Christmas Tree Promotion Board

Final Research Report

CTPB Project Number: 22-09-OSU

Project Title: Evaluation of insecticide alternatives to chlorpyrifos for needle midge management in PNW Douglas fir

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1. Technical Report

Methods.

2023 Field Trials.

Two sites with known Douglas fir needle midge history in Lane County, Oregon were selected for this research. Site 1 had higher needle midge pressure, based on visual assessment of damage observed from 2022, while Site 2 had lower needle midge pressure.

The treatment, rate, and treatment timings are shown in Tables 1 and 2. Treatment timing was determined using the Douglas fir needle midge degree day model on USPest.org (https://uspest.org/dd/model_app). At predicted emergence of Douglas fir needle midge adults, Timing A treatments were applied. Timing B applications were applied two weeks after A.

Tree spacing at both sites was 5’ by 5’. Tree height averaged approximately 5-6 feet tall. Treatments were applied with a Stihl SR-450 mist blower, calibrated to apply 15 GPA. Each replicate was a single tree (plot size = 25 ft^2). Site 1 had 16 replicates per treatment, and Site 2 had 5 replicates per treatment.

Site 1 was first treated on April 24, 2023. The mist blower was calibrated, then treatments mixed and applied within 10 minutes of mixing. The weather consisted of un-forecasted scattered rain showers, but no wind. The Time B applications were applied May 11, 2023; weather was sunny and calm with no rain.

Site 2 was treated on May 1, 2023. The weather was calm with no rain. There were no Time B applications at this site.

Treatments were evaluated on July 24, 2023. Evaluation was done by circling the tree and counting the number of shoots with needle damage. Differences in the number of damaged shoots per tree were log transformed and analyzed with ANOVA in R Studio.

Table 1. Treatments and rates at Site 1, which had high needle midge pressure.

Trt No.	Trade name	Active Ingredient	IRAC group	Rate	Timing
1	Untreated control	--	--	--	--
2	Admire Pro	imidacloprid	4A	2.8 fl oz/ac	A
3	Sivanto Prime	flupyradifurone	4D	14 fl oz/ac	A
4	Delegate	spinetoram	5	6 oz/ac	A
5	Exirel	cyantraniliprole	28	20.5 fl oz/ac	A
6	Brigade	bifenthrin	3A	12.8 fl oz/ac	A
7	Asana	esfenvalerate	3A	9.6 fl oz/ac	A
8	Senstar	spirotetramat + pyriproxifen	23 7C	18 fl oz/ac	AB
9	Brigade + Delegate	bifenthrin + spinetoram	3A 5	12.8 fl oz/ac 6 oz/ac	A B
10	Brigade + Exirel	bifenthrin + cyantraniliprole	3A + 28	12.8 fl oz/ac 20.5 fl oz/ac	A B
11	Ultor SC	spirotetramat	23	16 fl oz/ac	A

Table 2. Treatments and rates at Site 2, which had lower needle midge pressure.

Trt No.	Trade name	Active Ingredient	IRAC group	Rate	Timing
1	Untreated control	--	--	--	--
2	Admire Pro	imidacloprid	4A	2.8 fl oz/ac	A
3	Sivanto Prime	flupyradifurone	4D	14 fl oz/ac	A
4	Delegate	spinetoram	5	6 oz/ac	A
5	Exirel	cyantraniliprole	28	20.5 fl oz/ac	A
6	Brigade	bifenthrin	3A	12.8 fl oz/ac	A
7	Asana	esfenvalerate	3A	9.6 fl oz/ac	A
8	Ultor SC	spirotetramat	23	16 fl oz/ac	A

2024 Field Trials.

2024 efficacy trials were conducted at the same sites as 2023 (see site descriptions, above).

The treatment, rate, and timings are shown in Table 3. Treatment timing was determined using the Douglas fir needle midge degree day model on USPest.org (https://uspest.org/dd/model_app). Treatments were applied at the predicted emergence of Douglas fir needle midge adults.

Tree spacing at both sites was 5' by 5'. Tree height averaged approximately 7-8 feet tall. Treatments were applied with a Stihl SR-450 mist blower, calibrated to apply 15 GPA. Each replicate was a single tree (plot size = 25 ft^2). Treatments were replicated 10 times at each site. Both sites were treated on April 11, 2024. The mist blower was calibrated, then treatments mixed and applied within 10 minutes of mixing.

Treatments were evaluated on August 26, 2024 (Site 1) and September 13, 2024 (Site 2). Trees were evaluated for presence or absence of needle midge damage (damage, where present, was not severe). Data are presented as the proportion of trees in each treatment that had needle midge damage.

Table 3. Treatments applied to Site 1 and 2 in April 2024.

Trt No.	Trade name	Active Ingredient	IRAC group	Rate	Timing
1	Untreated control	--	--	--	A
2	Admire Pro	imidacloprid	4A	2.8 fl oz/ac	A
3	Sivanto Prime	flupyradifurone	4D	14 fl oz/ac	A
4	Exirel	cyantraniliprole	28	20.5 fl oz/ac	A
5	Brigade	bifenthrin	3A	12.8 fl oz/ac	A
6	Ultor SC	spirotetramat	23	16 fl oz/ac	A

Results.

2023 Field Trials.

The Senstar formulation (Table 1, treatment number 8) was not compatible with the sprayer and clogged the nozzles. Consequently, a low rate of Senstar went on Site 1, and this treatment was not included at Site 2 as originally planned.

Mean number of damaged shoots per tree at Site 1 are shown in Figure 1. While there are numeric differences between the treatments (e.g. Untreated versus Sivanto), none of the treatments were significantly lower than the untreated treatment, indicating that there is a high likelihood that the results observed were due to random chance, as opposed to true differences in the treatments. No shoot damage was observed at Site 2.

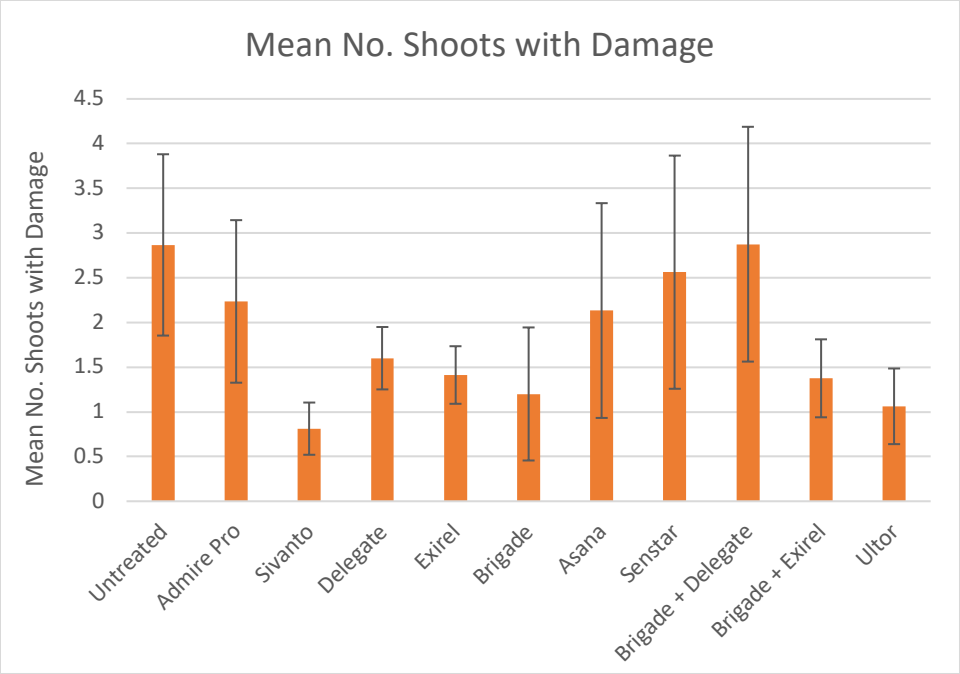

Figure 1. Mean number of damaged shoots per treatment at Site 1.

There are several other reasons to believe the results were seen by chance:

- No damaged shoots were observed at the low pressure site
- The Brigade alone treatment performed well numerically; however, the Brigade followed by Delegate treatment had numerically the highest counts of damaged shoots
- The materials which numerically performed the best are known aphid products, which may indicate that the damage attributed to needle midge may have been caused by aphids. Aphids were not present at the time of rating but may have been present earlier in the season

The shoots were likely rated too early in the season to see the full extent of needle midge damage. The low pressure site had no damage observed at the time that we did damage ratings. Ratings were conducted at the end of July in order to rate the damage before pruning crews came through, which would have potentially removed damaged shoots. However, needle midge damage is typically more obvious in later August and September.

2024 Field Trials.

Needle midge damage was positively identified in the 2024 trials when ratings were conducted later in the growing season (Figure 2).

The number of damaged shoots on a tree with needle midge damage was consistently low (3 or less per tree). Thus, the data presented here are the proportion of trees with needle midge damage at each site (Figures 3 and 4). Damage was found across the entire treatment area, and there was no reduction in damage in insecticide treated trees.

Figure 2. Damaged shoot from Douglas fir needle midge, showing bent needles and discoloration.

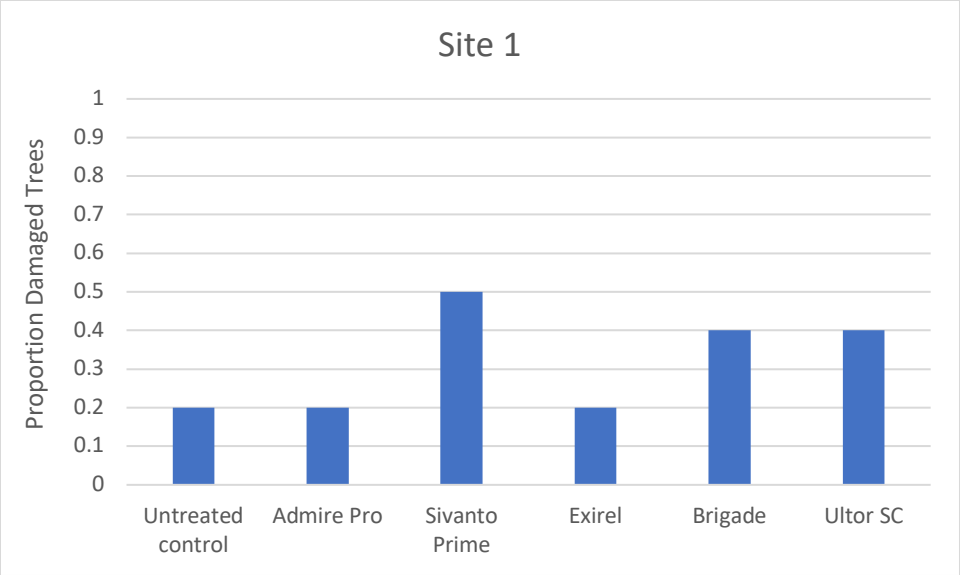

Figure 3. Proportion of damaged trees per treatment at Site 1. There were 10 trees treated per treatment.

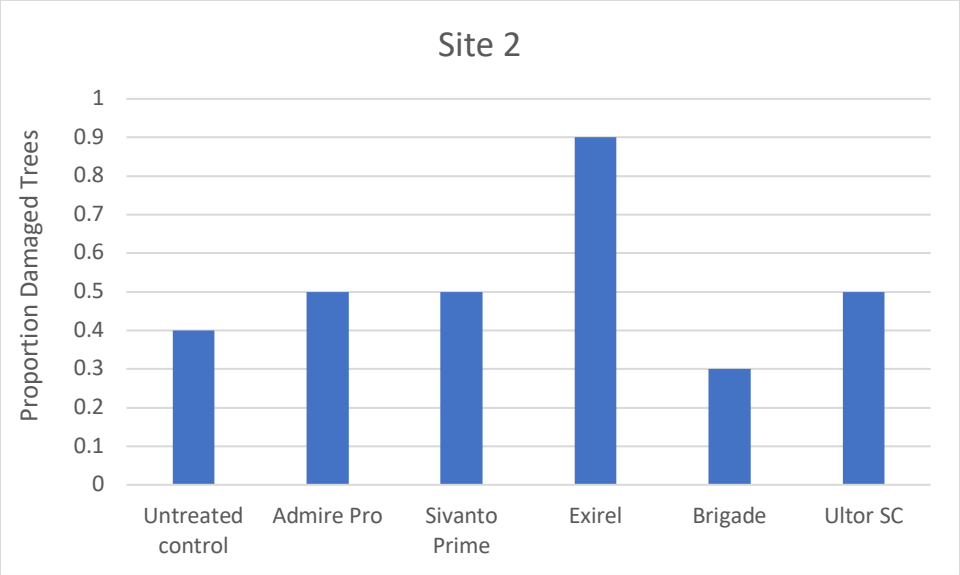

Figure 4. Proportion of damaged trees per treatment at Site 2. There were 10 trees treated per treatment.

Conclusions.

None of the insecticide treatments applied resulted in reduced incidence of Douglas fir needle midge damage. Research in plots where trees can remain unpruned through mid-September is critical in future work to ensure that damage is present.

2. Summary of Research Report

Needle midge is a small fly that lays eggs on Douglas fir shoots in early spring. The larvae of the midge cause galls to develop in the needles on the new growth. Damaged needles present as yellowed and/or with bends and kinks in the needles. The damaged needles drop in the fall, and highly affected trees can be partially defoliated.

Needle midge damage is not tolerated for Douglas fir export to Mexico, and damaged needles can cause rejection of shipments. Partially defoliated trees are also not suitable for the market. Traditionally, needle midge was controlled primarily with applications of chlorpyrifos (often made aerially). Chlorpyrifos has been highly litigated within the courts over the last 4 years, and use has already been phased out of several Christmas tree producing states, including Oregon and Washington in the PNW.

There is a need for evaluation of new materials that could provide control of needle midge in Douglas fir. This study looked at an array of currently labeled, as well as unlabeled, pesticides to see whether they may provide control of needle midge. Treatments evaluated in 2023 were Admire Pro, Sivanto Prime, Delegate, Exirel, Brigade, Asana, Senstar, Ultor SC, Brigade followed by Delegate, and Brigade followed by Exirel. Treatments evaluated in 2024 were Admire Pro, Sivanto Prime, Exirel, Brigade, and Ultor SC.

Trials were conducted in two Douglas fir fields per year; one with high pressure, and the other with low pressure. Treatments were timed to correspond to peak adult needle midge emergence using the needle midge degree day model on USPest.org.

In 2023, the number of damaged shoots per tree was assessed visually in late July, before trees were pruned. No significant differences were observed. Damage was likely evaluated too early in the season. In 2024, the presence or absence of damage was assessed visually in late August/early September. While Douglas fir needle midge damage was present at the later rating timings, there were no reductions in damage observed between treated and untreated trees.