MONITORING FOR THE RED CLOVER CASEBEARER MOTH IN EASTERN OREGON RED CLOVER SEED PRODUCTION REGIONS

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Introduction

The red clover casebearer moth (RCCB or *Coleophora deauratella*) was first detected in the Grande Ronde Valley of northeastern Oregon in June 2018, which caused great concern since RCCB was only recently discovered (2012) in the Willamette Valley, the primary growing region for clover seed in the United States (Anderson et al., 2014). Initial monitoring efforts in 2018 in the Grande Ronde Valley detected RCCB adult moths at high population levels in 2-year-old stands of red clover (*Trifolium pretense* L.) seed production fields. These observations indicated that the frequency and severity of seed head damage was very low, at 2% of collected seed heads. Adult moth and larvae specimens collected in 2018 were confirmed as *C. deauratella* by entomology personnel located at the Agriculture and Agri-Food Research Center in Beaverlodge, Alberta, Canada.

Based on these preliminary findings, eastern Oregon clover seed growers and industry representatives prioritized a need to increase pheromone-based monitoring efforts to further delineate RCCB distribution, population dynamics during the growing season, and potential impact on seed yield in red clover seed production east of the Cascade Mountain Range. The objectives of this study were to:

- Determine RCCB distribution, abundance, and population dynamics during the growing season in red clover seed production areas in Union, Baker, and Malheur counties in eastern Oregon.
- Evaluate red clover seed head damage/yield loss potential due to RCCB larvae infestation.
- Utilize monitoring data toward development of future phenology models and control strategies for RCCB.

Materials and Methods

On June 11, 2019, sex-pheromone-baited traps (Evenden et al., 2010) were placed in six commercial red clover (*Trifolium pretense* L.) seed production fields in an effort to detect the presence or absence of RCCB male moths. Fields utilized for RCCB monitoring were located in Union (two), Baker (one), and Malheur (three) counties, and all sites were second-year stands of red clover except for one site in Malheur County. At the time of trap installation, red clover growth stage at all monitoring sites was early bloom except for Malheur-2, which started blooming in mid-May, and Malheur-3 (first-year field), which started blooming in early July.

One green UniTrap was placed in each field at least 100 feet from the field edge and at crop canopy height. A gray septa baited with the RCCB male moth pheromone was placed in each trap and replaced one time after the first 30 days had elapsed. An insecticide vapor strip was placed in the bottom of each trap to euthanize captured moths; it was also replaced after the first 30 days had elapsed. Traps were monitored weekly for 8–10 weeks depending on stand age and production area. Monitoring efforts ended in late July to mid-August for all sites except for the 1-year-old stand in Malheur County (Malheur-3), where monitoring continued until September 3, 2019.

Weekly monitoring activities included: (1) collecting moth specimens from each trap for identification and quantification and (2) evaluating red clover seed heads for larvae presence and/or damage. Moths collected from each trap were identified utilizing a stereoscope and counted. All specimens were placed in the freezer until identification confirmation could be completed. Destructive clover seed head samples (25 heads/site) were randomly collected from the mid- to upper crop canopy on a weekly basis. The pink/red heads were processed by removing each individual floret and examining florets for the presence of eggs, larval feeding damage, and/or larvae.

To estimate potential impact on seed yield, 100 mature red clover seed heads were collected from each site prior to commercial harvest. Mature heads were processed and evaluated using the same protocol as that used for weekly destructive seed head evaluation. Soil surface residue and soil samples (three 1 ft^2 quadrats) were collected from the Union-1 monitoring site to determine whether RCCB pupae could be detected in postharvest crop residue after seed harvest.

Results and Discussion

Adult RCCB moths were captured in every field monitored, resulting in a total of 6,789 moths captured during the 2019 growing season. Union County RCCB adult populations were extremely high and represented

98% of the total captured RCCB. Interestingly, the Union-1 monitoring site was the only site that presented a distinct peak in RCCB adult activity from late June to mid-July (Figure 1). In all other monitoring sites, fewer than 100 RCCB adults/site were captured. At the time of trap installation on June 11, adult RCCB populations were already active in all 2-year stands of red clover, as indicated by the high numbers captured during the first week of trap deployment (collected June 17). In contrast, adults were not captured until July 8 in the first-year stand in Malheur County (Table 1, Malheur-3).

A total of 1,200 red clover seed heads were collected during the growing season to evaluate for the presence of eggs, larvae, and/or floret damage. Eggs were not detected on any of the destructive head samples. Overall, RCCB larvae detection was very low across all monitoring sites and resulted in totals of 23, 0, and 17 larvae collected in Union, Baker, and Malheur County, respectively, for the entire growing season (Table 1). Such low larvae detection levels represent 0.03 larvae/head. Larvae detection occurred earlier in the growing season in Union County when compared to Malheur County (Table 1). Floret damage from RCCB larvae feeding activity was very low, with only 0.2 damaged florets/head and only 239 damaged florets (Table 1) detected within an estimated 144,000 total florets examined during this study (based on an average of 120 florets/head).

At maturity, 705 red clover seed heads were evaluated for RCCB larvae damage, and results also indicate low infestation levels (Table 2). Only 3% of heads exhibited larval feeding damage, and only 80 damaged florets were detected in an estimated 80,400 florets examined, which equates to only 0.113 damaged florets/head. No RCCB pupae were detected in postharvest soil surface residue samples. Three species of weevils (*Sitona cylindricollis*, *Hypera nigrirostris*, and *Tychius picirostris*) were also found during the course of this study using destructive head sampling and sweep net techniques, but detection levels were low.

Conclusion

The presence of RCCB was detected in each of the red clover seed production areas of eastern Oregon. Notably, after 2 years of monitoring in commercial seed production fields, the RCCB appears to be very well established in the Grande Ronde Valley (Union County), given extremely high moth capture rates both

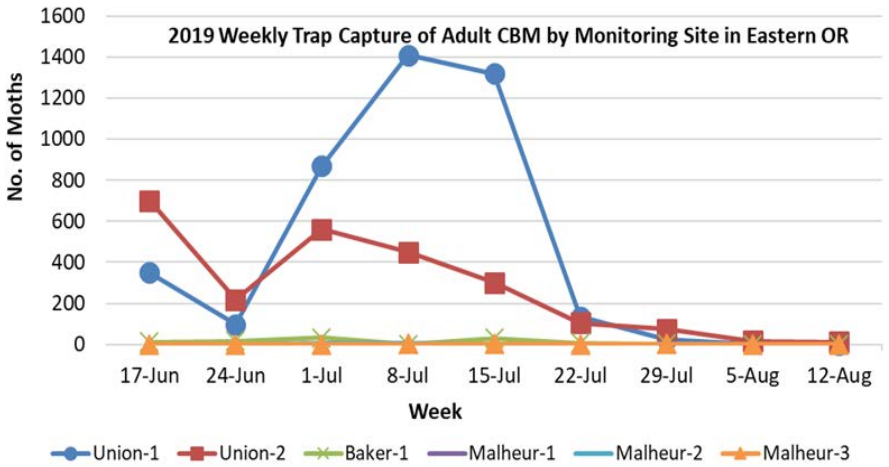

Figure 1. Weekly pheromone trap results for male red clover casebearer moths (RCCB) for each commercial red clover seed production field monitoring site in eastern Oregon. Lines for Malheur-1 and Malheur-2 are obscured by the Malheur-3 line.

Table 1. RCCB larvae and damaged florets from weekly destructive sampling of 25 red clover seed heads collected from each pheromone trap monitoring site in eastern Oregon, 2019.

Site	Field I.D.	Stand age	RCCB larvae/damaged florets								
		(yrs)	Jun. 17	Jun. 24	Jul. 1	Jul. 8	Jul. 15	Jul. 22	Jul. 29	Aug. 5	Total
Union-1	CR-1	2	0	0	0	1/66	0/11	0/12	0	0	1/89
Union-2	BD-4	2	17/8	3/13	2/8	0/2	0	0	0	0	22/31
Baker-1	JH-2	2	0	0	0	0	0	0	0	nd	0
Malheur-1	South-mow	2	0	0	0	1/0	4/9	2/30	1/10	0/1	9/50
Malheur-2	Middle	2	0/1	0	0	0	2/30	3/24	1/6	nd	6/61
Malheur-3	North	1	nd	nd	0	0	0	0	0	2/8	2/8
Total			17/9	3/13	3/8	2/68	6/50	5/66	2/16	2/9	40/239

years. The RCCB is present in Baker and Malheur counties; however, additional monitoring is needed over multiple seasons to better understand population density in those production areas.

Overall, the results of this study indicate that RCCB larvae populations are very low, levels of seed head damage and frequency are very low, and potential impact on seed yield is less than 1% loss. These results are similar to observations made during preliminary monitoring efforts in the Grande Ronde Valley in 2018. High early trap counts suggest RCCB moth flights begin earlier in the growing season, so pheromone monitoring should begin 4–6 weeks earlier. The discrepancy between moth capture rates and low damage levels in eastern Oregon, especially in Union County, suggests that an unidentified biological control agent may be limiting damage to the seed crop. This possibility warrants further investigation, as efforts continue to develop pest management strategies for RCCB.

References

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Acknowledgments

The authors thank J. Otani and A. Jorgensen, Agriculture and Agri-Food Canada Insect Pest Management Program, Beaverlodge Research Station, Alberta, Canada; Oregon Clover Commission; and Baker, Malheur, and Union County clover seed producers Joe Hill, Bryan Bachelder, Ken Laubacher, John Frisch, and Curt Ricker for their generous support of this project.

Table 2. Mature red clover seed head assessment for RCCB larvae damage from each pheromone trap monitoring site in eastern Oregon, 2019.

Site	Field I.D.	Mature heads collected	Collection date	Visible damage			Damaged florets	Larvae in heads
				Eggs		Larvae		
		(no.)		------ (no. heads with) ------			---------- (no.) ----------	
Union-1	CR-1 (2 yr)	100	Aug. 13	0	8	0	54	0
Union-2	BD-4 (2 yr)	100	Aug. 13	0	6	0	10	0
Baker-1	JH-2 (2 yr)	100	Aug. 6	0	1	0	1	0
Malheur-1	South-mow (2 yr)	100	Aug. 19	0	3	0	4	0
Malheur-2	Middle (2 yr)	105	Jul. 26	0	6	0	10	0
Malheur-3	North (1 yr)	100	Sep. 3	0	1	0	1	0
Malheur-4[1]	By North (2 yr)	100	Sep. 3	0	0	0	0	0
Total		705		0	25	0	80	0

[1]Malheur-4 was not monitored during the season with a pheromone trap; however, mature heads were collected and evaluated due to its proximity to Malheur-3.