EFFICACY OF APHID CONTROL OPTIONS IN RED CLOVER GROWN FOR SEED

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Introduction

Clover aphid (*Nearctaphis bakeri*) and pea aphid (*Acyrthosiphon pisum*) are small aphids that attack red clover. In red clover, aphids require annual control to prevent seed yield reduction and harvest issues resulting from the sticky honeydew produced by aphid feeding. Clover seed growers typically treat for aphids in mid-June, just prior to clover bloom (Anderson, 2021).

Chlorpyrifos is widely used by growers because it has a long residual period; an application just prior to bloom provides aphid control through the majority of the clover bloom period. This eliminates the need for a second application while honeybees are foraging. Clover seed producers identified aphids as a primary target for chlorpyrifos applications in two grower surveys conducted in 2021.

The Oregon Department of Agriculture finalized new rules in 2020 to phase out chlorpyrifos use in agricultural production by December 31, 2023 (ODA, 2020). The objective of these trials was to identify potential alternatives to chlorpyrifos for aphid control in red clover seed production.

Materials and Methods

Aphid control was evaluated at two commercial red clover seed production fields in Washington County, Oregon. The plot size at each site was 13 feet x 30 feet. Insecticide treatments (Table 1) were applied in a randomized complete block design with four replicates. Treatments were applied with a four-nozzle boom sprayer pressurized with CO_2 and calibrated to deliver 20 gal/acre through TeeJet XR11002VS nozzles at 30 psi. Applications at Site A were made on June 25, 2020, and applications at Site B were made on July 2, 2020.

Table 1. Insecticide treatments, trade names, and rates applied at each field site, 2020.

Active ingredient	Trade name	Rate
		(amt product/a)
Flonicamid	Beleaf 50 SG	2.8 oz
Bifenthrin	Brigade 2 EC	6.4 fl oz
Cyantraniliprole	Exirel	18.0 fl oz
Chlorpyrifos	Lorsban Advanced	16.0 fl oz
Afidopyripen	Sefina	6.0 fl oz
Afidopyripen	Sefina	3.0 fl oz
Flupyradifurone	Sivanto Prime 200 SL	10.5 fl oz
Sulfoxaflor	Transform 50 WG	1.5 oz
Untreated control	—	2.8 oz

Efficacy was determined by sampling 12 clover flowers per plot at 9, 13, 20, and 27 days after treatment (DAT) (Site A) or at 7, 14, 21, and 30 days after treatment (Site B). Samples were frozen until processed. Each clover flower was examined under a dissecting microscope, and the aphids present were counted. No differentiation was made between the two common species of aphids found. Data were $\log_{10}$ (X+1) transformed to meet model assumptions, analyzed with ANOVA, and means separated according to Fisher's Least Significant Difference (LSD) at $P = 0.05$.

Results and Discussion

Results, Site A (Table 2)

- No treatments were different from the untreated check on any of the sampling dates.
- At 9 DAT, Exirel had greater numbers of aphids than Beleaf, Brigade, Lorsban Advanced, Sefina (6 fl oz), and Transform treatments.
- At 27 DAT, Exirel had greater numbers of aphids than Sefina (3 fl oz) and Transform treatments.
- No phytotoxicity was observed with any of the insecticide treatments.

Results, Site B (Table 3)

- At 7 DAT, Lorsban and Sivanto performed better than Brigade, Exirel, Sefina (6 fl oz), and the untreated control.
- At 14 DAT, Brigade performed better than Exirel, and no treatments were different from the untreated check.
- At 21 DAT, both Sivanto and Transform had fewer aphids than the untreated check. Exirel had more aphids than Beleaf, Brigade, Sefina (both rates), Sivanto, and Transform.

- At 30 DAT, Brigade, Sefina (both rates), Sivanto, and Transform all had fewer aphids than the untreated check, Exirel, and Lorsban.
- No phytotoxicity was observed with any of the insecticide treatments.

Discussion

As is frequently the case in small-plot trials, variation in insect pressure among replications can sometimes obscure treatment effects, leading to what was observed at Site A—large numerical differences in means between treatments (e.g., the untreated control and Transform treatments at 27 DAT) but no statistical differences. Nonetheless, several patterns hold true across both sites:

- Exirel did not provide control of aphids and, in fact, seemed to exacerbate insect pressure. This led to numerically, but not statistically, higher insect counts in Exirel-treated plots than in untreated control plots in both trials.
- Several materials provided long-lasting reduction in aphid numbers (residual control) for as long

Table 2. Site A: average aphid counts (adults and nymphs) per 12 flowers at each sample timing.[1]

Treatment	Rate	Aphids (adults + nymphs)			
		(average per 12 flowers)[2]			
	(amt. product/a)	9 DAT	13 DAT	20 DAT	27 DAT
Beleaf 50 SG	2.8 oz	0.50 b	5.75	30.75	80.25 ab
Brigade 2 EC	6.4 fl oz	0.50 b	17.00	13.00	59.50 ab
Exirel	18.0 fl oz	14.00 a	8.50	61.25	224.25 a
Lorsban Advanced	16.0 fl oz	0.25 b	2.00	22.50	104.50 ab
Sefina	6.0 fl oz	0.25 b	4.75	7.25	35.00 ab
Sefina	3.0 fl oz	1.50 ab	1.25	13.00	17.50 b
Sivanto Prime 200 SL	10.5 fl oz	0.75 ab	3.25	11.00	58.50 ab
Transform 50 WG	1.5 oz	0.25 b	1.50	10.50	20.75 b
Untreated control	2.8 oz	6.25 ab	19.00	32.25	140.25 ab
P > F		< 0.01	0.7	0.3	0.02

[1]Means within columns followed by a common letter are not significantly different (*P* ≤ 0.05, Fisher's LSD).
[2]Log_{10} (X+1) transformed data used for ANOVA analysis; nontransformed means shown in table.

Table 3. Site B: average aphid counts (adults and nymphs) per 12 flowers at each sample timing.[1]

Treatment	Rate	Aphids (adults + nymphs)			
		(average per 12 flowers)[2]			
	(amt. product/a)	7 DAT	14 DAT	21 DAT	30 DAT
Beleaf 50 SG	2.8 oz	5.00 ab	13.50 ab	42.50 bc	74.75 ab
Brigade 2 EC	6.4 fl oz	10.00 a	3.50 b	16.75 bc	17.50 c
Exirel	18.0 fl oz	18.00 a	51.50 a	159.75 a	192.50 a
Lorsban Advanced	16.0 fl oz	2.00 b	29.75 ab	69.50 ab	89.50 a
Sefina	6.0 fl oz	11.00 a	11.00 ab	16.75 bc	18.25 c
Sefina	3.0 fl oz	13.75 ab	20.25 ab	18.25 bc	22.00 bc
Sivanto Prime 200 SL	10.5 fl oz	1.00 b	2.50 ab	12.75 c	14.25 c
Transform 50 WG	1.5 oz	1.75 ab	7.75 ab	15.25 c	17.00 c
Untreated control	2.8 oz	21.25 a	25.25 ab	61.50 ab	83.00 a
P > F		< 0.001	0.03	< 0.001	< 0.001

[1]Means within columns followed by a common letter are not significantly different (*P* ≤ 0.05, Fisher's LSD).
[2]Log_{10} (X+1) transformed data used for ANOVA analysis; nontransformed means shown in table.

as 30 DAT, including Sefina, Sivanto Prime, and Transform. Sefina and Sivanto Prime have labels for aphid control in clover seed production. Because of regulatory hurdles, a label for Transform is not being pursued at this time.

- Brigade (bifenthrin) also performed well over the duration of the trials. Although it could be a direct substitute for chlorpyrifos because of its broad-spectrum activity and relatively low cost, it poses a greater threat to pollinators than other better-performing materials in these trials (i.e., Sefina and Sivanto Prime). The pollinator risk makes Brigade less attractive than alternatives.

References

Anderson, N.P. 2021. Clover seed-aphid. In *Pacific Northwest Insect Management Handbook*. https://pnwhandbooks.org/node/7947.

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