b	5.3a	5.3ab	5.0a	6.0a	4.8a
TRISTAR	0.16/L	1.0b	2.5a	2.8a	3.8ab	4.4a	5.0ab	5.0a	5.6a	5.0a
ORTHENE	0.85/L	1.0b	2.5a	4.8a	4.4ab	4.4a	5.4ab	5.8a	5.4a	4.8a
INTERCEPT	0.044/pot	1.3ab	1.8a	4.3a	3.8ab	4.3a	3.8b	4.5a	4.5a	4.8a

[1]Mean of 12 plants per plot in a randomized complete block with four replicates per treatment. Treatments followed by the same letter within the same column are not significantly different in Duncan's Multiple Range Test at P=0.05.

Table 6: *Acer circinatum*: Mean visual plant quality ratings on a scale of 1 to 9, 9=worst [1]

Treatment	Rate g product	13-May	27-May	11-Jun	23-Jun	8-Jul	22-Jul	5-Aug	19-Aug	2-Sep
UTC	0	7.5a	4.0a	4.0ab	4.5a	5.1ab	6.0a	6.0ab	6.4ab	5.0abc
MERIT	0.35/pot	6.3a	5.3a	4.8ab	4.8a	4.6ab	6.5a	5.0b	5.5abc	4.3bc
ACTARA	0.025/L	6.3a	4.5a	3.8b	3.6a	4.1ab	5.5a	4.8b	4.0bc	4.1bc
TRISTAR	0.048/L	6.3a	4.5a	4.3ab	4.3a	3.5b	5.8a	3.9b	4.5bc	3.1c
TRISTAR	0.08/L	6.5a	5.0a	4.5ab	3.9a	3.8b	7.0a	4.9b	3.3c	3.1c
TRISTAR	0.16/L	6.3a	4.3a	5.1a	4.0a	4.1ab	5.8a	5.9ab	4.3bc	3.1c
ORTHENE	0.85/L	6.3a	4.0a	4.9ab	3.9a	6.4a	5.0a	7.5a	7.5a	7.6a
INTERCEPT	0.044/pot	6.5a	5.3a	4.5ab	3.4a	4.6ab	5.8a	5.8ab	6.3ab	6.3ab

[1]Mean of 12 plants per plot in a randomized complete block with four replicates per treatment. Treatments followed by the same letter within the same column are not significantly different in Duncan's Multiple Range Test at P=0.05.

Table 7: *Acer circinatum*: Mean number of buds with maggots per plot.[1]

Treatment	Rate g product	13-May	27-May	11-Jun	23-Jun	8-Jul	22-Jul	5-Aug	19-Aug	2-Sep
UTC	0	0a	0b	8.8a	5.3a	10.0a	4.3a	5.3abc	4.5a	0.8a
MERIT	0.35/pot	0.8a	0b	1.3b	2.5a	5.8a	3.3a	2.8bc	3.3a	1.8a
ACTARA	0.025/L	0.3a	1.3a	3.5ab	3.3a	6.0a	4.3a	3.5abc	2.5a	0.8a
TRISTAR	0.048/L	0a	0b	3.8ab	1.8a	7.3a	2.8a	4.3abc	2.3a	1.5a
TRISTAR	0.08/L	0a	0b	2.0ab	4.3a	6.3a	4.8a	4.0abc	2.0a	2.0a
TRISTAR	0.16/L	0a	0b	4.0ab	3.3a	9.8a	5.5a	8.5a	4.8a	3.5a
ORTHENE	0.85/L	0.3a	0.3b	4.0ab	1.8a	9.0a	4.3a	7.0ab	4.5a	1.0a
INTERCEPT	0.044/pot	0.5a	0.3b	5.5ab	1.8a	4.8a	1.8a	1.5c	1.5a	0.3a

[1]Mean of 12 plants per plot in a randomized complete block with four replicates per treatment. Treatments followed by the same letter within the same column are not significantly different in Duncan's Multiple Range Test at P=0.05.

CONCLUSIONS:

Rosa spp., Acer circinatum (vine maple) and *Salix lasiandra* (Pacific willow) flush out new flower and leaf buds on a continual basis throughout the growing season and the three midge species affecting these crops have multiple generations that cycle continuously throughout the growing season also. Adult rose midge fly catches on yellow sticky traps peaked approximately every two weeks with major peaks in late July-early August and again in early-mid September. *Acer* midge emergence peaked in mid-June and the *Salix* midge in mid-July. However, adult trap catch was not correlated with crop damage in untreated check plots. In blueberries, it has been observed that a single midge may lay eggs in more than one bud and a single bud may be visited by more than one egg-laying female (Dr. Jasbir Mann, D.M. Consulting Ltd., personal communication). Thus, a small number of adult midges can cause high level of crop damage.

None of the insecticide treatments demonstrated a commercially acceptable level of control of midge damage in these crops. Imidacloprid (Intercept 60WP and Merit G) and the high rate of acetamiprid (Tristar 70 WSP at 0.16 g/L) suppressed maggot damage somewhat in all three crops. Two applications of Merit 0.5 G granular to the container surface and watered-in, in May and August, were more effective than bi-weekly drenches with Intercept 60WP. A bi-weekly drench with imidacloprid would not be an acceptable label application method due to the potential for pest resistance and environmental impact. Actara (thiamethoxam) was also somewhat effective in *Acer*. Tristar was not effective on midge in this crop but did result in the highest plant quality ratings at the end of the trial, perhaps due to control of thrips.

In *Acer circinatum*, midge maggots were found in only a small fraction (about 20%) of midge-damaged leaf buds in bi-weekly damage assessments. Similar data was obtained in *Rosa* and *Salix* on at least two evaluation dates. Since midge continuously cycles in these crops many maggots in infested buds had probably gone from egg to mature larval stage (in which larvae drop to the soil to pupate) in the 14-day interval. Once the maggots leave the bud to pupate in the soil, maggot-damaged buds shrivel and turn black but remain on the plant for more than two weeks.

A. circinatum was also heavily infested with thrips which probably contributed to bud injury. Both midge maggots and thrips were often found in the same damaged leaf bud or newly-opened leaf. However, midge maggot damage could be distinguished from thrips injury by the swollen, distorted and/or blackened buds. Thrips were also observed in *Rosa* buds affected by midge, but thrips injury in *Rosa* is easily distinguished from midge maggot damage by the same criteria.

Nevertheless, this demonstrates the need for an acceptable management method for both midge and thrips in *Rosa* and *Acer*. It is recommended that combined treatments be assessed, such as alternating treatments with products like Merit G, Intercept 60WP and Tristar, which show some ability to reduce crop injury, perhaps with predatory nematodes such as *Heterorhabditis* spp. or *Steinerema* spp. which may attack pupating larvae in the soil. Although spinosad was ineffective in 2003, there may be other products, such as

Avid (abamectin), Matador (cyhaluthrin-lamda) or newer “reduced-risk” insecticides not yet registered in Canada such as buprofezin (Talus), dinotefuran (Safari) or pyriproxyfen (Distance) that could be evaluated also. In hybrid roses, further work is also needed to identify resistant cultivars, some of which were identified in a preliminary survey of 30 cultivars in 2003.

Adult midges of all three species were sent to the Biosystematics Laboratory in Ottawa for identification in 2003. Results are pending. The *Acer circinatum* (vine maple) midge appeared for the first time in BC nurseries in 2003 and has not previously been identified in the Pacific Northwest. Its ability to infest other maple species is not yet known.

REFERENCES:

1. J. F. Elmhirst and B. Costello. Development of an IPM Program for Rose Midge (*Dasyneura rhodophaga*). CNLA Project # 2003-08. Final Report, March 15, 2004.

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