INVESTIGATING THE IMPACT OF ROW SPRAYING ON ESTABLISHED WHITE CLOVER

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Introduction

White clover seed producers in the Willamette Valley struggle with highly variable yields from year to year. Seed yield depends primarily on flower head density, which in turn is affected by environment, management, and cultivar (FAR, 2006). In Oregon, white clover seed yields vary widely due to the difficulty in managing crop vigor with grazing and to variable weather patterns. Researchers in New Zealand have increased white clover seed yield and stability by refining the time sheep are removed from the field, adopting optimal irrigation practices and row spacing, and managing second-year growth with herbicides.

White clover spreads by stolons. Flowers are produced on the tips of stolons, as long as the stolons continue to grow outwards. Therefore, creating the proper conditions for stolon elongation is deemed a critical contributing factor for maximum seed yield. Second-year growth needs to be managed to allow light to reach the growing points of primary stolons and to create space for primary stolons to grow outwards. If stolons are limited by light and space, the viability of reproductive seed heads will be decreased.

Optimal production of primary stolons is hard to manage with grazing or mowing alone, as over-grazing leads to high production of secondary and tertiary stolons. Later-developing stolons are less likely to produce seed and thus reduce yield (Clifford, 1980). In New Zealand, herbicides have long been used in second-year crops to reduce plant density. Recently, row spraying with herbicides has been used to optimize primary stolon number and length, as well as flower density (Thomas et al., 2009).

Willamette Valley growers are interested in the feasibility of row spraying in rain-fed white clover seed production systems. Several growers in the Willamette Valley have experimented with row spraying in established white clover stands (Aldrich-Markham, 2011), but no measurable data have been collected to quantify impacts on seed yield. Herbicides and application timing need to be evaluated to know whether row spraying is a viable tool.

The goal of this research was to evaluate the effectiveness of row spraying in second-year white clover seed stands in the Willamette Valley. More specifically, the objectives were to: (1) evaluate herbicides for row spraying white clover based on row formation, row persistence, crop tolerance, and seed yield, and (2) evaluate different row spray application timings to determine the optimal timing window to achieve maximum flower head density and seed yield.

Materials and Methods

The trial was conducted in 2017 on a second-year stand of ladino-type white clover ('VNS') established at Hyslop Research Farm in the fall of 2015. This was the second trial year of this experiment; the first year of the trial was conducted in 2016 on a second-year white clover stand (Sullivan et al., 2017). The stand was not fertilized, and no pesticide applications outside of herbicide treatments were made during the growing season. Field sweeps were conducted for white clover seed weevils, but weevil numbers were well below the threshold for an insecticide application.

The trial was arranged as a randomized complete block design with four replications of each treatment. Plot size was 8 feet x 30 feet. A bicycle sprayer was used to apply eight herbicide treatments (Table 1) at three timings in the late winter/early spring of 2017, resulting in a total of 24 treatment combinations (Table 2). The sprayer was

Table 1. Herbicide treatments used for row spraying in established white clover stands. ***None of the listed herbicide treatments is labeled for use in white clover grown for seed.***

Treatment	Active ingredient	Rate
		(lb ai/a)
Control	—	—
Alion + Rely	Indazaflam + glufosinate	0.0196 + 0.88
Express	Tribenuron	0.0078
Goal[1]	Oxyfluorfen	0.0625
Rely	Glufosinate	0.88
Sharpen	Saflufenacil	0.0445
Sharpen broadcast	Saflufenacil	0.0445
Chateau	Flumioxazin	0.128

[1]Goal is labeled for use as a dormant application but is not labeled for row spraying use.

set up to create a 4-inch white clover row by spraying out an 8-inch band using six nozzles (40 03) mounted to the boom at 12-inch spacing.

The three herbicide application timings in 2017 were: "early timing" (January 26), "mid timing" (April 3), and "late timing" (May 4). The intention was to advance the row spray timings in 2017 as compared to 2016, aiming for timings in early January, mid-February, and mid-March. However, due to difficult weather conditions from January onward, we were unable to move up the second and third spray times to our desired intervals. Sheep did not graze the field, but the trial was mowed on April 19 and the residues were removed from the field with a forage harvester.

Plots were visually evaluated for row persistence and crop injury six times between March 13 and May 31, 2017. Flower head density was measured once on June 22 by counting the number of flowers in two 0.5 m^2 quadrats per plot. The white clover crop was swathed on August 1 and combined on August 7. Harvested seed was cleaned, and yield was calculated. Seed germination counts for seed quality measurements have yet to be completed.

Table 2. Average white clover flower head density and seed yield of the 24 row spraying treatments in 2017. Ranked from highest to lowest seed yield.[1]

Treatment	Herbicide	Timing	Flower density[2]	Seed yield
			(heads/ft^2)	(lb/a)
24	Control	—	23 abcd	356 a
4	Goal	Early	23 abcd	354 ab
7	Sharpen broadcast	Early	23 abcd	346 ab
5	Rely	Early	21 abcde	344 ab
2	Alion + Rely	Early	22 abcd	342 ab
23	Control	—	20 abcde	340 abc
8	Chateau	Early	24 ab	336 abcd
6	Sharpen	Early	18 bcde	324 abcd
1	Control	—	24 ab	314 abcde
22	Chateau	Late	27 a	300 abcdef
11	Goal	Mid	25 ab	293 bcdefg
3	Express	Early	14 cdef	278 cdefgh
15	Chateau	Mid	23 abc	276 defgh
18	Goal	Late	26 ab	261 efgh
13	Sharpen	Mid	12 ef	260 efgh
9	Alion + Rely	Mid	21 abcde	246 fghi
14	Sharpen broadcast	Mid	12 ef	236 ghi
12	Rely	Mid	18 bcde	229 hi
19	Rely	late	22 abcd	191 ij
17	Alion + Rely	Late	20 abcde	185 ij
20	Sharpen	Late	19 abcde	181 ij
21	Sharpen broadcast	Late	14 cdef	160 j
16	Express + Rely[3]	Late	14 def	131 jk
10	Express	Mid	8 f	84 k
LSD (P = 0.05)				62

[1]Means followed by the same letter within the same column are not significantly different at LSD (P = 0.05).
[2]Flower head counts taken on June 22, 2017.
[3]Rely was added to the late Express treatment by accident; there is no late treatment of Express alone.

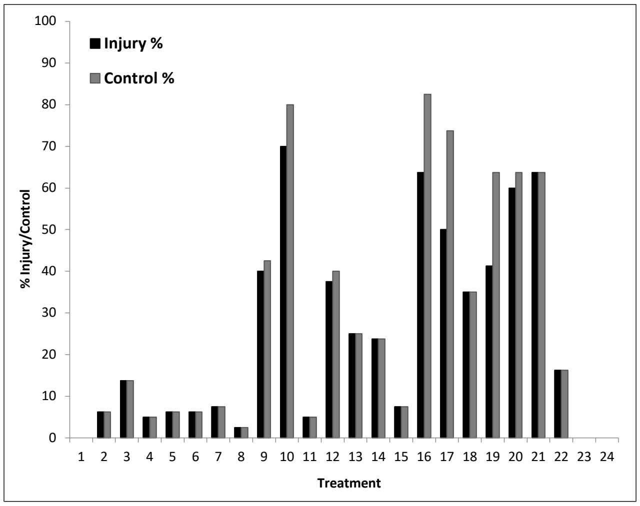

Figure 1. Percent crop injury and percent control (row persistence) in each treatment evaluated on May 31, 2017. Treatments 1, 23, and 24 are control plots, 2 to 8 are early application, 9 to 15 are mid application, and 16 to 22 are late application.

Results and Discussion

The final visual evaluation conducted on May 31, 2017 revealed low crop injury and low row persistence in the early application plots, with significantly higher crop injury and row persistence for the mid and late row spray timings (Figure 1). Crop injury was much higher at the mid application timing in 2017, as compared to the 2016 trial, likely due to an excessive amount of clover foliage at the mid application timing in 2017.

Flower head density counts taken June 22 revealed very similar flower head densities between the control plots and the Goal and Chateau herbicide treatments applied at any timing (Table 2). For any given treatment timing, none of the treatments evaluated were significantly different, compared to the untreated control (22/ft^2). However, average flower head density was significantly reduced in the mid treatment timing (17/ft^2).

None of the row-spray treatments resulted in higher seed yields, compared to the untreated control plots, but six out of seven of the early timing row spray treatments yielded as high as the control plots (Table 2). Average seed yield for the early treatments was 332 lb/acre, which was as high as the control plots and significantly greater than the mid (232 lb/acre) and late (201 lb/acre) application timings. There was no direct correlation between flower head density and clover seed yield. Goal and Chateau resulted in relatively higher seed yields, but only with the early row spray timing.

Conclusion

In both study years, early row spray treatments of Goal (treatment 4) and Chateau (treatment 8) stood out as the herbicide treatments with relatively highest flower head densities and seed yields. However, they did not yield significantly higher than the untreated control. Visually, these treatments most closely resembled the untreated control plots with low crop injury and low control (row persistence), indicating that the treatments that performed best were those that essentially acted as control plots.

Based on these two years of data, there is no seed yield benefit from row spraying second-year white clover fields, especially with the added cost and time required to make an additional herbicide application. If future row spraying trials are pursued, it is advised to look at timings between December to early March at the latest.

References

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Acknowledgments

This research was funded by the Oregon Clover Commission.