1. **Title:** Management Options to Control Lesser Clover Leaf Weevil in Red Clover
2. **Funders:** Saskatchewan Forage Seed Development Commission (SFSDC)
   The project was supported in part by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward bi-lateral agreement.
3. **Contact:**
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4. **Researchers:** Stewart Brandt and Stephanie Ginter, Northeast Agriculture Research Foundation, Melfort SK.
5. **Objectives:**
   Controlling lesser clover leaf weevil has become an important operation in the production of red clover seed in Saskatchewan, yet producers are often unsure of proper timing of application. SFSDC wanted to evaluate and demonstrate the proper timing and efficacy of insecticide applications to benefit growers.
6. **Methodology:**
   On June 9, 2015 red clover (variety Belle) was planted at 4.2 kg/ha seeding rate in an area approximately 50M x 90M into a tilled seedbed at the Agriculture and Agri-Food Canada (AAFC) Research Farm, Melfort, SK. Planting was done with a Conserva-Pak seeder. Seedbed moisture conditions were good, the site having received ample rain during the previous week. The red clover established very well, but was somewhat weedy in 2015. The crop was mowed 2 times during the summer of 2015 to reduce competition with weeds and restrict weed seed development. By the spring of 2016 it was well established and very competitive with weeds to the extent that it was relatively weed free.
   In 2016, 3M x 8M plots were measured in the established red clover and the treatments were replicated 4 times.
   Starting May 16, 2016 and approximately every three days, the planned test area was monitored for the presence of lesser clover leaf weevil **(Figures 1 and 2)**. On each monitoring date, 20 red clover plant stems were analyzed and the number of weevil larvae was counted. On June 6, 2016 the hatch was determined to be underway and the first timing of the insecticide was applied **(Table 1)**. Decis EC was applied at 100ml/ac in 40 L/ac spray solution, using a hand-held sprayer. The following week, 5 stems were collected and analyzed from each plot. The later application of Decis EC at 100ml/ac in 40 L/ac spray solution was made on June 13, 2016. The red clover commenced flowering June 13, 2016. Weevil counts were repeated June 27, 2016.
   On June 20, 2016 and July 20, 2016 sweep nets were utilized to collect and identify the insects **(Figure 3)** that were present in the trial.
   The trial was desiccated with a double pass of Reglone at 0.7 L/ac in 91 L/ac water to ensure good coverage. Harvest was completed on August 30, 2016 with a Wintersteiger plot combine. Grain samples were dried to 0 per cent moisture, cleaned and weighed to assess yield.

Table 1: Treatment list for lesser clover leaf weevil trial at Melfort SK 2016

Treatment	Timing	Product
1		untreated
2	Early (June 6)	Decis EC
3	Late (June 13)	Decis EC

7. Results:

Weather

The 2016 growing season was characterized by being both warmer and wetter than normal (**Table 2**). The only month where the average monthly temperature was cooler than normal was August, and the average for April 1 through October 31 was 1.1 degrees above the long term normal. In addition, 2016 had a long frost free period with the first fall frost recorded on October 4 when it normally occurs near September 10. The season started quite dry with much less than normal rain in April and May. Crops recovered well with near normal rain in June and much above normal rain in July and August.

Table 2: Mean temperatures and precipitation collected from the AAFC weather station at Melfort, Sk., in 2016 from April to October.

	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Ave/Total
				--- Temperature (^{o}C) ---				
2016	**2.9**	**13.6**	**17.1**	**18.1**	**16.3**	**13.2**	**4.3**	**12.2**
Long –Term[z]	**2.8**	**10.7**	**15.9**	**17.5**	**16.8**	**10.8**	**3.3**	**11.1**
				--- Precipitation (mm) ---				
2016	**14**	**16.8**	**53.2**	**128.7**	**80.8**	**41.3**	**57.7**	**392.5**
Long-Term[z]	**27**	**42.9**	**54.3**	**76.7**	**52.4**	**38.7**	**27.9**	**319.9**

[z] Long-term data is 1981 to 2010 from Environment Canada records

Lesser Clover Leaf Weevil Monitoring and Counts Discussion

On May 16, 2016, one lesser clover leaf weevil larva was noted in the 20 stems examined. On May 19 and 24, 2016, no larvae were detected, only one on May 27, 2016 and 3 on May 30, 2016. On June 1, 2016, 3 larvae were detected, with 2 on June 3, 2016 and 5 larvae in 20 stems on June 6, 2016.

On June 13, 2016, after the first insecticide applications, but before the late application, weevil larvae numbers were highest in the untreated check (Treatment 1), and lower where Decis EC had been applied (**Table 3**). Note: Treatment 3 was not evaluated at this time. On June 20, 2016, weevil larvae numbers had increased compared to June 13 in the untreated check (**Figure 4**). In addition, larvae numbers were lower where Decis EC (Treatments 2 and 3) was applied. It did not appear there were differences in weevil larvae numbers where the insecticide was applied early (Treatment 2) versus late (Treatment 3).

However, to detect differences in control between application timings would require more data collection on both insect numbers over time as well as evaluation of the degree of leaf damage caused by the weevils. For example, early or late applications may be equally effective at controlling the weevil larvae, but late application may allow

them to do considerably more damage before they are controlled.
On June 27, 2016, weevil larvae were counted in the untreated check and Treatment 3. At this time, weevil larvae numbers were highest for the untreated check treatment and lower in the Decis EC treated areas (**Table 3**).
Note: No statistical analysis of the weevil larvae numbers were done, so results need to be viewed with some caution.

Table 3. Lesser clover leaf weevil numbers per 20 stems examined at 3 dates after insecticide application at Melfort in 2016.

		Treatment Number		
Sampling Date	**Weevil stage**	**1**	**2**	**3**
June 13	**Larvae**	**8**	**2**	**-**
	Pupating	**0**	**0**	**-**
	Second Hatch	**2**	**0**	**-**
	TOTAL	**10**	**2**	**-**
June 20	**Larvae**	**15**	**2**	**2**
	Pupating	**0**	**1**	**0**
	Second Hatch	**0**	**1**	**0**
	TOTAL	**15**	**4**	**2**
June 27	**Larvae**	**6**	**-**	**2**
	Pupating	**2**	**-**	**1**
	Second Hatch	**1**	**-**	**0**
	TOTAL	**9**	**-**	**3**

Seed Yield
Red clover seed yield (**Table 4**) did not appear to be affected by any treatment. This is likely because lesser clover leaf weevil numbers were too low to cause significant crop damage. With very favorable moisture conditions during 2016, it is likely that the crop recovered from any damage caused by the insect pest or at least to compensate for damage. Under more stressful conditions or where weevil numbers are higher, yield responses could occur. For these reasons, it would be advisable to conduct trials over more locations or years to generate a good understanding of the efficacy of insecticide treatments in protecting red clover seed yield from damage by this pest.

Table 4: Influence of lesser clover leaf weevil control on red clover seed yield at Melfort in 2016.

Treatment	**Yield (lb/ac)**
Untreated Check	**578**
Decis EC Early	**561**
Decis EC Late	**563**

Other Insects
On June 20, 2016 and July 20, 2016, Stephanie Ginter, NARF and Victoria Nameth,

Saskatchewan Agriculture carried out sweep net monitoring of the insects within the clover area at the NARF site near Melfort SK. This activity was not used to measure insect control, but for identification only. Each sample consisted of two 180 degree sweeps and the insects were collected and identified. Insects present in this survey included pests such as: lygus bug (**Figure 7**), lesser clover leaf weevil adults (**Figure 8**), pale legume bug, tarnished plant bug, stink bug, aphids, Western tarnished plant bug and chinch bug as well as beneficial insects like: lady bug, damsel bug (**Figure 5**), and lacewing (**Figure 6**).

8. Conclusions:

The 2016 growing season was characterized by being both warmer and wetter than normal. Extensive monitoring of the established red clover crop for lesser clover leaf weevil, starting on May 16, 2016, revealed that the hatch was determined to be underway on June 6, 2016 and the first timing of the insecticide was applied.

After the first application of Decis EC, weevil larvae numbers were higher in the untreated check and lower where Decis EC had been applied. After the late application, weevil larvae numbers had increased in the untreated check and larvae numbers were lower where Decis EC had been applied. Weevil numbers did not vary from where the insecticide was applied early versus late.

Red Clover seed yield did not appear to be affected likely because lesser clover leaf weevil numbers were low and they did not cause significant damage to the crop.

For these reasons, it would be advisable to conduct trials over more locations or years to generate a good understanding of the efficacy of insecticide treatments in protecting red clover seed yield from damage by this pest.

This project provided valuable experience in monitoring and identifying development and activity of lesser clover leaf weevil in red clover seed crops. This information will be put to great use in future research projects.

9. Acknowledgements:

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Figure 1. Adult lesser clover leaf weevil damage. Melfort SK. June 9, 2016. Source: SFSDC

Figure 2. Lesser clover leaf weevil larva feeding in stem. Melfort SK. June 9, 2016. Source: SFSDC

Figure 3. Lesser clover leaf weevil project. Melfort SK July 2016. Source: SFSDC

Figure 4. Lesser clover leaf weevil larva in untreated check. Melfort SK June 20, 2016. Source: NARF

Figure 5. Damsel bug nymph. Melfort SK. July 20, 2016. Source: Sask. AG

Figure 6. Lacewing larva eating aphid. Melfort SK. July 20, 2016. Source: Sask. AG

Figure 7. Lygus bug adults. Melfort SK. July 20, 2016. Source: Sask. AG

Figure 8. Lesser clover leaf weevil adults. Melfort SK. July 20, 2016. Source: Sask. AG