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Pest Management Centre - Agriculture and Agri-Food Canada

Pesticide Risk Reduction Strategies Initiative

Final Report
December 31, 2011

Project Title: On-farm Field Demonstration of the Use of Bio-fungicides within an Integrated Approach: (To Manage Sclerotinia Diseases in Dry Bean and Canola Crops)

Project Code: 01B68-8-0736

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Expenditures to date (FY 10/11):

Professional Fees	FY 2008/09	FY 2009/10	FY 2010/11	FY 2011/12
Student Labor	$0	$10,000	$10,000	$10,000
Project Supervision	$6,000	$9,000	$9,000	$9,000
Cooperator Compensation	$0	$10,000	$10,000	$10,000
Materials & Supplies	$4,500	$2,500	$2,500	$2,500
Travel & Incidentals	$4,000	$5,000	$5,000	$5,000
Project Coord. & Admin	$4,000	$5,000	$5,000	$5,000
Ceiling Price	**$18,500**	**$41,500**	**$41,500**	**$41,500**

Executive Summary

A soil-borne fungus, *Sclerotinia sclerotiorum*, is an economic threat to more than 380 ornamental, field crop, vegetable, and herb plants worldwide. It causes white mold, a major disease on canola and dry bean in western Canada. The fungus survives in soil for years as sclerotial bodies, the hard black survival structures produced by the fungus.

Some positive results have been found following a three year evaluation of two biofungicides, Contans WG and Serenade Max, to control Sclerotinia. Contans WG is a biological fungicide that controls Sclerotinia diseases by attacking the sclerotia in the soil before it can germinate and produce ascospores that can infect a susceptible plant. Once applied to the soil, Contans WG, which is the naturally occurring soil fungus *Coniothyrium minitans*, attacks the sclerotia. Contans WG is produced by Prophyta GmbH and distributed by United Agri Products. Serenade Max contains the active ingredient *Bacillus subtilis*

(QST 713) that effectively attacks spores of a wide variety of fungal disease organisms and prevents infection. Serenade Max, developed by AgraQuest, Inc. is distributed by United Agri Products.

Reductions in incidence and/or severity of sclerotinia in canola and white mould in beans and increases in yield were observed in many treated areas in commercial fields. However, there were cases in which the products did not appear to effectively reduce disease levels. This may be a result of field variability, application and incorporation issues such as timing, rates and methods of incorporation, or soil conditions, or possibly infection from neighbouring fields.

Strides have been made in increasing the awareness and adoption of biofungicides in an integrated management approach for crops susceptible to sclerotinia diseases. Over three years, 28 Contans applications were made on ten field sites in southern Alberta, in addition to the SARA R & D demo site at Lethbridge. These applications included rates of 2 and/or 4 kg/ha, and various foliar fungicides were also applied in combination with these treatments. Incorporation methods included various types of tillage, irrigation, and natural precipitation. Serenade was applied to 12 fields, six of which were also treated with Contans. Overall, 2009 field trials had the most severe disease ratings, with high incidence and severity seen in all but one. Producers' experiences with this high level of infection led to an unwillingness by most to leave untreated checks in the fields where trials wer located in 2010 and 2011.

Small mesh bags, called depots, containing sclerotia (bodies producing infectious sclerotinia spores) were buried in each treatment following each Contans application and then taken out and examined in the lab to estimate the rate at which the sclerotia were degraded by the Contans application. Depots in 2008 showed few positive results as only two treatments showed any *Coniothyrium*-colonized sclerotia. In 2009, three of eight sites showed Contans treatments with more colonized sclerotia than the untreated check. In 2010, it was four of seven sites, and in 2011, two of six sites. There was no clear trend or determining factor as to why sclerotia in some depots were colonized and others were not.

Two applications of Lance (boscalid) fungicide in Co-operator 5's bean field in 2009 was the most effective treatment in the entire project, with a yield increase of 67% over the untreated check. The largest yield increases compared to the check for Contans and Serenade were 11.2% in Co-operator 6's field in 2011 and 14.9% in Co-operator 9's field in 2009, respectively.

Reactions by co-operators to both the Contans and Serenade trials and the results have varied. However, Contans has been seen in a more positive light than Serenade. Several co-operators have stated that they like Contans, but are unsure that its cost is justified by the increase in yield. The greatest barrier to more broad use of biofungicides is the perceived lower rate of return on investment when compared to conventional fungicides. Also, the longer-term approach required of Contans makes it more difficult to evaluate since the full benefit of the application may not be realized for several years to come.

Definitions

Contans application timing presents four options for producers to consider (Figure 1). The first option is to apply Contans in the fall of the year before a susceptible crop (BSC), indicating fall product application when a susceptible crop is planned for the following spring. The next option is BSC in the spring, where application occurs just before the seeding of a susceptible crop. A third option is applying after a susceptible crop (ASC) in the fall, with application just after the harvest of the susceptible crop. Finally, there is the option to apply ASC in the spring, in which case the product is applied just before the seeding of a non-susceptible crop into a field where a susceptible crop was grown the previous season.

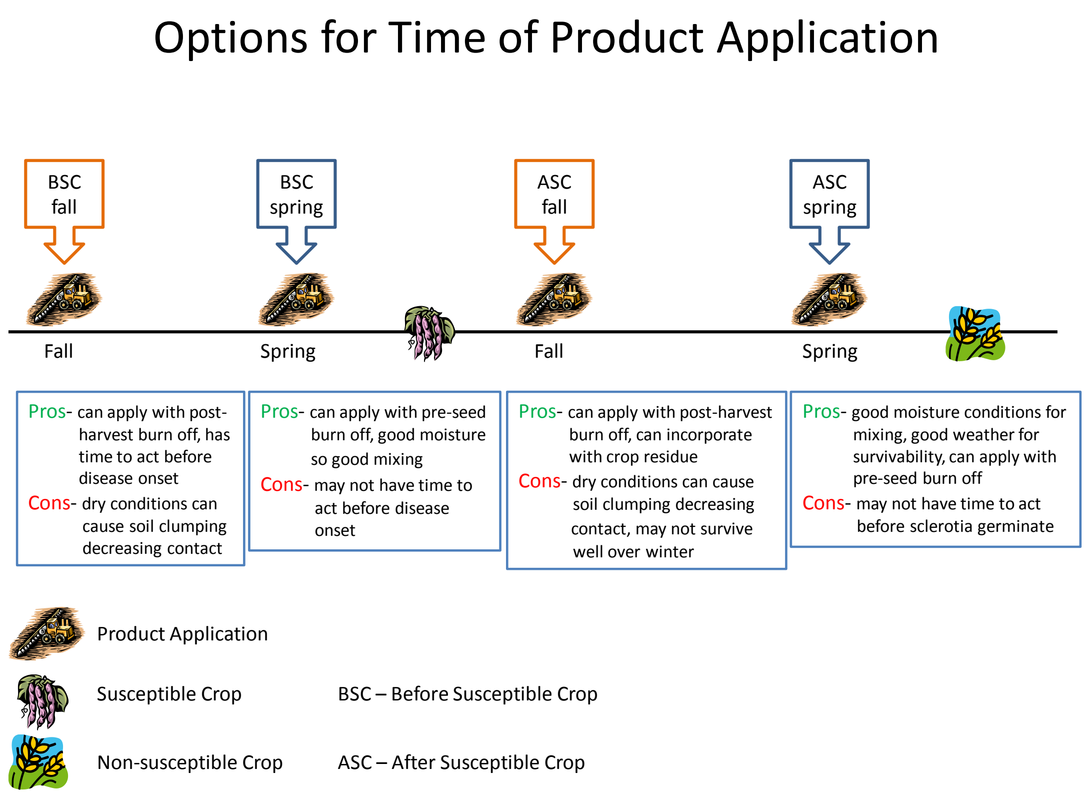


Figure 1. Application timing options for Contans

Materials and Methods

Commercial Field Sites

The 2011 study included ten commercial field sites and one demonstration site (Table 1, Figure 2). All sites had check strips with no Contans (but foliar fungicides were applied in all but three cases) and treatments of either two or four kilograms of Contans WG per hectare. Several fields and the demonstration site included both rates (Table 2). Contans applications were completed in the fall and spring, and the product was incorporated into the soil using tillage, precipitation or irrigation. Details are outlined in Table 2 and Figure 3. Treatments in the Serenade trial included Serenade alone and tank-mixed with Lance or Allegro.

Co-operator	Location	Latitude	Longitude
Contans			
1	Enchant	50.1900	-112.4671
2	Nobleford	49.8330	-112.9984
3	Grassy Lake	49.6586	-111.6472
4	Tempest	49.8332	-112.4827
5	Bow Island	49.8986	-111.3636
6	Bow Island	49.6950	-111.4328
7	Grassy Lake	49.6877	-111.6247
8	Vauxhall	50.1171	-111.9666
9	Bow Island	49.9132	-111.3864
10	Lethbridge	49.7017	-112.7395
11	Chin	49.8149	-112.4489
Serenade Only			
3	Grassy Lake	49.6625	-111.6647
6	Bow Island	49.7063	-111.4389
8B	Vauxhall	50.1864	-111.9726
8C	Vauxhall	50.1866	-111.9498
12	Burdett	49.7491	-111.5292
13	Scandia	50.2157	-112.1319

Table 1. Geographic locations of Contans and Serenade field demonstrations

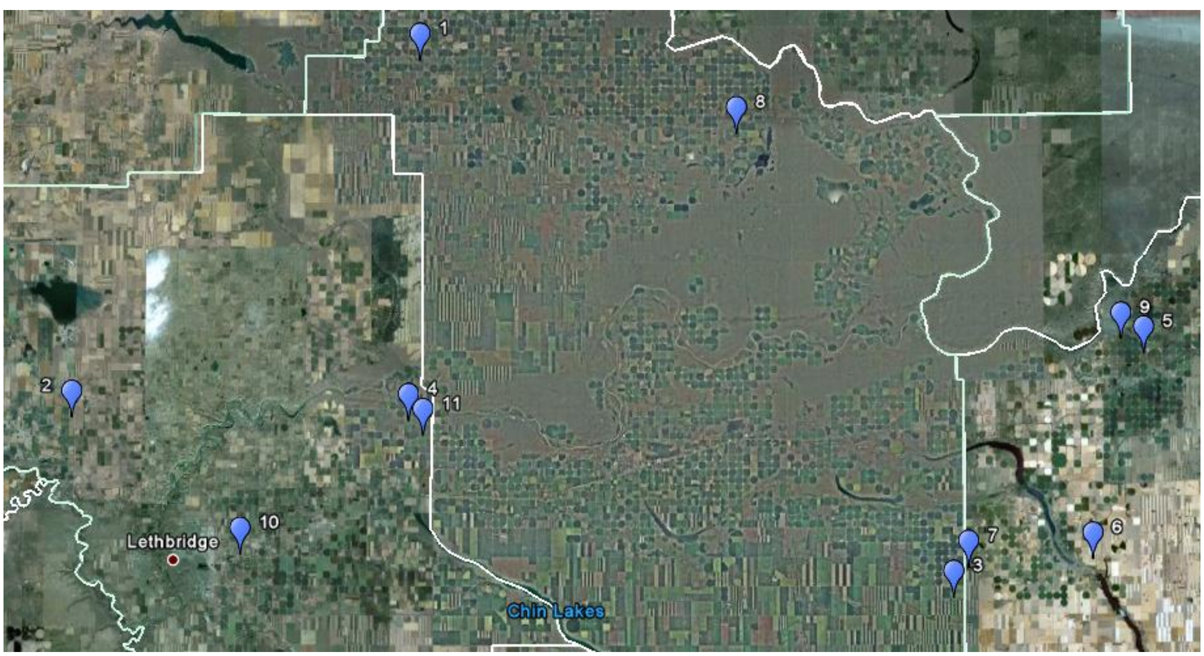


Figure 2. Locations of the eleven Contans demonstration sites.

Co-operator	Year	Crop	Application Rates	App. Date	Incorporation Method	Incorp. Date
1	2008	Durum	2 kg/ha	Oct. 20	Heavy Harrows	Oct. 20
	2009	Durum	not applied	N/A	N/A	N/A
	2010	Seed Canola	2 kg/ha	Apr. 27	Heavy Rain	Apr. 28
	2011	Durum	not applied	N/A	N/A	N/A
2	2008	Silage Corn	2 kg/ha	Oct. 18	Cultivator Harrow Packer	Oct. 18
	2009-11	no longer participating	N/A	N/A	N/A	N/A
3	2008	Dry Beans	2 kg/ha	Oct. 9	Irrigation (0.63 cm)	Oct. 10
	2009	Canola	2 kg/ha	Oct. 6	Irrigation (0.63 cm)	Oct. 6
	2010	Cereal	not applied	N/A	N/A	N/A
	2011	Flax	2 kg/ha	July 5	Irrigation (1.26 cm)	July 5
4	2008	Silage Corn	2 kg/ha	Oct. 27	Disc ripper X 2	Oct. 28
	2009	Dry Beans	2 kg/ha	Nov. 3	Disc Ripper X 2	Nov. 4,5
	2010	HRS Wheat	2 kg/ha	Oct. 28	Disc Ripper X 2	Oct. 29
	2011	Potatoes	not applied	N/A	N/A	N/A
5	2008	HRS Wheat	2 kg/ha	Oct. 24	Cultivator Harrow Packer	Oct. 24
	2009	Dry Beans	not applied	N/A	N/A	N/A
	2010	HRS Wheat	4 kg/ha	May 16	Cultivator Harrow Packer	May 17
	2011	Sugar Beets	2 and 4 kg/ha	June 21	Irrigation (0.63 cm)	June 22
6	2008	HRS Wheat	2 and 4 kg/ha	Oct 23	Cultivator Vibrashank	Oct. 24 & 31
	2009	Canola	not applied	N/A	N/A	N/A
	2010	Cereal	not applied	N/A	N/A	N/A
	2011	Dry Beans	2 and 4 kg/ha	July 12	Irrigation	July 14
7	2008	Durum	2 kg/ha	Oct. 12	Disc Ripper	Oct. 13 &14
	2009	Dry Beans	not applied	N/A	N/A	N/A
	2010	HRS Wheat	2 kg/ha	May 16	Disc Ripper	May 16
			2 kg/ha	Oct. 12	Disc Ripper	Oct. 12
	2011	Dry Beans	not applied	N/A	N/A	N/A
8	2008	Canola	2 and 4 kg/ha	Oct. 27	Discer	Oct. 27
	2009	Wheat	not applied	N/A	N/A	N/A
	2010	Dry Beans	2 and 4 kg/ha	May 19	Discer	May 20
			2 and 4 kg/ha	Oct. 15	Discer	Oct. 15
	2011	Cereal	not applied	N/A	N/A	N/A
9	2008	HRS Wheat	2 and 4 kg/ha	Oct. 24	Cultivator Harrow Packer	Oct. 24
	2009	Dry Beans	not applied	N/A	N/A	N/A
	2010	Durum	2 and 4 kg/ha	Apr. 27	Heavy Rain	Apr. 28
	2011	Sugar Beets	2 and 4 kg/ha	May 7	Cultivator Harrow Packer	May 7
10	2008	Barley	2 and 4 kg/ha	Nov. 13	Cultivator Harrows	Nov. 13
	2009	Canola + Dry Beans	2 and 4 kg/ha	Nov. 4	Cultivator Harrows	Nov. 4
	2010		2 and 4 kg/ha	Nov. 5	Cultivator Harrows	Nov. 5
	2011		not applied	N/A	N/A	N/A
11	2008	Silage Corn	not on project	N/A	not applicable	N/A
	2009	Potatoes				
	2010	Spring Wheat	4 kg/ha	July 30	Irrigation (0.6 cm)	July 30
	2011	Dry Beans	4 kg/ha	July 21	Irrigation (0.07 cm)	July 21

Table 2. Contans application, incorporation, and site details 2008 to 2011

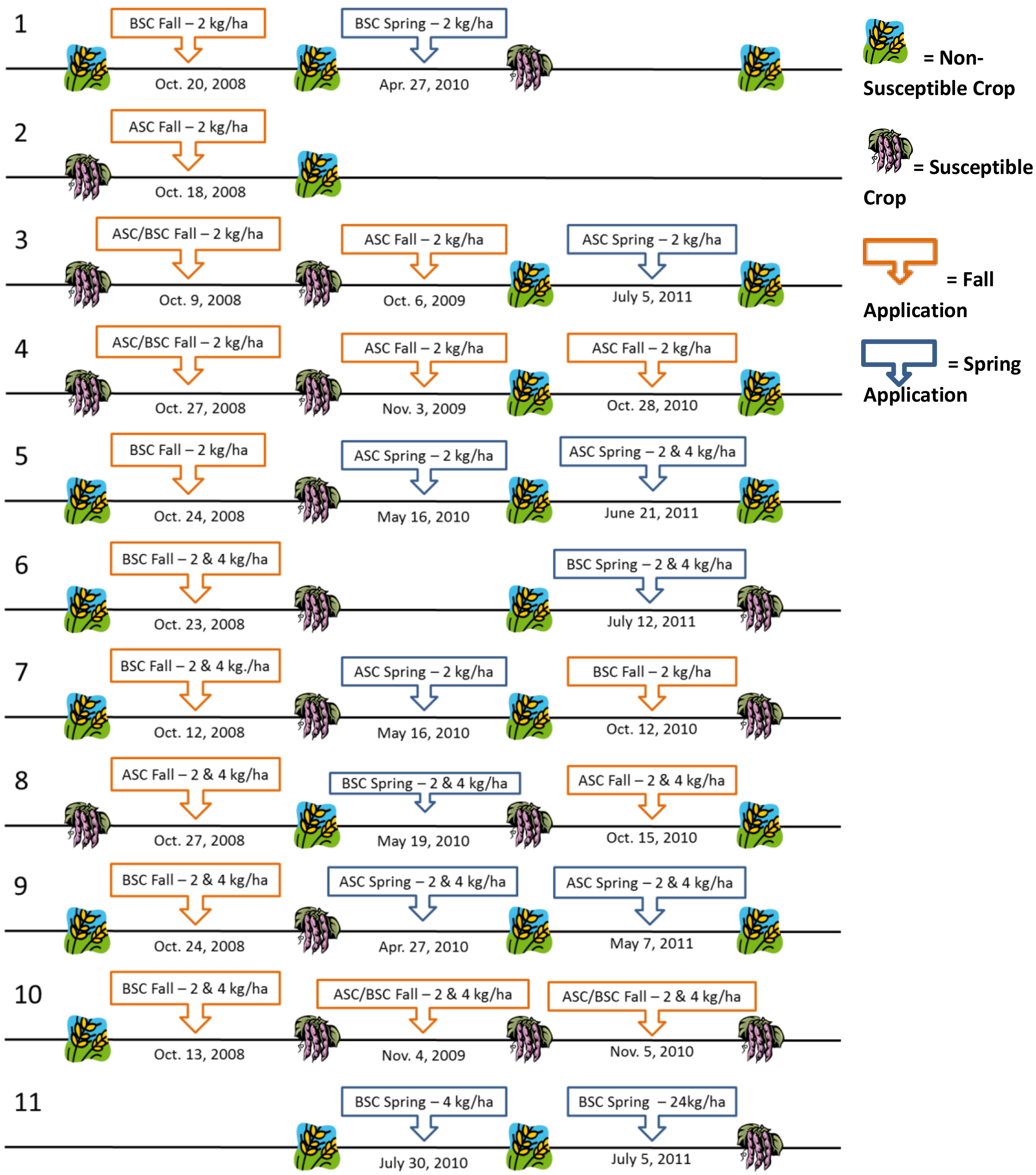


Figure 3. Contans application timings and sequences of susceptible and non-susceptible crops.

Depots and Disease Ratings

Depots for the fall-sprayed sites were exhumed in the spring. Depots from the spring and summer sprayed sites were exhumed one to three months after they were planted. They were analyzed by staff from Dr. Ron Howard's lab (ARD Pathologist) at Brooks, as per the protocol found in Appendix A (Figures 4 & 5).

Figure 4. Removing sclerotia from depot soil

Figure 5. Sclerotia ready to be plated

Disease ratings were taken on the Contans trial fields that were sown to susceptible crops each year, and in the bean fields that included only Serenade trial applications. Plants in each field were assessed for disease incidence and severity according to the rating scales in Tables 3 and 4. All ratings started 50 meters from the field edge and continued at 30 meter intervals from this initial sampling location.

Rating	Weight	Location	Symptoms
0	0.00	None	Healthy Plant (no disease)
1	0.10	Pod	Infection of pods only
2	0.25	Upper	Lesion situated on main stem or branch(es) with potential to affect up to 1/4 of seed formation and filling on plant
3	0.50	Upper	Lesion situated on main stem or on a number of branches with potential to affect up to 1/2 of seed formation and filling on plant
4	0.75	Upper	Lesion situated on main stem or on a number of branches with potential to affect up to 3/4 of seed formation and filling on plant
5	1.00	Lower	Main stem lesion with potential effects on seed formation and filling of entire plant

Table 3. Sclerotinia stem rot rating guide for canola

Moderate/Low Infection		Severe Infection*	
Rating	**Description**	**Rating**	**Description**
0	Healthy Plant (no disease)	0	Healthy Plant (no disease)
1	1-15% of the foliage infected (mostly small branches and occasional pods infected)	1	1-25% foliage infected (several small branches and pods infected and/or slight infection of the main stem
2	16-25% of the foliage infected (several small braches and pods infected and/or slight infection of main stem)	2	26-50% of the foliage infected (several small branches and pods infected and/or moderate to severe infection of the main stem; some plants dead)
3	>25% of the foliage infected (several small branches and pods infected and/or any infection to main stem; some plants dead)	3	>50% of the foliage infected; many plants dead

Table 4. White mould rating guide for beans

*Severe Infection scale rating was used for all fields

SARA Demonstration Site at Lethbridge

The SARA demonstration site was established in the spring of 2009 and continued through the next two seasons. Contans was applied for three consecutive years in early November and incorporated with cultivator harrows the same day in the tilled plots. No incorporation was done on the no-till plots. The product was applied at both the 2 and 4 kg/ha rates. The plots were seeded in the spring with canola approximately two weeks before bean seeding. Vantage Plus Max II was applied for weed control in the canola portion of the plots, and Solo + Basagran Forte in the bean portion (Figure 6).

Figure 6. SARA R & D research plots, July 2011

Tillage

Tillage information was collected for all sites over the duration of the trial (Table 5).

Co-operator	2008 Tillage	2009 Tillage	2010 Tillage	2011 Tillage
1	Heavy harrow (<2")	Vertical tillage machine (low disturbance)	None	None
2	Cultivator harrow packer	None	N/A	N/A
3	None	Heavy harrow (<2")	None	None
4	Disc ripper (3 -5")	Spring- cultivator (5"), fall- disc ripper (3 -5"),	Fall- Disc ripper (3 -5"), spring- cultivator (5")	Potato hilling (6")
5	Disc ripper (10")	Spring- harrow (3-4"), ridged for beans (5")	Fall- disc ripper (10")	Spring- cultivator packer x2 (2")
6	Pending	Pending	Pending	Pending
7	Disc ripper (1'), vibrashank (<2")	Vibrashank (<1")	Spring & fall- Disc ripper (1')	None
8	Disc (1.5"), vibrashank	Disc ripper (12"), disc (5")	Ridged for beans (4")	None

9	Cultivator harrow packer (2")	Spring- cultivator x2 (4"), in-row cultivation (2"), dammer-dyker (5") Fall- chisel plow (7") cultivator w/ air seed (4")	Spring- cultivator (3") Fall- disc ripper (12"), cultivator (4")	Spring- cultivator harrow packer (3"), dammer-dyker (5")
10	Cultivator harrows x2 (tillage plots only)	Cultivator harrows x2 (tillage plots only)	Cultivator harrows x2 (tillage plots only)	None
11	N/A	N/A	Fall- heavy harrow (<1"), cultivator harrows (3"), subsoil tillage- little mixing (16")	Spring- cultivator harrow x2 (4"), cultivated (2"), dammer-dyking (4") Fall- light chisel (2"), chisel (3")

Table 5. SARA R & D research plots, July 2011

Results and Discussion

Environmental Conditions

Weather conditions throughout the term of the trial made completing necessary operations difficult for the co-operators. Conditions were dry in the fall of 2008, causing clumping of soil, preventing good incorporation of Contans and contact of the product with the sclerotial bodies. The growing season of 2009 was cool and wet, with frequent precipitation during the critical disease development period, leading to high levels of white mold.

2010 brought a very wet spring (see Appendix B), with considerable flooding throughout southern Alberta (Figure 7). Many of the trial fields had drowned-out areas and/or delayed seeding, and Co-operator 6's field did not receive a Contans treatment at all in 2010 due to excessive moisture. Weather difficulties in the spring lead to some co-operators being unwilling to leave untreated checks, as they were already concerned about potential white mold severity and yield reductions. This removed the ability to compare biofungicides to untreated check scenarios.

Figure 7. Flooding near Co-operators 4 and 11's fields

Spring of 2011 was also very wet, and the excessive moisture caused issues with spring applications. Co-operator 1's field did not receive a spring treatment of Contans due to poor weather conditions. Co-operators 6 and 11's bean fields did not receive the in-crop Contans treatment until approximately a month before flowering, due to environmental conditions, and the inability to incorporate the Contans using irrigation. The excess moisture also led to late seeding in some cases, and drowned-out areas in two fields. Unwillingness to leave checks did not allow a comparison of biofungicides to untreated areas, except in Co-operator 11's case, where a small check strip was left.

Sclerotial Depots

Depots were buried, dug up and analysed each year from most of the commercial field sites (Table 6). The sclerotia from the depots were tested for colonization of *C. minitans* and the number of sclerotia that were colonized from each treatment was recorded. The first complete set of depots was exhumed in December 2008, approximately one month after application and incorporation, to determine how much colonization activity by the *C. minitans* had occurred since Contans applications. Results from these assessments showed positive results for Co-operator 6's untreated check and Co-operator 8's 2 kg/ha treatment (Table 5). The presence of colonized sclerotia in the untreated checks is likely due to naturally occurring *C. minitans* in the soil, as this fungus is native to Alberta soils.

The second complete set of depots was removed in the spring of 2009 and assessed by Dr. Howard's lab. Analysis of these depots proved difficult as many of the sclerotial bodies had deteriorated and/or broken in several parts. Positive identification of *C. minitans* was complicated by the presence of other colonizing fungi, such as *Rhizopus*, *Mucor* and *Trichoderma*. Irrigated soils are very biologically active and a wide variety of microflora and microfauna contribute to the breakdown of organic matter, such as sclerotia. *Coniothyrium* incidence on sclerotia in untreated and treated fields and ranged from 0 to 100% (Table 6). The highest positive results were from Co-operator 4 and 5's fields.

Co-operator	Contans	2008 # Positive*/ Total Plated	2009 # Positive*/ Total Plated	2010 # Positive*/ Total Plated	2011 # Positive*/ Total Plated
1	Untreated	0/5** (0%)	0/8 (0%)	6/31 (19%)	N/A
	2 kg/ha	0/5 (0%)	4/33 (12%)	12/22 (55%)	N/A
2	Untreated	0/5 (0%)	0/25 (0%)	N/A	N/A
	2 kg/ha	0/5 (0%)	0/28 (0%)	N/A	N/A
3	Untreated	0/5 (0%)	0/6 (0%)	N/A	0/20 (20%)
	2 kg/ha	0/5 (0%)	0/7 (0%)	N/A	1/16 (6%)
4	Untreated	0/5 (0%)	13/29 (45%)	4/30 (13%)	0/24 (0%)
	2 kg/ha	0/5 (0%)	7/9 (78%)	6/38 (16%)	0/29 (0%)
5	Untreated	0/5 (0%)	5/7 (71%)	7/16 (44%)	1/5 (20%)
	2 kg/ha	0/5 (0%)	6/6 (100%)	N/A	0/1 (0%)
	4 kg/ha	N/A	N/A	19/20 (95%)	12/16 (75%)
6	Untreated	1/5 (20%)	N/A	N/A	25/28 (89%)
	2 kg/ha	0/5 (0%)	N/A	N/A	6/31 (19%)
	4 kg/ha	N/A	N/A	N/A	33/36 (92%)
7	Untreated	0/5 (0%)	10/27 (37%)	6/20 (30%)	N/A
	2 kg/ha	0/5 (0%)	3/29 (10%)	4/17 (24%)	N/A
8	Untreated	0/5 (0%)	2/24 (8%)	8/28 (29%)	N/A
	2 kg/ha	1/5 (20%)	6/27 (22%)	8/26 (31%)	N/A
	4 kg/ha	0/5 (0%)	5/30 (17%)	14/24 (58%)	N/A
9	Untreated	0/5 (0%)	3/9 (33%)	7/16 (44%)	2/4 (50%)
	2 kg/ha	0/5 (0%)	1/8 (13%)	2/12 (17%)	4/7 (57%)
	4 kg/ha	0/5 (0%)	0/3 (0%)	12/27 (44%)	2/8 (25%)
10	Check – no sclerotia, no till	N/A	0/4 (0%)	N/A	0/30 (0%)
	Check – sclerotia, no till	N/A	0/2 (0%)	0/14 (0%)	4/18 (22%)
	Check – sclerotia, 1 till	N/A	0/5 (0%)	2/24 (8%)	0/8 (0%)
	2 kg/ha – sclerotia, no till	N/A	1/9 (11%)	0/24 (0%)	0/19 (0%)
	4 kg/ha – sclerotia, no till	N/A	2/4 (52%)	5/27 (19%)	0/17 (0%)
	2 kg/ha – sclerotia, 2 till	N/A	0/6 (0%)	7/26 27%)	0/6 (0%)
	4 kg/ha – sclerotia, 2 till	N/A	0/4 (0%)	14/27 (52%)	0/5 (0%)
11	Untreated	N/A	N/A	5/17***(29%)	32/35 (91%)
	4 kg/ha	N/A	N/A	9/18***(50%)	15/30 (50%)

Table 6. Depots results for commercial field-scale sites and SARA demonstration site

*Positive refers to the sclerotia that were colonized by *C. minitans*

**For the 2008 depots, five sclerotia were deposited per treatment. For 2009-2011 depots, 30 sclerotia were deposited per treatment.

***Only 20 sclerotia were analyzed for each of these two treatments in 2010.

The results from the depots in 2010 were inconclusive for co-operators 4, 7, 8, and 9 (Table 7). However, the results from Co-operators 1, 5, and 11 showed a higher percentage of *Coniothyrium*-colonized sclerotia in the Contans treatments compared to the untreated checks. It is uncertain what caused this difference, as co-operators from both groups made spring applications at similar times, and a variety of incorporation methods were seen among all fields.

Depot results from 2011 were inconclusive for co-operators 3, 4, 9, and 11. Co-operator 5 had a positive result in the 4 kg/ha treatment, with a much higher colonization rate than in the check and 2 kg/ha treatments. Co-operator 6 also had a high colonization rate in the 4 kg/ha treatment, but the check also had a high rate of *Coniothyrium* recovery.

SARA Demo Plot Depot Results

Depots exhumed from the Lethbridge plots in 2009 tested positive for *C. minitans* only in the zero-tillage treatment, with 11% and 50% colonization in the 2 kg/ha and 4 kg/ha rates, respectively (Table 6).

The analyses of the depots from 2010 have provided some interesting results. A key lesson from these data is that incorporation is a very important contributor to the efficacy of the Contans product, as the percentage of sclerotia from the depots that tested positive for *C. minitans* colonization was much higher in the tilled plots than the corresponding untilled plots.

The results of the depot analysis in 2011 have proven to be inconclusive. Only one plot (2) showed any colonized sclerotia, i.e. the sclerotia recovered from the check plot receiving no tillage. However, it is important to note that less than the 30 sclerotia that were deposited were recovered for plating because they were degraded and unrecoverable, except in Plot 1. This may have been due to the reduced efficacy of the Contans applied, enhanced activity of *C. minitans* and other sclerotia-degrading microorganisms already found in the soil, or the very wet soil conditions occurring in the spring from above-average amounts of snow and rain.

Disease Assessments and Seed Yields

Disease assessments were made in Contans- and Serenade-treated fields for all three years of the trial. Results varied greatly, with incidence and severity ranging over the entire scale for both parameters. Overall, 2009 saw the highest disease ratings, with high incidence and severity levels seen in all but one field.

It is important to note that, in most cases, higher disease ratings for treatments did not necessarily translate to lower yields. This can be attributed to two factors, or a combination of both. The first is the nature of the white mold disease, since it develops in the healthiest areas of the crop due to increased humidity in a denser canopy. This may reduce yield, but often not reducing it below comparable yields in less dense areas of the crop, where disease incidence and/or severity are often lower. Second is the variability of disease based on previous years' infestations and variability of soils. These factors can make it difficult to interpret disease ratings and draw conclusions about the efficacy of the products.

2009 Season - Contans

Disease pressures in 2009 were such that percent incidence in the untreated checks and Contans treatments were close to 100% at all sites, with the exception of Co-operator 6's canola (Table 7). Two applications of Lance at Co-operator 5's bean field was the most effective treatment where disease incidence was reduced from 88 to 28%, severity from 1.9 to 0.65, and yield increased 67% from 2315 to 3439 kg/ha compared to the untreated check.

The Contans treatments did not reduce disease incidence when used in combination with Lance at any of the trial locations, and the severity increased at all locations. The reason for the increased severity is unknown; however it is unlikely that this increase was caused by the application of Contans.

Crop yields increased at three locations for the Contans treatment. Co-operator 6's canola yield increased 10% from 3369 to 3706 kg/ha and Co-operator 5's beans increased 17% from 2315 to 2709 kg/ha. Co-operator 5's Serenade + Contans treatment marginally increased yield compared to the untreated check by 111 lb/ac (4.7%), the Contans only treatment by 394 lb/ac (17.0%), and the Contans + Lance treatment by 784 lb/ac (33.9%). However, the Lance x2 treatment had the greatest efficacy, with a yield increase of 1124 lb/ac (48.6%) over the untreated check. Co-operator 9's Contans applications also had higher yields than the untreated check, with yield increases ranging from 60 lb/ac (4.1%) for the Contans only treatment to 712 lb/ac (49.5%) for the Contans + Lance treatment.

Co-operator	Crop	Treatment	Severity Rating	% Incidence	Yield (lb/ac)
2	Canola	Untreated	1.2	71	N/A
		Contans	1.7	90	N/A
		Paired t-test P	0	0	
		P (trt)	0	0	
		Std. Error	0.03	2	
3	Canola	Untreated	1.49	88	N/A
		Contans	2.03	99	N/A
		Contans and Serenade	1.9	98	N/A
		Serenade	2.16	100	N/A
		P (trt)	0.22	0.32	
		Std. Error	0.22	5	
4	Beans	Untreated	1.9	88	3355
		Contans	2.03	94	3341
		Paired t-test P	0.24	0.15	
		P (trt)	0.48	0.3	
		Std. Error	0.12	3	
5	Beans	Untreated	1.9	88	2315
		Contans	2.2	94	2709
		Contans and Serenade	2.15	93	2426
		Contans and Lance	0.88	47	3099
		Serenade	1.23	52	2594
		Lance X 2	0.65	28	3439
		P (trt)	<.0001	<.0001	
		Std. Error	0.14	5	
6	Beans	Serenade	2.69	99	1654
		Lance	1.98	91	2526
		Lance and Serenade	2.06	93	2170
		P (trt)	0	0.03	
		Std. Error	0.1	2	
6	Canola	Untreated	0.22	17	3369
		Contans	1	83	3706
		Paired t-test P	0	0	
		P (trt)	0	0	
		Std. Error	0.08	6	
9	Beans	Untreated	2.58	100	1437
		Contans	2.65	100	1497
		Contans and Serenade	2.7	100	1659
		Contans and Lance	2.87	100	2149
		Serenade	2.48	97	1651
		Lance	1.92	93	2111
		P (trt)	<.0001	0	

		Std. Error	0.07	1	
13	Beans	Untreated	1.85	97	N/A
		Serenade	1.58	93	N/A
		Paired t-test P	0.11	0.24	
		P (trt)	0.22	0.49	

Table 7. 2009 Disease Ratings and Yield

2009 Season – Serenade

Serenade was applied in bean fields by Co-operators 5, 6, 9 and 13 (Table 7). Co-operator 6 did not leave an untreated check due to concerns over potential yield losses arising from unchecked white mold infection. Serenade had significantly less efficacy at this site compared to Lance, and yield was reduced by 35% in the Serenade treatment compared to Lance. Serenade did show measurable efficacy compared to the untreated checks at the three remaining fields for disease incidence, severity and yield (avg. 13.5% increase). However, additional yield increases or reductions in disease were not observed at all four sites where Serenade was applied with Lance.

It is possible that under severe white mold infestation either higher rates or split applications of Serenade may be required to achieve a measure of control. All Serenade treatments were sprayed at a total of 2 L/ha.

Co-operators 5 and 9's bean fields showed 33% and 32% yield increases with the application of Lance, respectively. Significant differences were also seen between the disease severities in untreated crops versus those treated with Lance. This highlights the ecological and economic importance of controlling this disease in beans.

2010 Season - Contans

Overall disease incidence ratings in 2010 were lower than in 2009, with average incidence across all fields dropping from 85% to 40%. The only exception was in Co-operator 5's bean field, which had a 98% disease incidence for both treatments (Table 8). These numbers are likely due to over fertilization resulting in a lush, tight canopy, thus increasing humidity which encouraged disease development. The field was over fertilized as the producer was originally planning to seed sugar beets, which require significantly more fertilizer than beans.

Figure 8. White mould hotspot in beans

Figure 9. Shauna Fankhauser rates canola plants

The most positive result came in Co-operator 1's canola field, where the 2 kg/ha Contans + Proline treatment showed a significant reduction in disease severity from the Proline only treatment. The disease incidence also decreased from 21% in the Proline only treatment to 6% in the Contans + Proline treatment. The disease pressure was very low in this field; however, the reduction in incidence was encouraging.

The other result of note was from Co-operator 8's field. This field showed no differences in disease levels between the Lance only and Contans 2 kg/ha plus Lance treatment, but significantly higher severity and incidence for both the Contans 4kg/ha + Lance treatment and the Contans 4 kg/ha + Lance plus Serenade treatment. This difference may be explained by field variation. The area of the field where the 4 kg/ha Contans treatment was applied was a low area in the field where moisture accumulated and severe disease pressure occurred where beans were grown four years ago. This may have resulted in a high sclerotial load in this region of the field, making the disease more severe. Despite the higher disease ratings in the Contans 4 kg/ha treatment, yield increased 333 lb/ac (11.8%) compared to the Lance only treatment to the Contans 4 kg/ha + Lance treatment, with a more modest increase of 187 lb/ac (6.6%) in the Contans + Lance + Serenade treatment. The data did need to be filtered as some of the yield numbers for the Contans 4 kg/ha + Lance and Contans 4 kg/ha + Lance + Serenade treatments included drowned-out areas, making the yield comparisons biased.

Co-operator	Crop	Treatment	Severity Rating	% Incidence	Yield (lb/ac)
1	Canola	Proline 480SC Only	0.36a	21	N/A
		Contans kg/ha + Proline 480SC	0.10b	6	N/A
		P (trt)	0.02		
		Std. Error	0.07		
3	Beans	Lance Only	0.47	28	N/A
		Serenade + 1/2 Rate Lance	0.25	17	N/A
		P (trt)	0.15		
		Std. Error	0.09		
5	Beans	Lance Only	2.77b	98	1684
		Serenade Only	2.88a	98	1886
		P (trt)	0.02		
		Std. Error	0.02		
8	Beans	Lance Only	0.24b	9	2824
		Contans 2 kg/ha + Lance	0.19b	8	2744
		Contans 4 kg/ha + Lance	1.00a	48	3157*
		Contans 4 kg/ha + Lance + Serenade	0.87a	42	3011*
		P (trt)	<.0001		
		Std. Error	0.09		
12	Beans	Lance Only	1	41	N/A
		Serenade + Lance	1.43	61	N/A
		P (trt)	0.38		
		Std. Error	0.33		

Table 8. 2010 Disease Ratings and Yield

*Yields were filtered to remove bias due to drowned-out spots in these treatments

2010 Season - Serenade

Co-operator 5's bean field showed statistically significant results, where the Serenade only treatment had a higher severity rating at 2.88 than the Lance only treatment at 2.77. However, the incidence was the same for both treatments and neither product seemed to provide control of the disease as both severity ratings were close to the maximum rating of 3 for bean crops. Nonetheless, the yield for this field (Table 8) shows an increase in yield for the Serenade only treatment compared to the Lance only treatment, with yield increasing 202 lb/ac (12.0%). This is the strongest positive results observed during the project for a Serenade treatment.

2011 Season - Contans

Disease ratings and yield data showed positive results for both Contans and Serenade applications in 2011. Co-operator 6 showed positive results from the Contans applications, with yield increasing 6.63% from 3245 to 3460 lb/ac in the 2 kg/ha treatment than in the check (Table 9), and yield increasing 11.25% from 3245 to 3610 lb/ac in the 4 kg/ha treatment versus the check. It is interesting to note, however, that disease ratings were almost identical for the untreated and 4 kg/ha treatments, yet a large yield difference was observed.

Figure 10. Rating beans

Figure 11. Combining beans

Co-operator 7 had slightly lower disease ratings where Contans 2kg/ha was applied compared to the untreated check at 0.013 versus 0.000; however, disease pressure was extremely low in this field, and the difference was not statistically significant. This field saw lower yields in the Contans treatment compared to the untreated check, with yield reduced 10.48% from 2601 to 2356 lb/ac. However, this difference was not expected to be a result of the Contans application, as disease pressure was extremely low, and machinery problems during cutting resulted in high shatter losses, which likely confounded these results.

Co-operator	Crop	Treatment	Severity Rating	% Incidence	Yield (lb/ac)
6	Beans	Untreated	1.05a	100.00	3245
		Contans 2 kg/ha	1.18b	96.5	3460
		Contans 4 kg/ha	1.01a	100.00	3610
		Contans 4 kg/ha	(one year only)	N/A	3200
		P (trt)	0.01		
		Std. Err	0.03		
7*	Beans	Untreated	0.013a	1.33	2601
		Contans 2 kg/ha	0.000b	0.00	2356
		P (trt)	0.034		
		Std. Err	0.003		
8B	Beans	Allegro	1.02	100.00	3300***
		Allegro + Serenade	1.03	100.00	3550***
		P (trt)	0.49		
		Std. Err	0.01		
8C*	Beans	Allegro	1.68	82.31	3400***
		Allegro + Serenade	2.19	95.01	3400***
		P (trt)	0.13		
		Std. Err	0.19		
11	Beans	Untreated	1.35	100.00	2734
		Contans 4 kg/ha + Lance	1.85	99.45	2850**
		Serenade	1.39	100.00	2907
		½ rate Serenade & Lance	1.36	99.76	2792
		Lance	1.48	100.00	2757
		Lance x2	1.47	100.00	2813
		P (trt)	0.37		
		Std. Err	0.19		

Table 9. 2011 Disease Ratings and Yields

*Fields were rated after swathing

**Treatment was in different area of the field planted with different bean variety. Yield is approximate based on yield map.

***Estimated by producer from running yield monitor.

Co-operator 11 had a higher mean disease rating in the Contans + Lance portion of the field than in the Lance only portion of the field, with ratings of 1.85 and 1.48, respectively. The yield was not significantly different at ~3.4% higher in the Contans + Lance treatment. Mean disease rating and incidence were not significantly different between the Lance and Lance x2 treatments, but these were significantly higher than the check, Serenade, and ½ rate Serenade + Lance treatments.

2011 Season - Serenade

The Serenade trial results were variable in 2011. Co-operator 8's field B showed no statistically significant differences in disease ratings and incidence between the Allegro and Allegro + Serenade treatments, however, it yielded 200-300 lb/ac more throughout the length of the field (see map in Appendix C) in the Allegro + Serenade treatment than in the Allegro alone treatment. Field C showed the largest difference of all trials in terms of disease ratings, with the Allegro + Serenade treatment showing a 30% higher mean disease rating and 12.7% higher incidence compared to the Allegro alone treatment. However, no yield difference was detected between the two treatments.

In Co-operator 11's field, there was no significant difference in disease rating between the untreated check, the Serenade only, and the ½ rate Serenade + Lance treatments. However, the Serenade treatment did yield 173 lb/ac (6.3%) higher than the check treatment, the largest difference among all the treatments in that field. However, the field was quite variable, so this difference may be due to inherent variability more than the treatment itself.

Co-operator Reactions

Reactions to the Contans and Serenade trial results have varied. However, Contans has been seen in a more positive manner than Serenade.

After the second season of the Contans trials, many of the co-operators remained sceptical. Co-operator 5 felt "Contans is not very good and I don't think it could ever replace chemical fungicides" and continued on to say he based his opinion on the first year results. Co-operator 1 was of the opinion that "for my rotation and low Sclerotinia I am unsure it would pay for itself." He is a seed grower, and said his inconsistent rotations make planning hard. Co-operator 1 also found that Contans plugged his sprayer filter and has to remove it for spraying.

Many of the co-operators are interested in observing how Contans will perform after three years (or two in some cases) of applications. Much of the interest comes from those growing beans, as "controlling [white] mould is the big issue", according to Co-operator 11, which was echoed by the other co-operators. Co-operator 5 stated that he was prepared to track differences in white mould presence and bean yield when he grows beans on his Contans field next season. This field had three Contans applications.

Co-operators 3, 5, and 6 were asked in 2011 if they would be willing to participate in the Serenade portion of the trial, and all said "No" due to their previous experience with Serenade having lower efficacy than their chosen fungicide. However, Co-operators 8 and 11 tried the product. Co-operator 8 used Serenade on two different fields with different bean types, and Co-operator 11 used several fungicide treatments in his field, including Serenade alone as well as a half rates of Serenade and Lance tank-mixed.

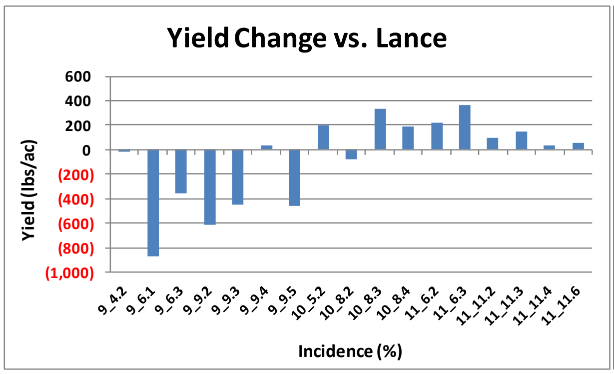
Co-operator 8 observed, during harvest, bean yields were 200-300 lb/ac higher in the area of field B sprayed with Allegro + Serenade compared to the adjacent area sprayed with Allegro alone. However, he remained unconvinced as field C showed no advantage from tank-mixing. The fields were close geographically, so the difference may have been due to the different bean types (Great Northern and Pinto) or due to slightly different crop stage or conditions experienced during fungicide application.

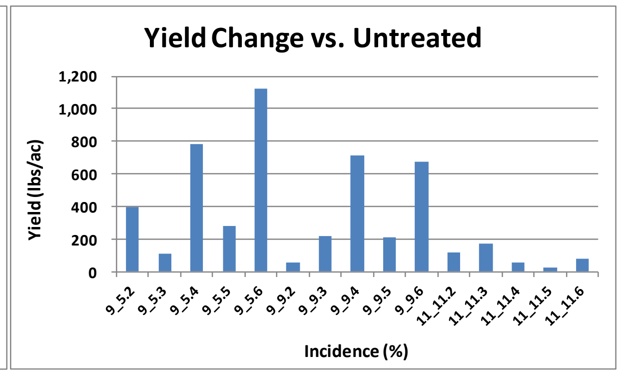
Economics and perception of cost plays a large part in decisions, as does convenience and timing of application. Several producers stated that they liked Contans, but were unsure that its cost was justified by the increase in yield or decrease in disease severity. Likewise, Co-operator 8 commented that he didn't expect to use Serenade unless either the price of Serenade decreased or bean prices rose considerably.

Economic Evaluation

A partial budgeting approach is taken to evaluate fungicide choices. The intent is to tally added costs of the treatment, including the change in fungicide costs, relative to an untreated base or standard "check" application (Lance), estimated by treatment, in $/acre, plus custom spraying costs, estimated as the number of spray passes required to lay in the treatment, and added revenues arising from the treatment, including change in yield, relative to a check or base treatment, multiplied by an average price per lb.

It is common to compare practices to an untreated "check" (Figure 12). However, in this circumstance, it was not possible to maintain an array of untreated strips to support such a comparison. A standard application of Lance has become the new "check", or baseline (Figure 13).





Figures 12 & 13. Treatment yields vs. untreated checks and treatments vs. Lance

To bridge, in part, from an untreated to a Lance check, two trials were available with an untreated check (Figure 14). The net benefit results were mixed. In one instance the benefit to applying Lance was about $150/acre, driven by a large improvement in yield. In the other, the net loss was in excess of $50/acre. A minimal improvement in yield was offset by the added fungicide and application costs.

Comparing other treatments to the Lance base, only five of seventeen options returned a profit relative to the Lance treatment (Figure 15). These were: Serenade (twice), and Contans 2 kg/ha + Lance (once) and Contans 4 kg/ha + Lance (twice). It is interesting to note that all five net benefit changes occurred in 2010 and 2011, and the negative net benefit changes were much lower in these years than in 2009. This may be due to the very high disease pressure in 2009, due to the long-term action of Contans in the case of the four Contans treatments, or a combination of the two.

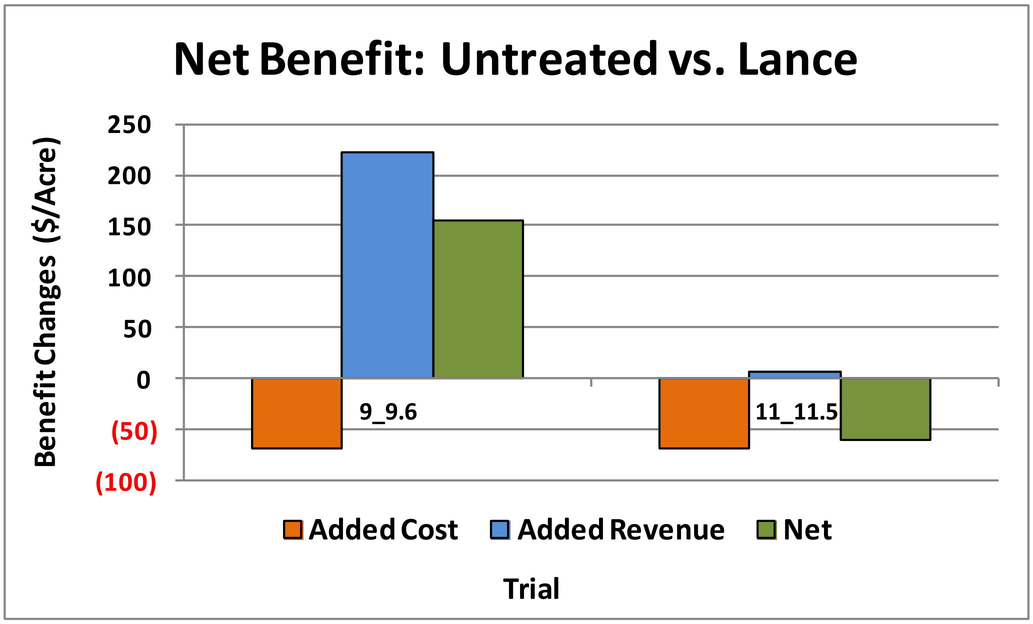


Figure 14. Cost-benefit comparison, untreated vs. Lance

***Note: 9_9.6 refers to 2009, Co-operator 9, Lance treatment, and 11_11.5 refers to 2011, Co-operator 11, Lance treatment**

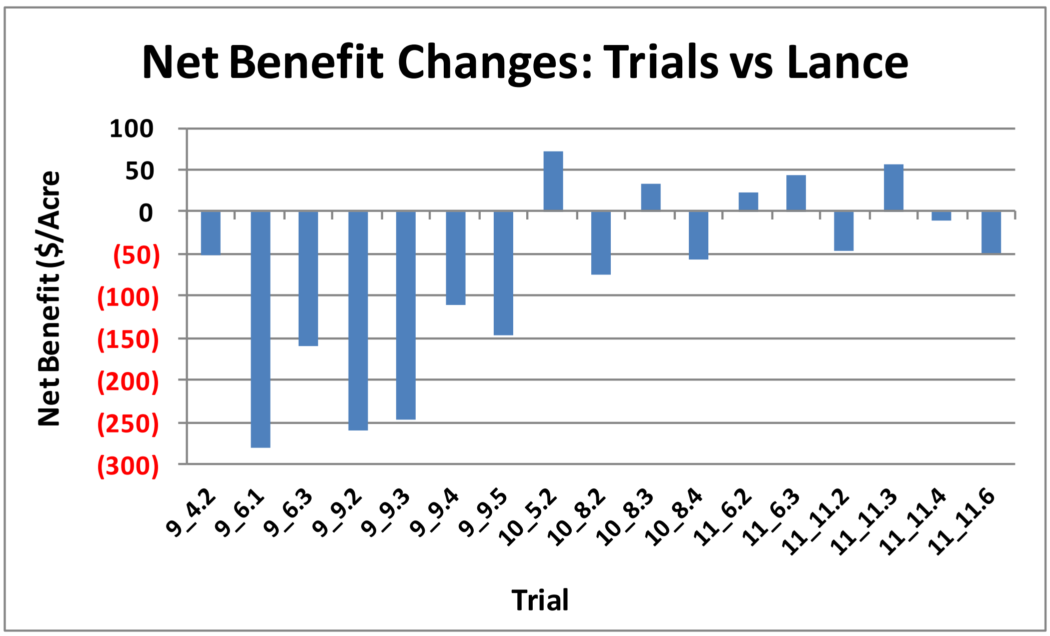


Figure 15. Net benefit changes, trials vs. Lance

***Note: To determine treatments, follow "Year_Co-operator.Treatment #" format & refer to Tables 7-9**

The basic premise of an economic evaluation is that an input (fungicide) will only be applied if the added costs of the application are covered by the added returns – in this case, staving off the mold-related yield reduction. There are several observations in this regard. First, results to-date are inconclusive as to whether or not specific fungicide programs will pay. Adding further trial years will improve the ability to draw more solid conclusions. Second, as the benefit of Contans is expected to be spread over multiple years, a subtle change in the evaluation procedure is required. Third, given the timing of the mold event, defining a preventative fungicide application program is likely required – and will hinge on a producer's evaluation of net profit and the associated risk. In this instance, a fungicide program can essentially be viewed as production insurance.

Thanks to Dale Kaliel of AARD for his contributions toward the economic analysis.

Extension Progress

Co-operating producers participating in this project have been a major component of extension for the project. They have a wide reach through their relationships with neighbouring producers and agronomists, and producer groups such as crop councils and marketing groups. Those contributing to this project have also played an invaluable role in disseminating information, including Drs. Ron Howard and Michael Harding, AARD, Dr. Ty Faechner, ARECA, Dr. Tobias Laengle, AAFC, Dr. Peter Lüth and Matthias von Erffa, Prophyta GmbH, and UAP and Viterra staff.

The Contans trial was featured at SARA's 2009 Diagnostic Field School, and was also discussed at both the 2010 and 2011 Diagnostic Field Schools. Attendance for the three years was 280, 260, and 290 participants, respectively. The project was also highlighted at numerous crop walks over the course of the three years, including being prominently featured at the 1st and 2nd Annual Disease Crop Walks in 2010 and 2011, with attendance reaching 82 and 63 participants, respectively. These were held at the SARA site in August, featuring the Contans demonstration plots, a general discussion of the biofungicide demonstration project, and discussion of Sclerotinia diseases. Other crop walks included 5 in 2009 with attendance of 160 people.

Figures 16 & 17. Dr. Mike Harding, 2010 disease crop walk, and Dr. Ron Howard, 2011 disease crop walk

Several presentations about the project were made since its inception, including at SARA Annual General Meetings for all three years of the project, the 2008 SACA conference, at FarmTech Conference in 2009 and the Alberta Pulse Growers' Zone 1 Annual General Meeting in 2009.

A poster was made explaining the project and showing results from the first two years of the trial. This poster was displayed at the 2010 SACA Conference in Medicine Hat, in Lethbridge at the Advanced Agronomy Conference in 2010, and in Lethbridge at Agronomy Update and Ag Expo in 2011. This poster is attached in Appendix D.

Media coverage concerning the project included a full video from *Prairie Farm Report* in 2010 and a segment on Global Lethbridge's Agri-Business program in 2011. Additionally, various articles have appeared in the popular and farm press, including two articles in the *Western Producer* and two in SARA's own Farming Smarter magazine. Several of these articles are attached in Appendix D.

Information on the project has been featured on the AAFC and ARECA websites for the duration of the project.

The project is also featured on SARA's website www.farmingsmarter.com. Social media sites including Facebook, Twitter, and YouTube were also used to extend the reach of the project.

Lessons Learned

A number of things have been learned from this project. First of all, much has been learned about conducting field-scale trials in general. Success of field-scale trials is largely dependent on choosing good co-operators who are willing to put in the time and effort for the trial, which was achieved for this project. Also, using precision agriculture tools, such as GPS, guided spraying and yield monitors combined with yield mapping makes data collection both simpler and more robust. Finally, the simpler the project is, the more likely that co-operators will be willing to take the necessary steps to make the different treatments or facilitate collection of data.

Another lesson learned is the truly social nature involved with evaluating products, including these two biofungicides, on a field scale. The co-operating producers have been very interested in not only the results collected from their particular field, but also from other co-operators, and often ask how other co-operators have handled various challenges relating to the trial. Trying new products is often greatly influenced by what they have heard from other producers. Often a product can be dismissed because of one bad experience by themselves or a neighbour; conversely, it can be adopted on a large scale if a positive comment is heard.

It was also learned that disease ratings are not always a good indicator of yield. There is great difficulty in evaluating the true impact of Sclerotinia diseases, which is due to the nature of these diseases, which flourish where the crop canopy is the densest. Yields tend to be reduced in the healthiest areas which often still yield better than the areas of the crop that have less dense canopies and, therefore, lower disease levels. When it appears that the Contans is not working to reduce the impact of the disease, it may in fact simply be masked. This is also why, when examining the data, it was often found that a particular treatment with a higher disease incidence and severity often also had the best yield within that field.

In the fall of 2011 it was also learned that immediate incorporation of Contans is not always necessary, but that a delay period of days or even a few weeks should not reduce the efficacy of the product. This means that there is greater flexibility in application timing that previously though, allowing spraying of the product some time before incorporation by tillage or precipitation can occur. This flexibility could greatly increase the possibility of fall applications on a larger scale, as it would allow application of the product shortly after or even during lulls in harvest, with incorporation occurring later as schedules allow.

A final lesson is that producers are not opposed to adopting biofungicides, but they must be economically feasible, both in terms of cost to buy and ability to reduce damage to the crop from disease.

Conclusions and Recommendations

Over the course of three years, good results have emerged from the biofungicide trial, despite some challenging environmental conditions. Positive results were seen from both Contans and Serenade applications in a variety of fields. Reductions in disease ratings were not as useful in predicting yields as anticipated, but yields increased to varying degrees in almost all cases where application of these biofungicides was compared with an untreated check. Even more positive results are expected from the fields in which Contans was applied, as this product has a longer-term effect on the Sclerotinia pathogen. Both products were put to a big test, as disease pressure is usually high in southern Alberta due to the use of irrigation, the endemic nature of *Sclerotinia sclerotiorum*, and intensive rotation of susceptible crops, and the products performed well. More positive results were received in 2009 than in the following years, as disease pressure was highest due to weather that favoured disease development.

In the entire duration of the trial, two applications of Lance at Co-operator 5's bean field in 2009 was the most effective treatment, with disease incidence reduced from 88 to 28%, severity from 1.9 to 0.65 and yield increased 67% from 2315 to 3439 kg/ha compared to the untreated check. The best result received from a Serenade treatment was in Co-operator 9's field in 2009, with a yield increase of 214 lb/ac (14.9%) over the check. In many cases, one or two applications of Lance was as effective as or more effective than treatment with either of the trial biofungicides, but there were cases were efficacy was similar. The most effective Contans treatment in three years was in Co-operator 6's trial field in 2011, with the 4 kg/ha treatment yielding 365 lb/ac (11.2%) higher than the check.

Ten producer co-operators and many of their peers were exposed to these products and made aware of the availability and use of biofungicides in general through the field demonstration portion of the project, and many more through SARA's demonstration plots and extension activities since 2008. This project has helped pave the way for producer adoption of biofungicides as part of an integrated management plan. Continued work on these and other biofungicides with increased efficacy in controlling Sclerotinia diseases will encourage the use of biofungicides within an integrated approach.

If possible, it would be beneficial to monitor fields which received Contans treatments to determine the effect of applications in the coming years, as Contans is intended to be a long-term product. An optimum application rate and timing has yet to be established for Contans, and so a closer look should be taken to determine the best management practices for use of this product and the length of time necessary to see the full effect of the product applications. Additional work should also be considered to determine optimum application timing for foliar fungicides, including Serenade.

Appendix A – Resources

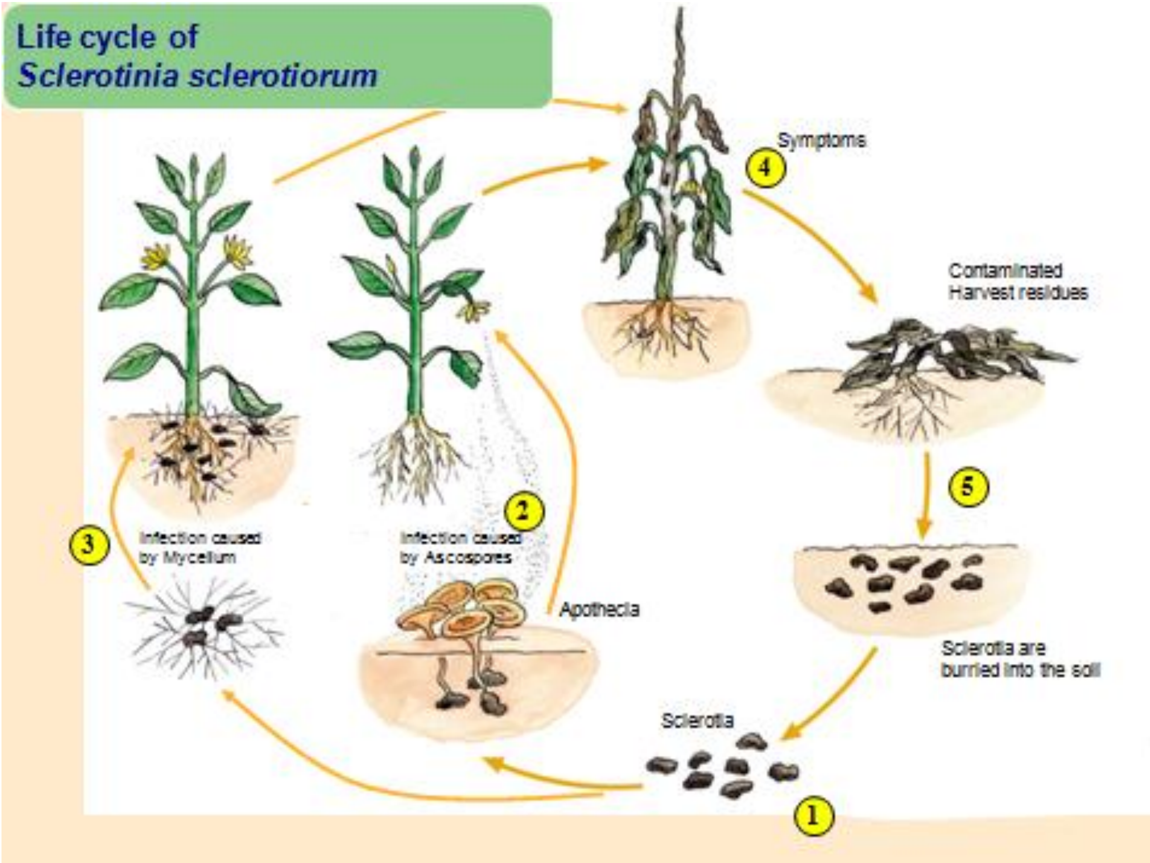


Figure 18. Life cycle of *Sclerotinia sclerotiorum.* Courtesy of Prophtya.

How to Plant Depots

- Place depots just after the field has been sprayed and the product worked in
- Count out 10 sclerotia from the bag collected at the bean plant, and put them into the depot bags.
- Fill depot with soil from an area at least 25m from the field edge (area with uniform spraying). Add a couple handfuls of soil, mix with the sclerotia bodies, then top the bag off and seal the top with staples.
- Bury 3 depots in each treatment filled with soil from the same strip
- Depots should be buried at about a 3 cm depth and in a group at the edge of the field
- Place a stake at either end of the depots
- GPS their placement

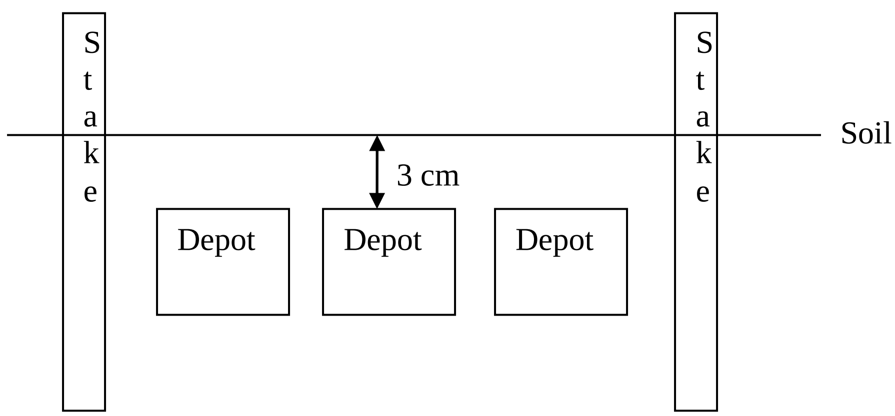


Figure 19. Field instructions for burying depots

Protocol for Isolation of *C. minitans* from Sclerotia Depots - June, 2009

1. Remove sclerotia from depots (ten sclerotia per depot and three depots per treatment were used). All fields have two or three treatments. Since the depots have been in the ground over winter it may be difficult to find all of the sclerotia.
2. Keep the sclerotia in clearly labelled Petri dishes. Keep the sclerotia from the depots, treatment and field separate. Label both the top and bottom.
3. Wash the sclerotia in beakers covered with cheesecloth with tap water for ca. 30 seconds. The sclerotia should achieve a tumbling action to ensure thorough washing.
4. Let the sclerotia dry and plate onto Acidified Potato Dextrose Agar (PDA-A)[1] with two sclerotia per plate. Be sure to keep each depot, treatment and field separate.
5. Score the plates after ca. two weeks by observing for the presence or absence of *C. minitans* colonizing each sclerotium. Gently scrape the surface of sclerotia and mount the material on a slide. Ideally, the mature pycnidia will secrete conidia which will give the sclerotia a ‘slimy’ appearance. Take care to mount the ‘ooze’ on the slide and not material from the sclerotia. Add a drop of mountant[2] such as lactophenol[3] and apply a cover slip. Slides can be stored at room temperature for up to two days. Observe at 800x for the presence or absence of spores.

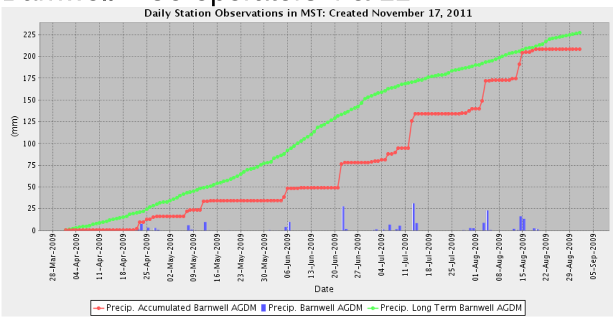
[1]Add 39.0 g of Potato Dextrose Agar to 1000 mL of distilled water and autoclave. Cool to ca. 50°C and add ca. 3.0 mL of sterile lactic acid. Check pH which should be ca. 3.5.
[2]Any substance used to immerse or impregnate a specimen or smear for microscopic examination.
[3]Mix phenol (20 g), distilled water (20 mL), lactic acid (20 mL) and glycerol (30 mL) and warm slightly.

Figures 20 and 21. Field disc cultivator used to incorporate Contans

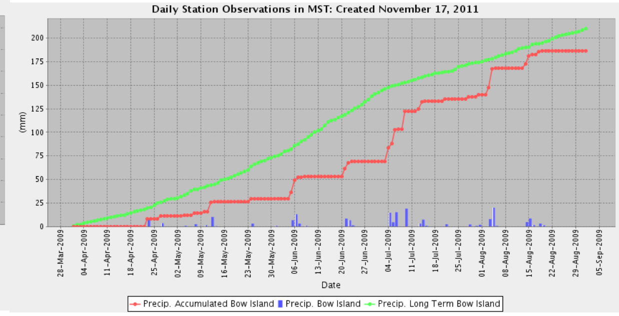
Figure 22. Cultivator harrows used to incorporated Contans in small plot demo

Appendix B – Weather Data

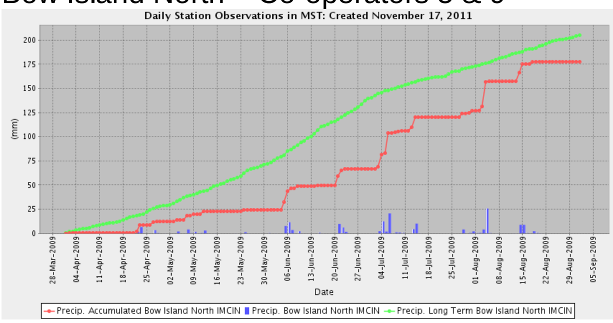
Barnwell – Co-operators 4 & 11



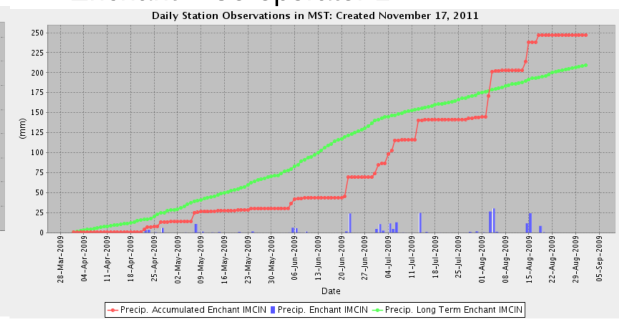
Bow Island – Co-operators 3, 6, 7



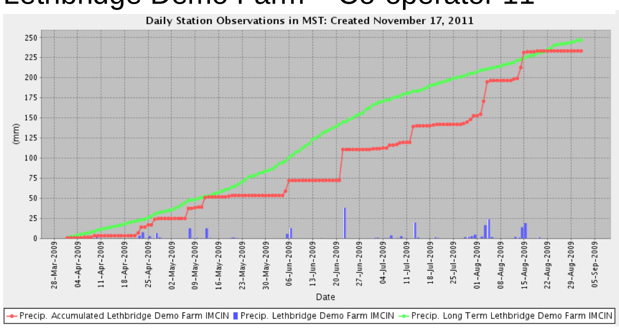
Bow Island North – Co-operators 5 & 9



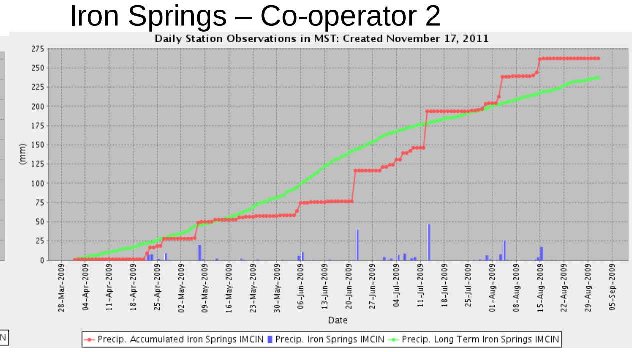
Enchant – Co-operator 1



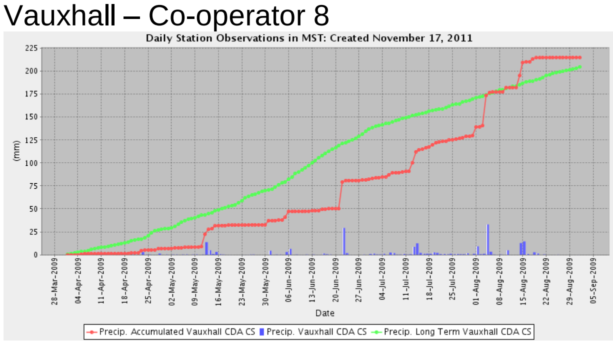
Lethbridge Demo Farm – Co-operator 11



Iron Springs – Co-operator 2



Vauxhall – Co-operator 8



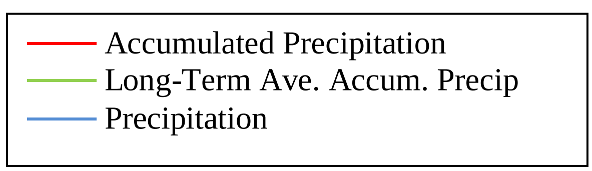
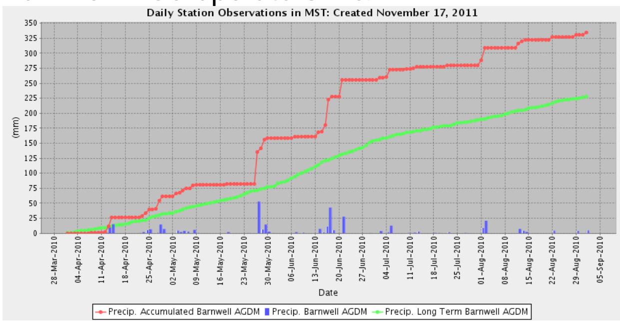
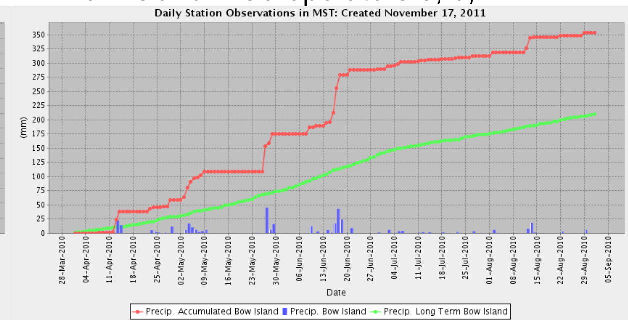


Figure 23. 2009 precipitation data for all co-operators

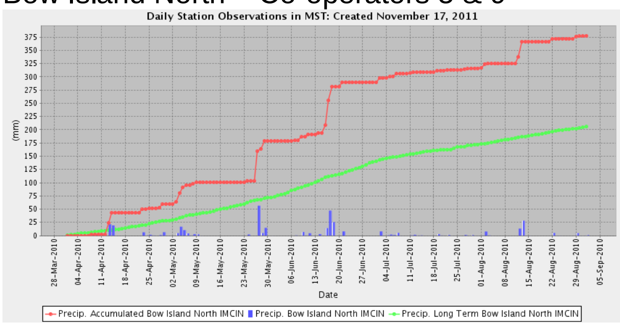
Barnwell – Co-operators 4 & 11



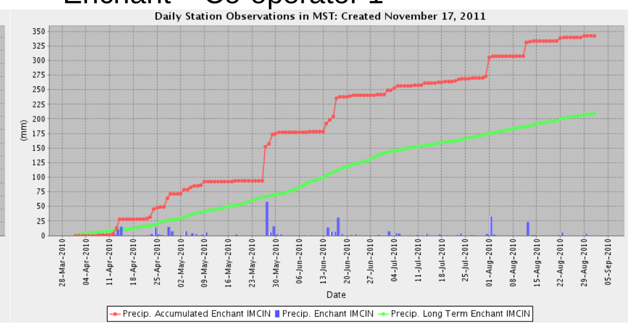
Bow Island – Co-operators 3, 6, 7



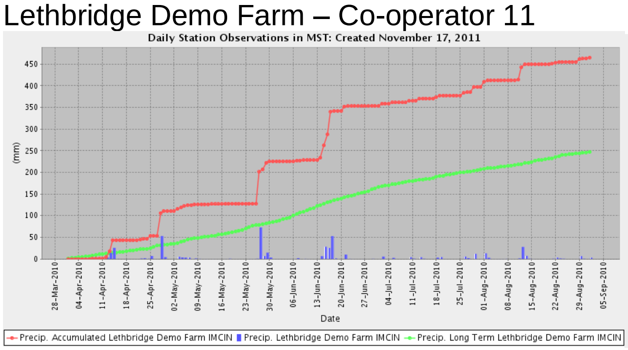
Bow Island North – Co-operators 5 & 9



Enchant – Co-operator 1



Lethbridge Demo Farm – Co-operator 11



Vauxhall – Co-operator 8

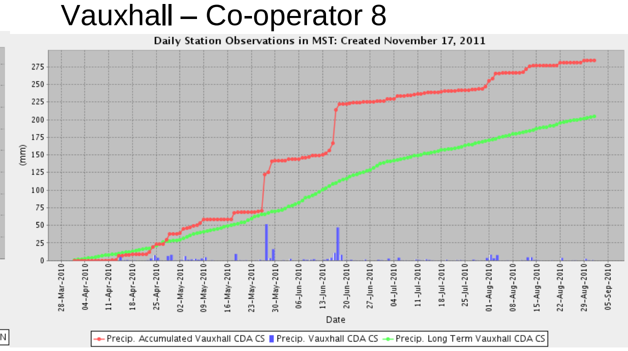
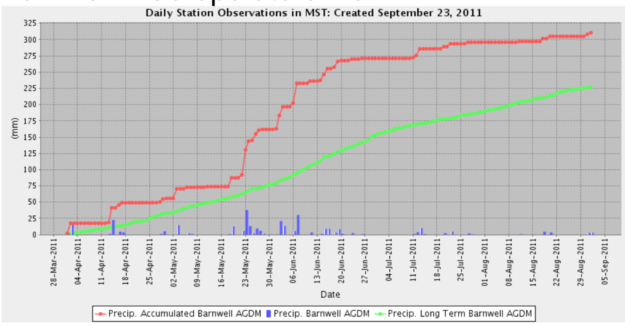
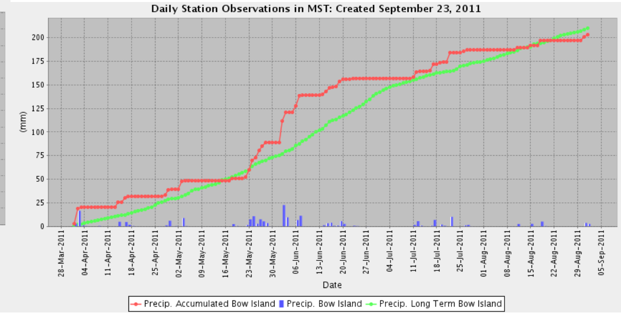


Figure 24. 2010 Precipitation data for all co-operators

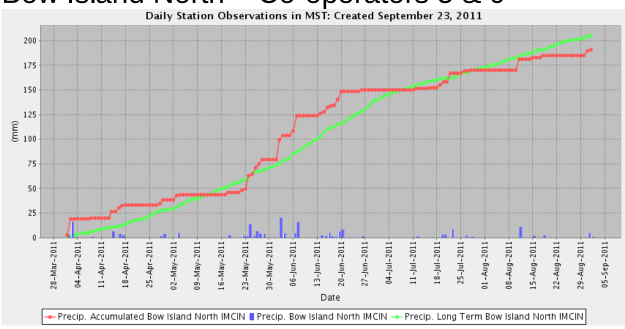
Barnwell – Co-operators 4 & 11



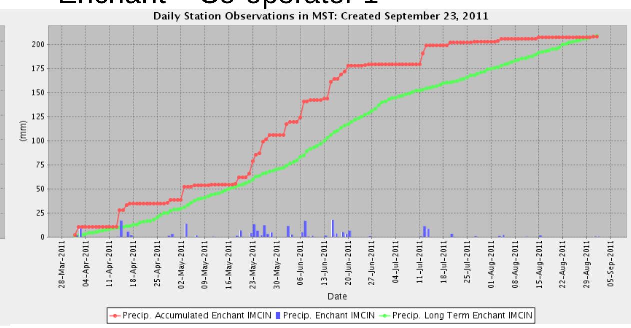
Bow Island – Co-operators 3, 6, 7



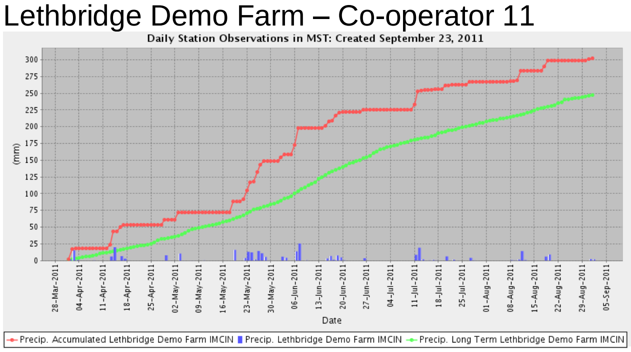
Bow Island North – Co-operators 5 & 9



Enchant – Co-operator 1



Lethbridge Demo Farm – Co-operator 11



Vauxhall – Co-operator 8

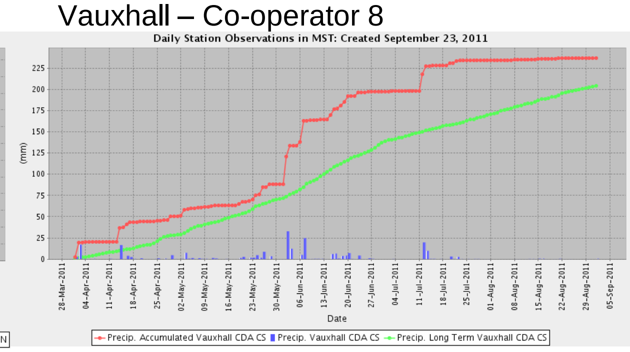
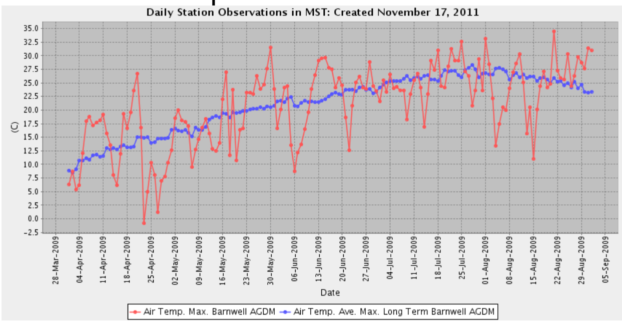
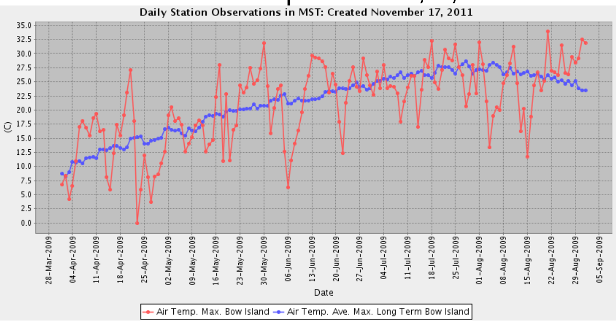


Figure 25. 2011 precipitation data for all co-operators

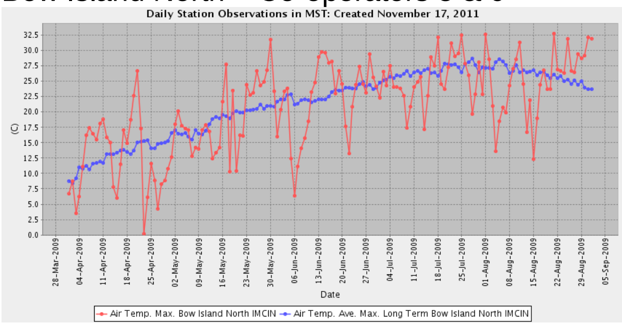
Barnwell – Co-operators 4 & 11



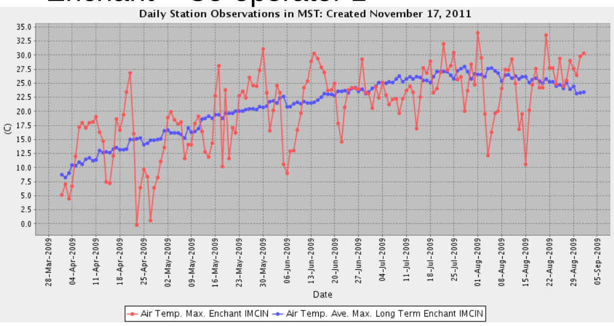
Bow Island – Co-operators 3, 6, 7



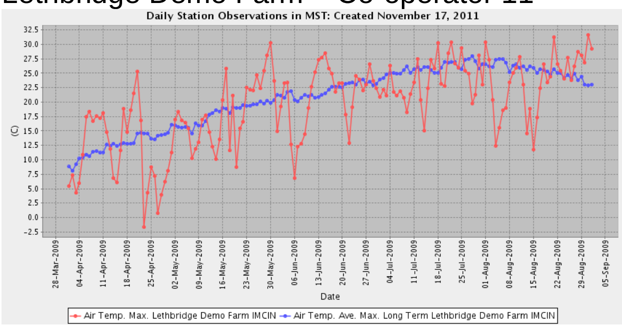
Bow Island North – Co-operators 5 & 9



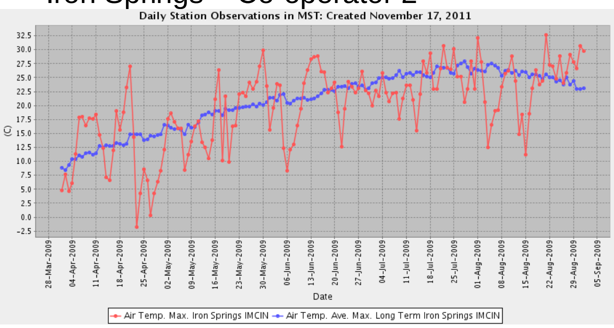
Enchant – Co-operator 1



Lethbridge Demo Farm – Co-operator 11



Iron Springs – Co-operator 2



Vauxhall – Co-operator 8

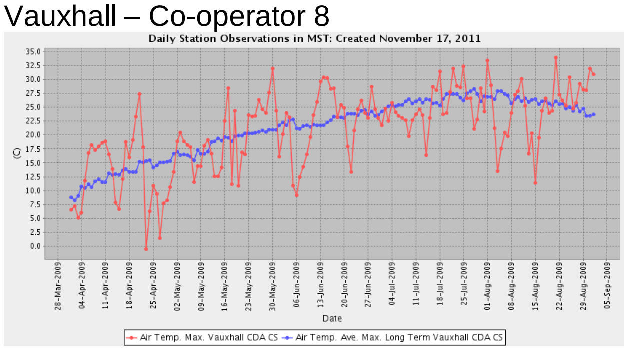
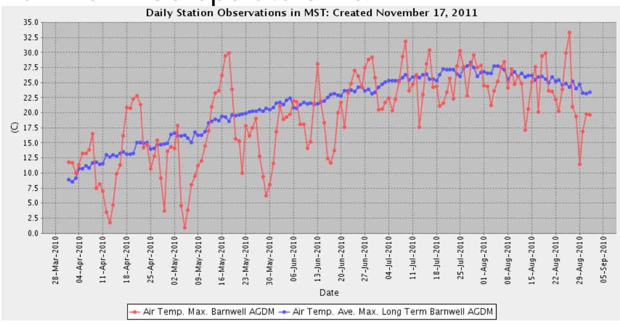
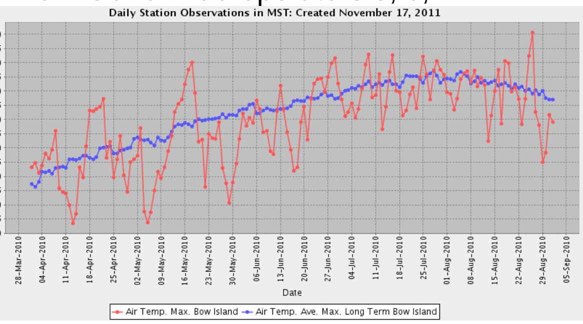


Figure 26. 2009 temperature data for all co-operators

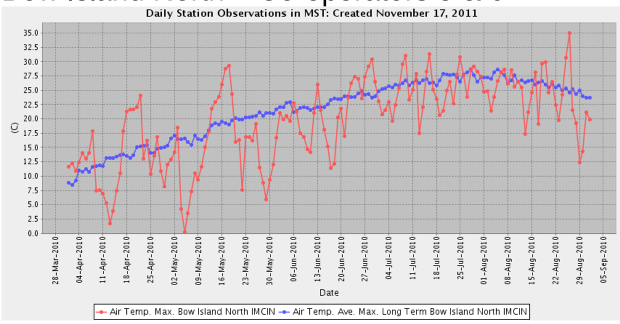
Barnwell – Co-operators 4 & 11



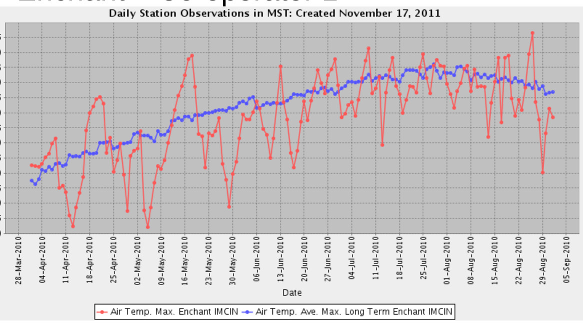
Bow Island – Co-operators 3, 6, 7



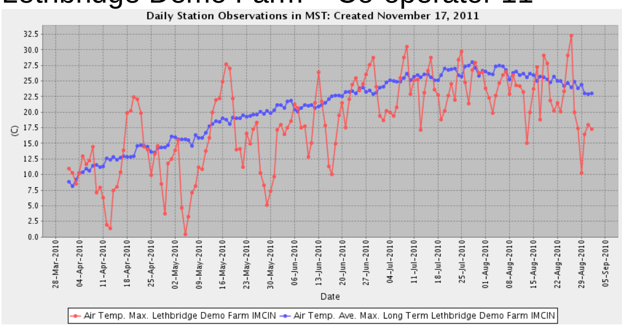
Bow Island North – Co-operators 5 & 9



Enchant – Co-operator 1



Lethbridge Demo Farm – Co-operator 11



Vauxhall – Co-operator 8

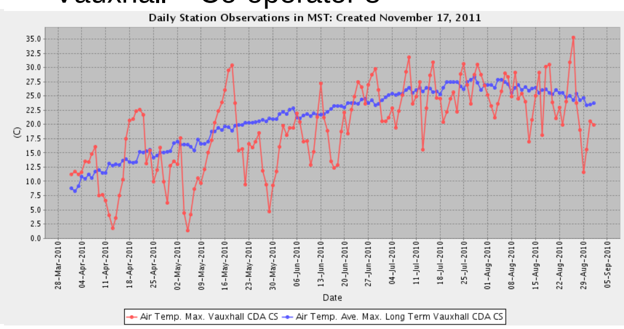
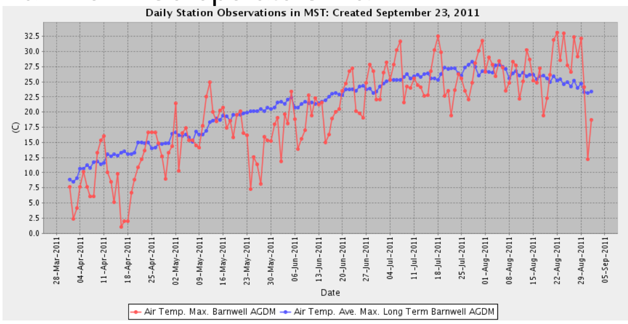
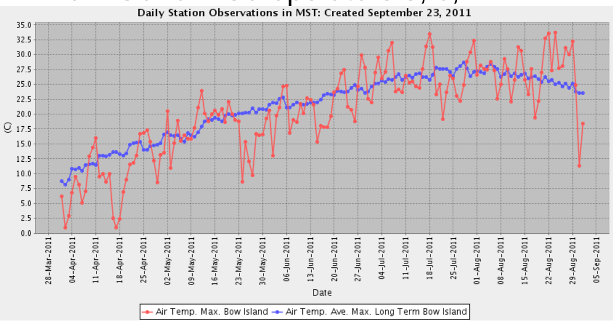


Figure 27. 2010 temperature data for all co-operators

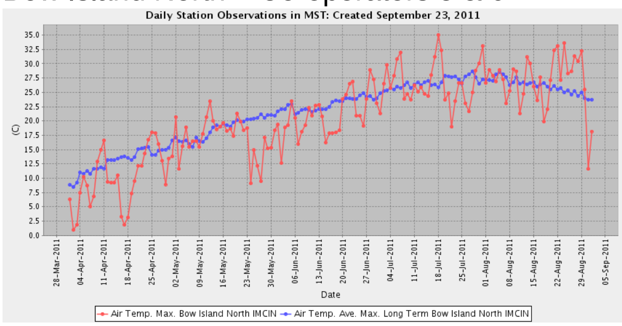
Barnwell – Co-operators 4 & 11



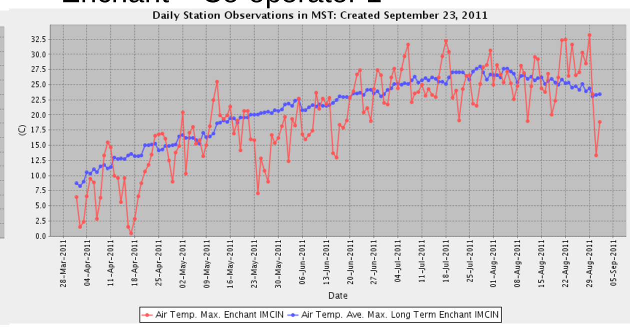
Bow Island – Co-operators 3, 6, 7



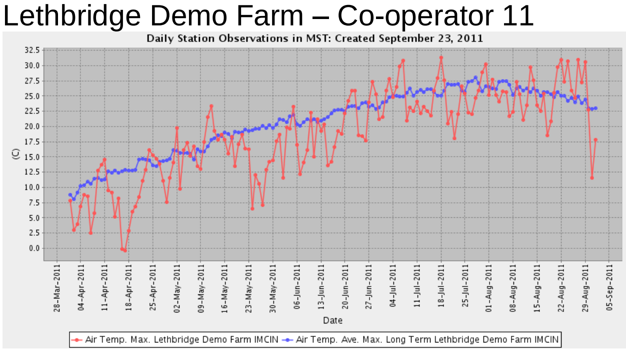
Bow Island North – Co-operators 5 & 9



Enchant – Co-operator 1



Lethbridge Demo Farm – Co-operator 11



Vauxhall – Co-operator 8

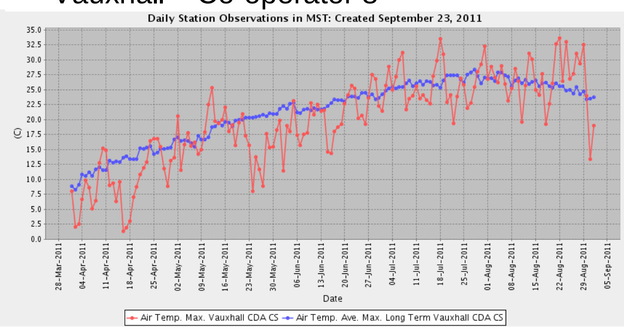


Figure 28. 2011 temperature data for all co-operators

Appendix C – Co-operator Maps

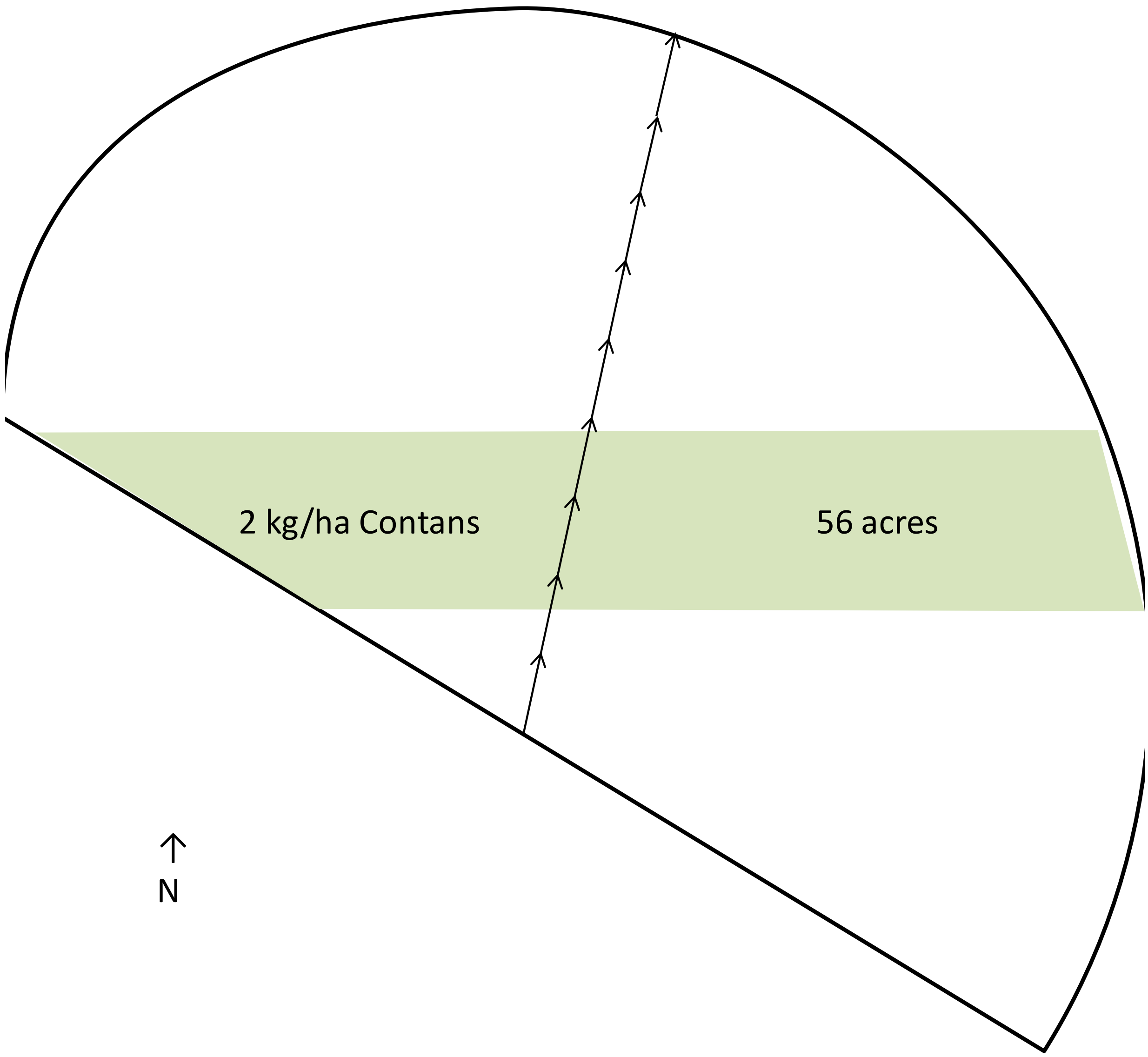


Figure 29. Field Trial Plot Plan, Co-operator 1, Contans

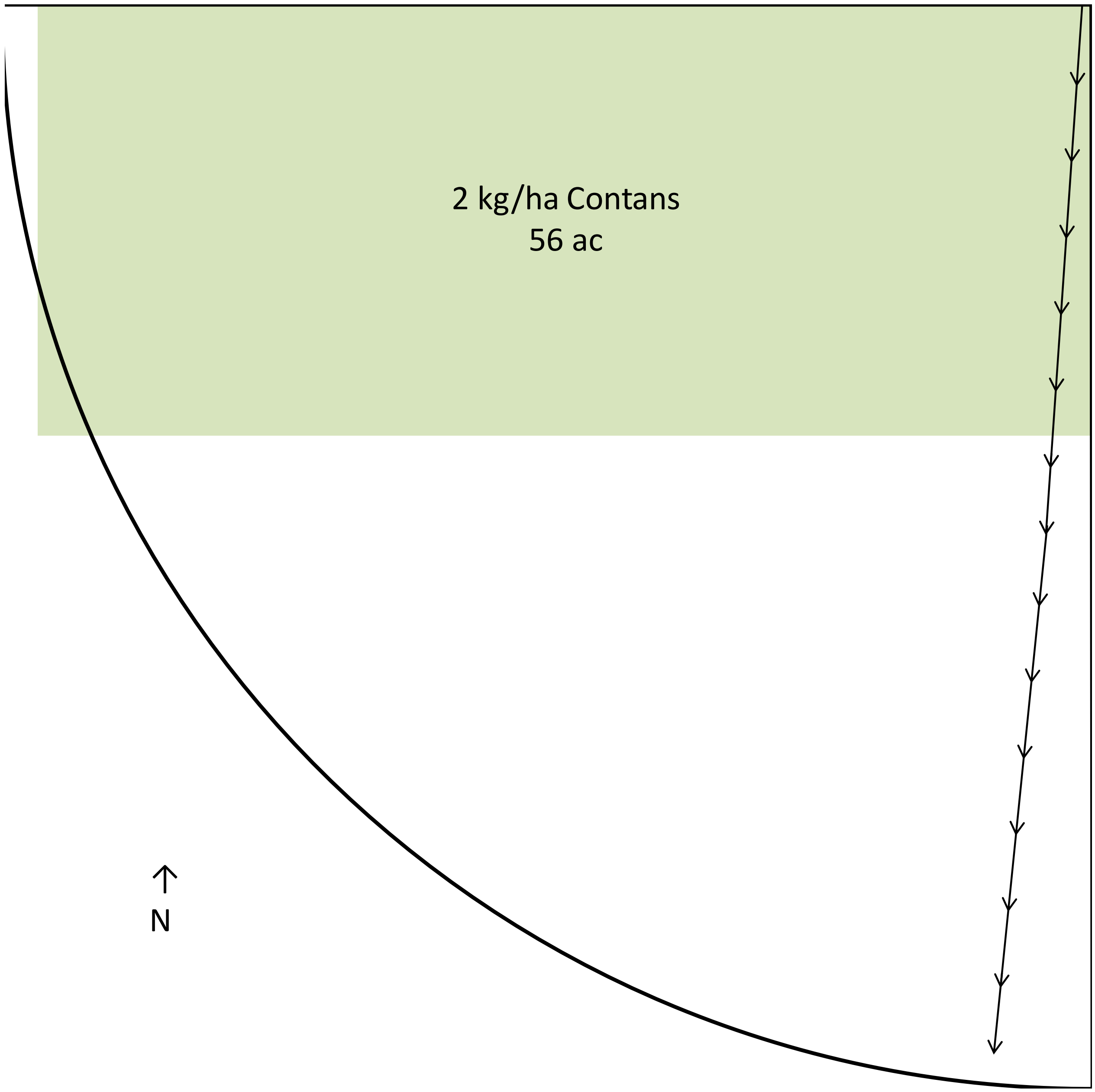


Figure 30. Field Trial Plot Plan, Co-operator 3, Contans

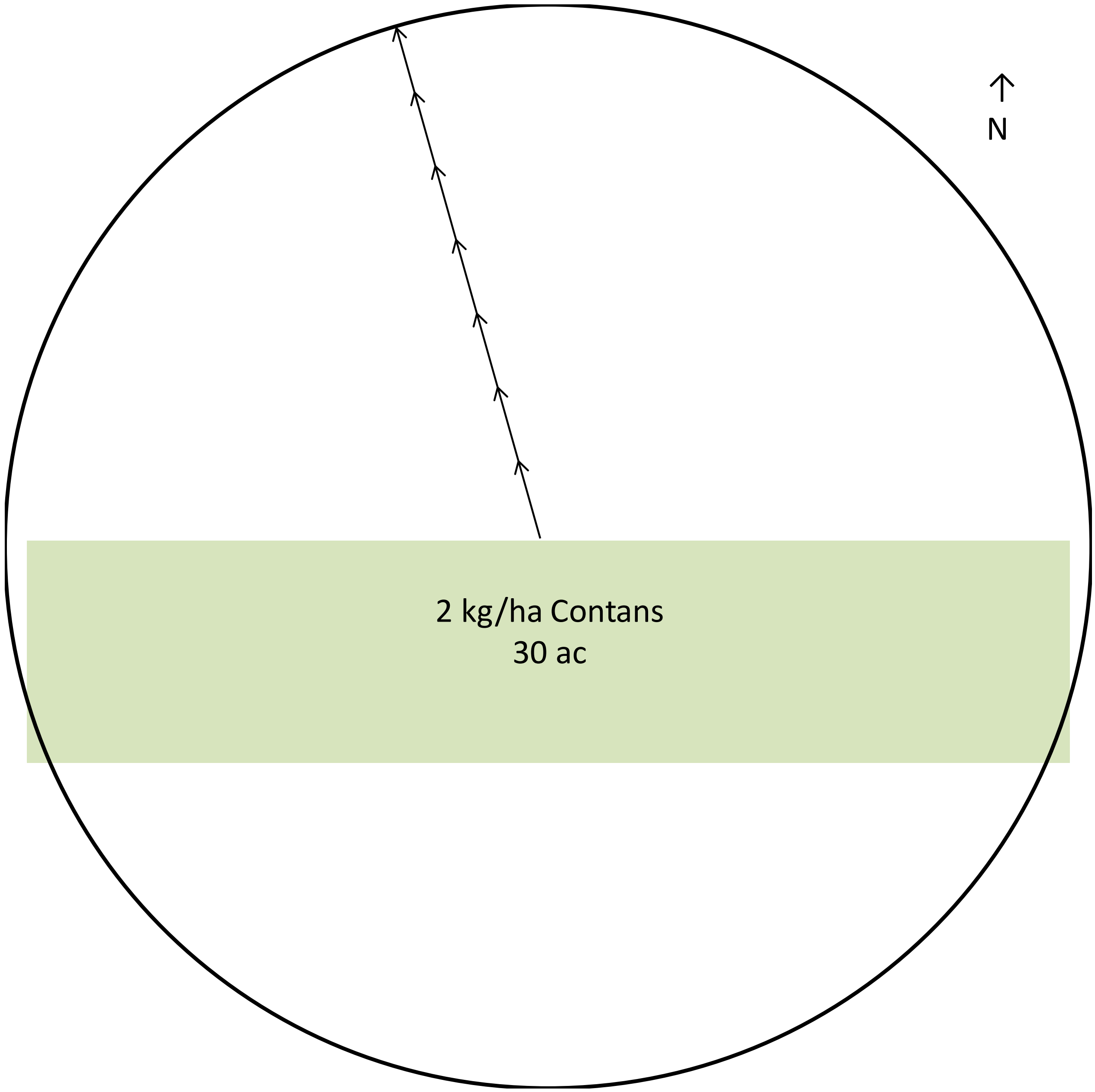


Figure 31. Field Trial Plot Plan, Co-operator 4, Contans

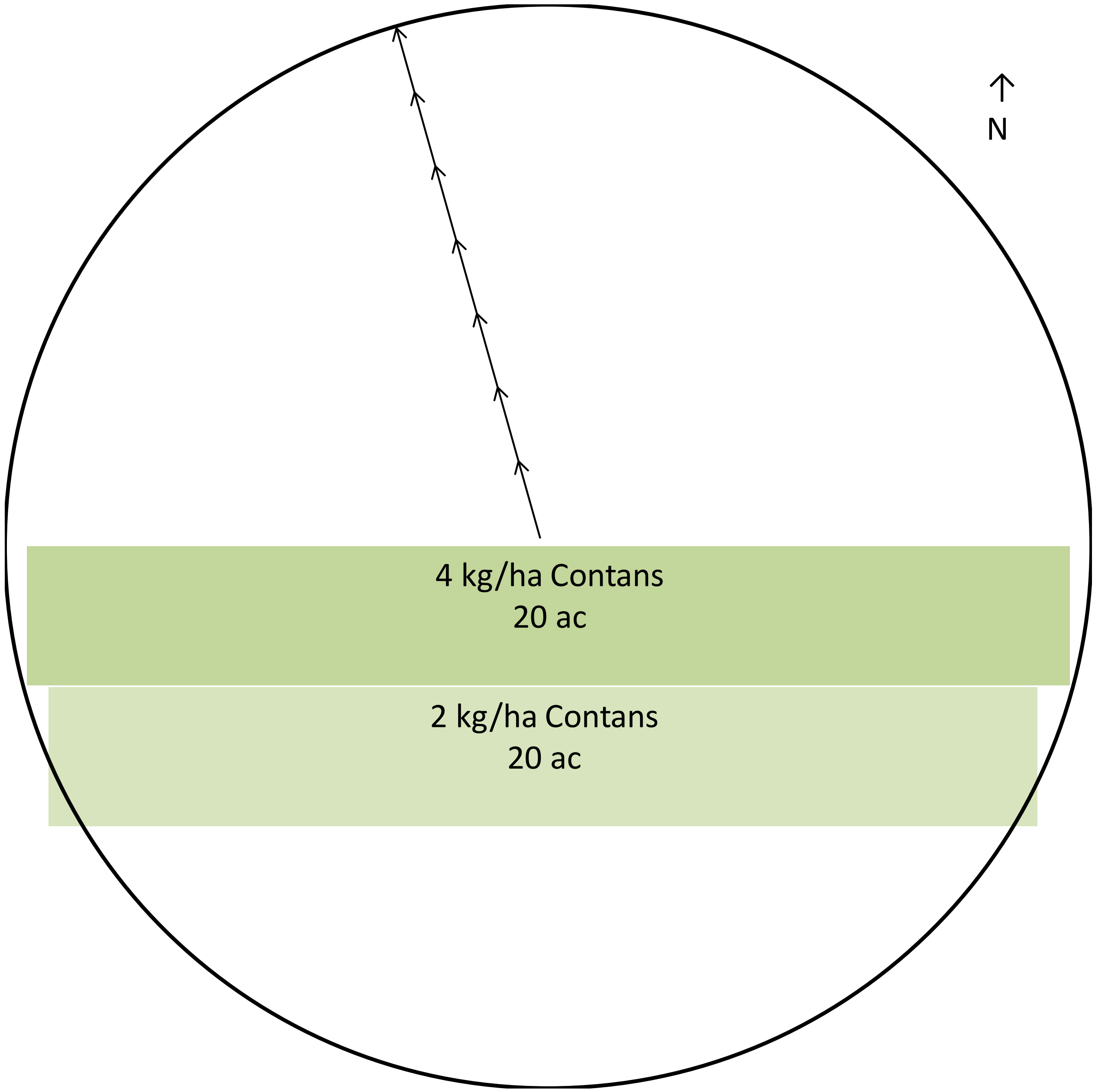


Figure 32. Field Trial Plot Plan, Co-operator 5, Contans

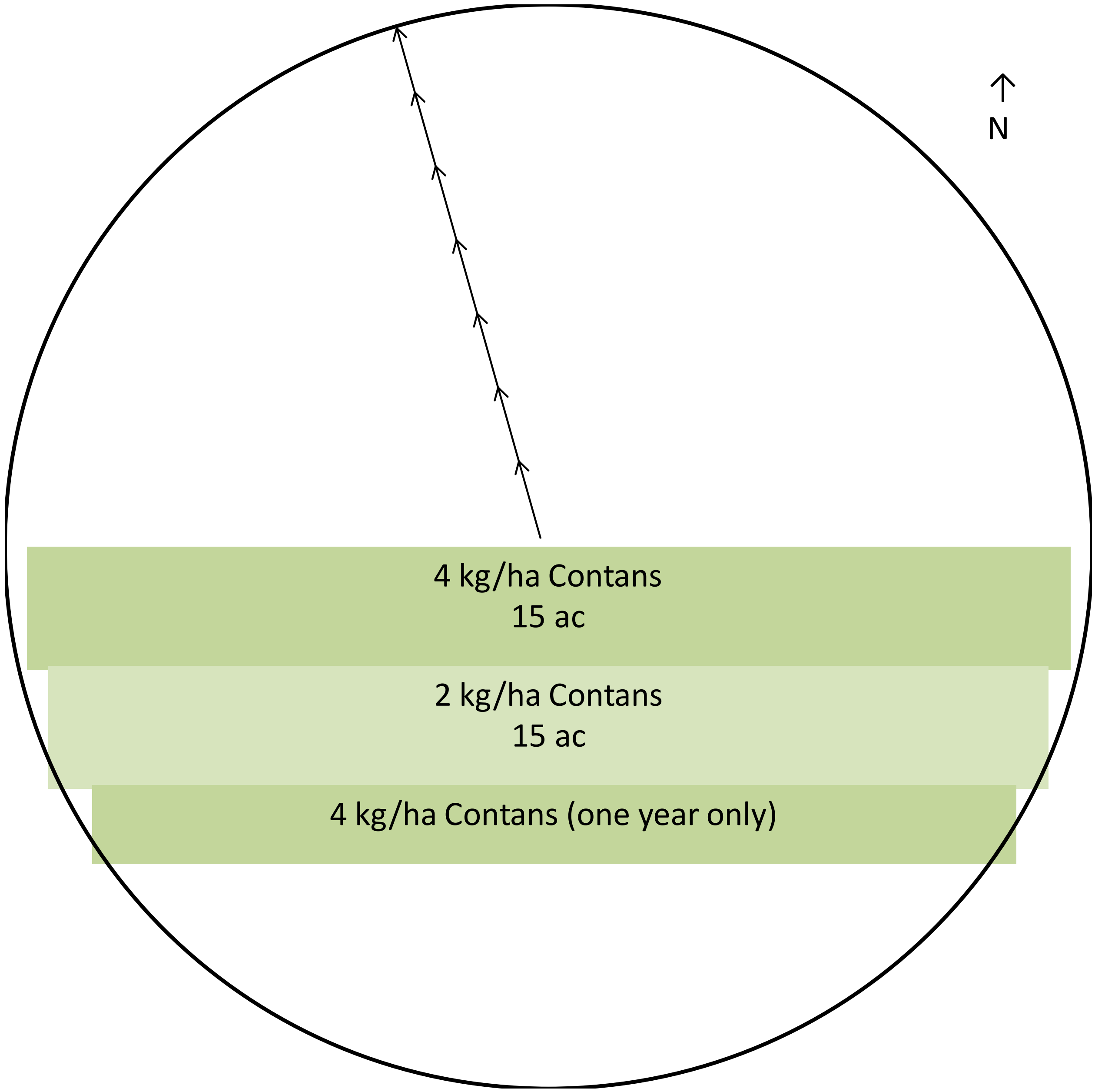


Figure 33. Field Trial Plot Plan, Co-operator 6, Contans

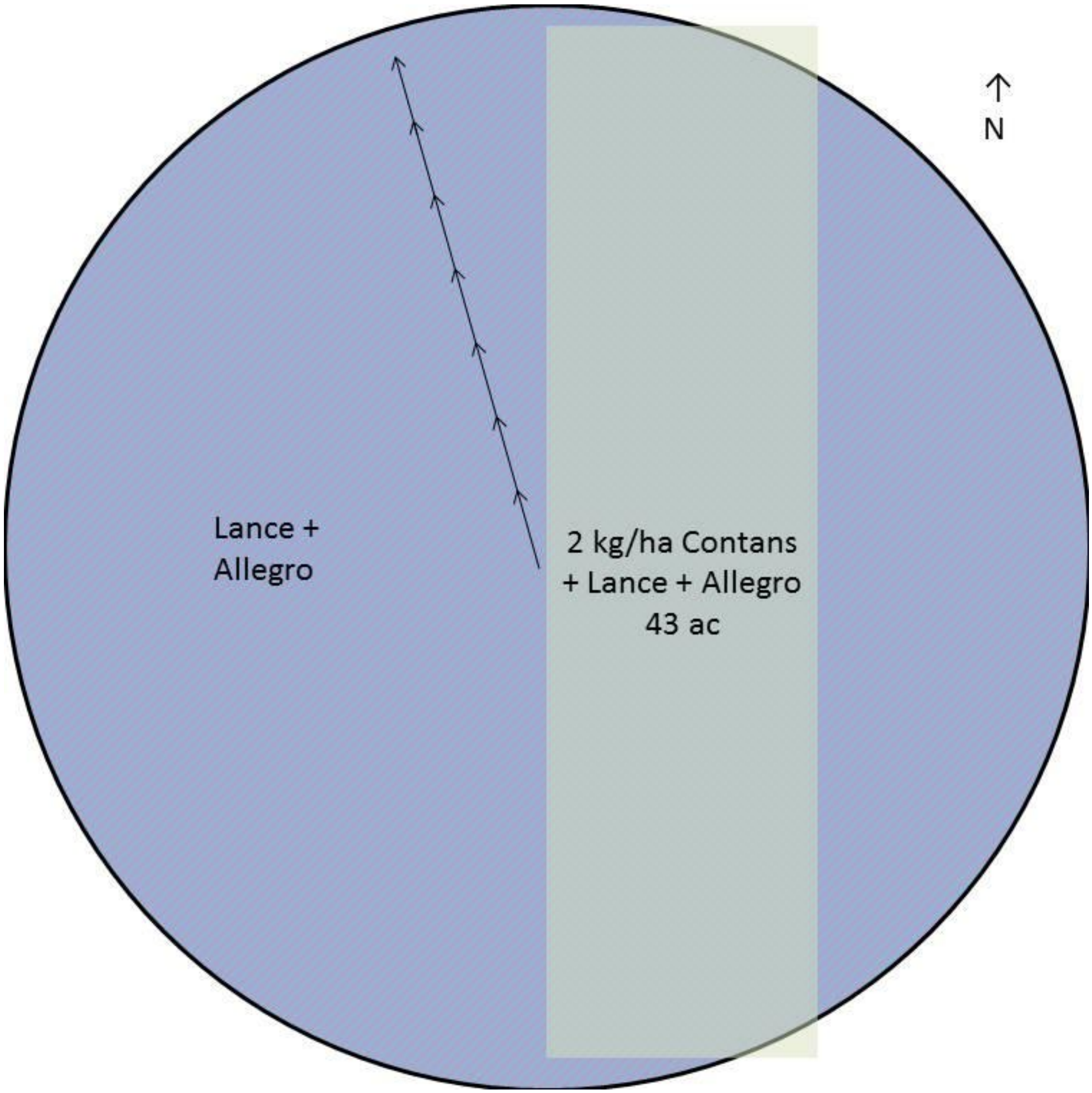


Figure 34. Field Trial Plot Plan, Co-operator 7, Contans

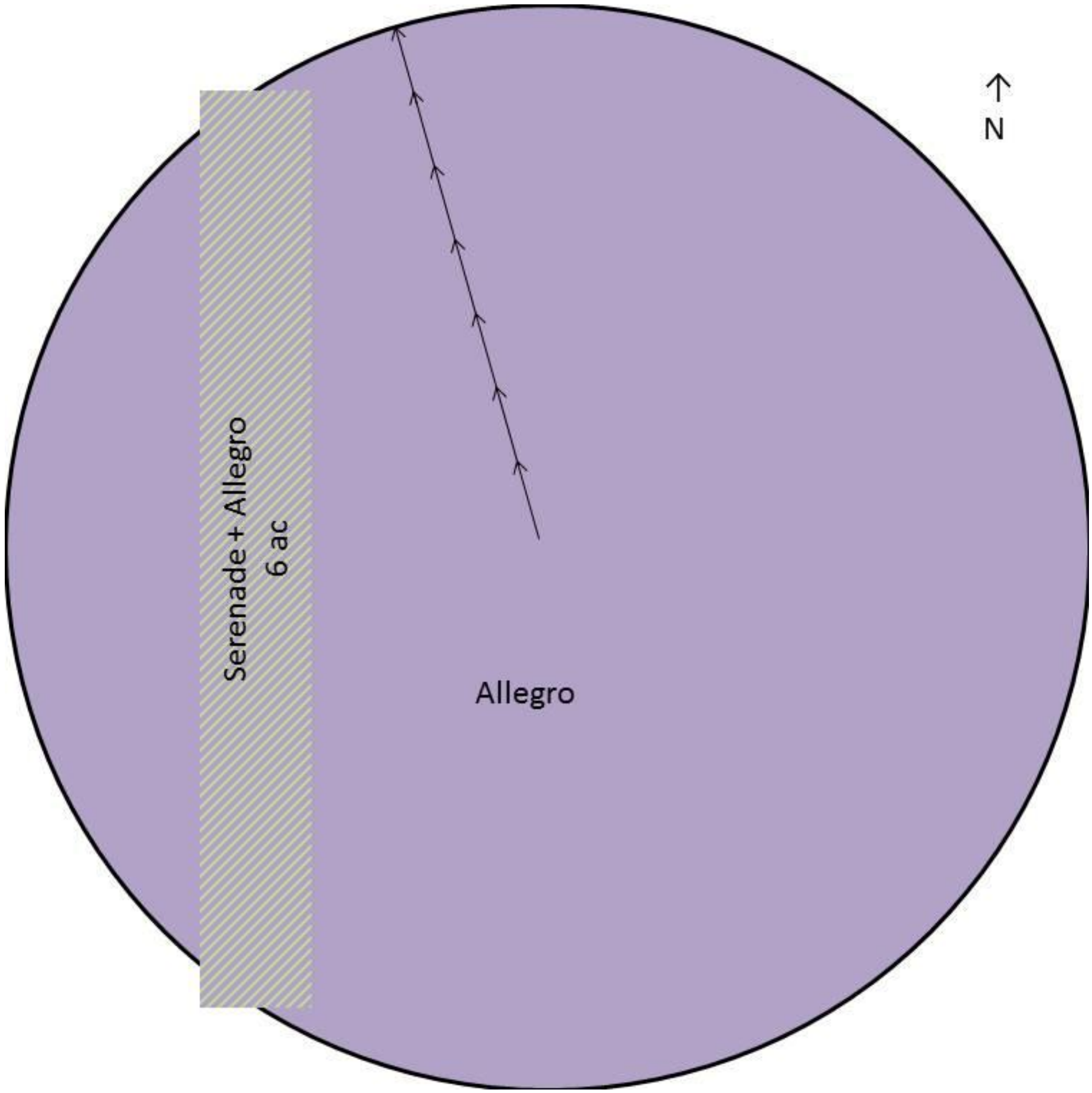


Figure 35. Field Trial Plot Plan, Co-operator 8, Field B, Serenade

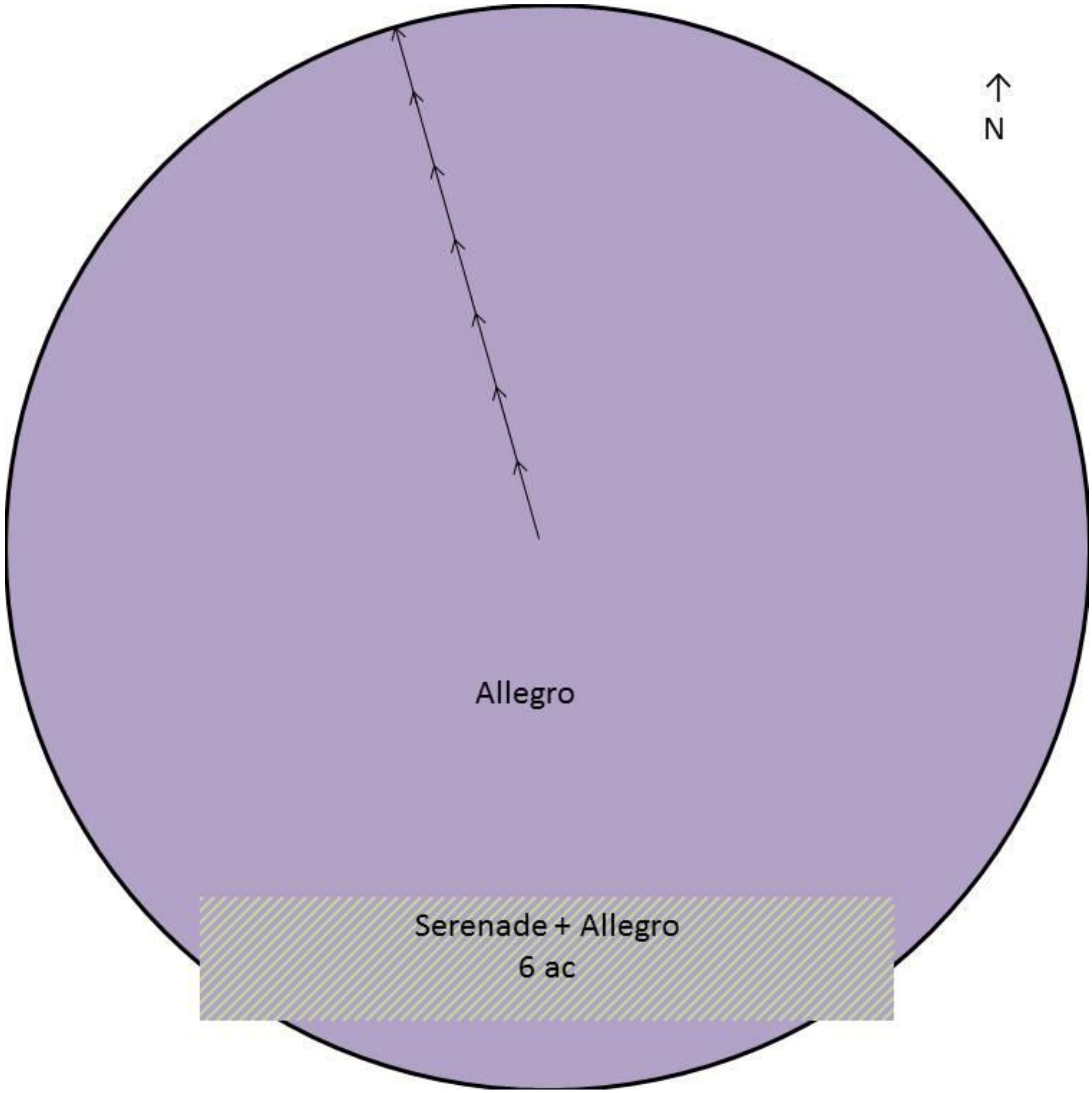


Figure 36. Field Trial Plot Plan, Co-operator 8, Field C, Serenade

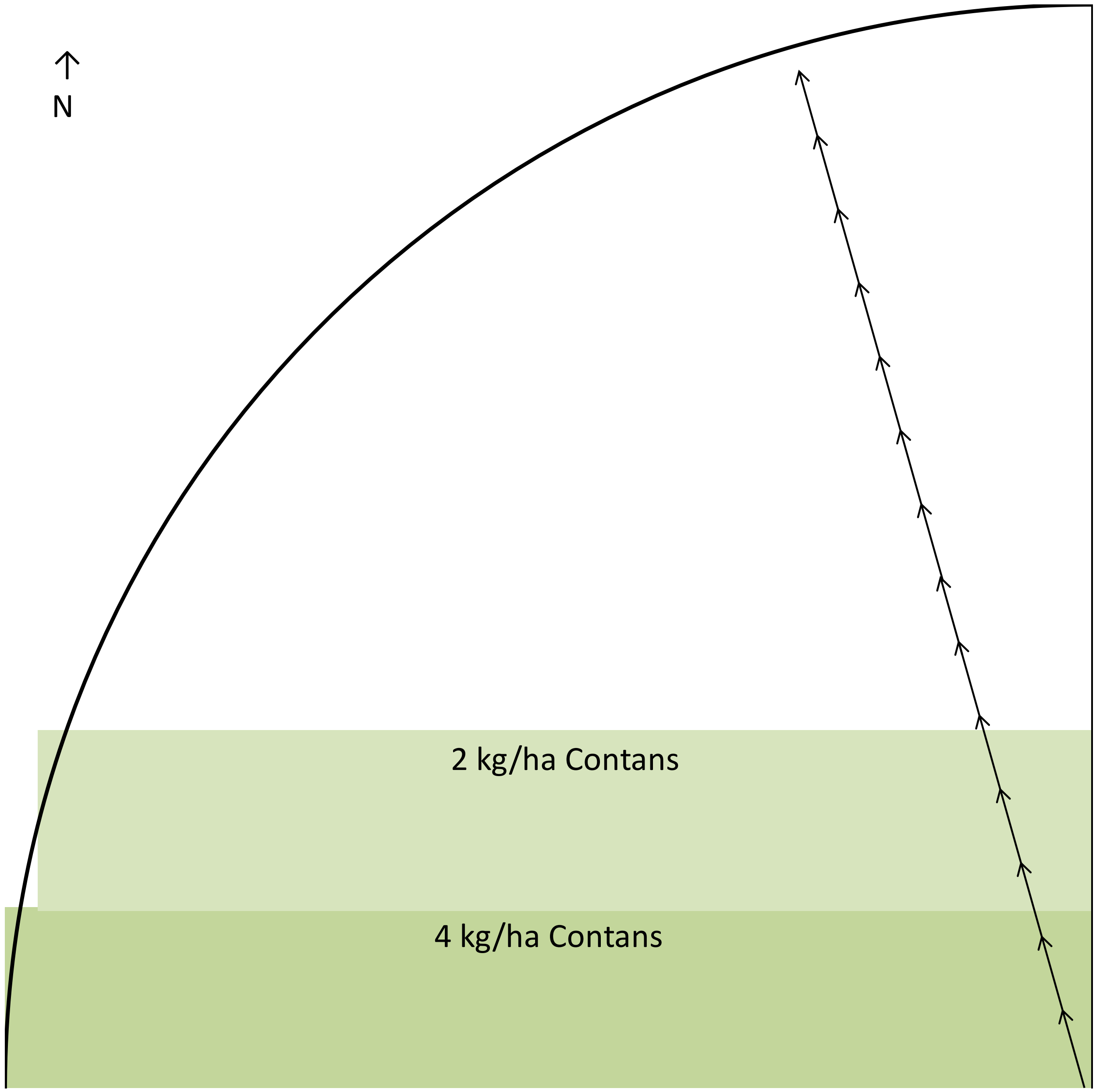


Figure 37. Field Trial Plot Plan, Co-operator 9, Contans

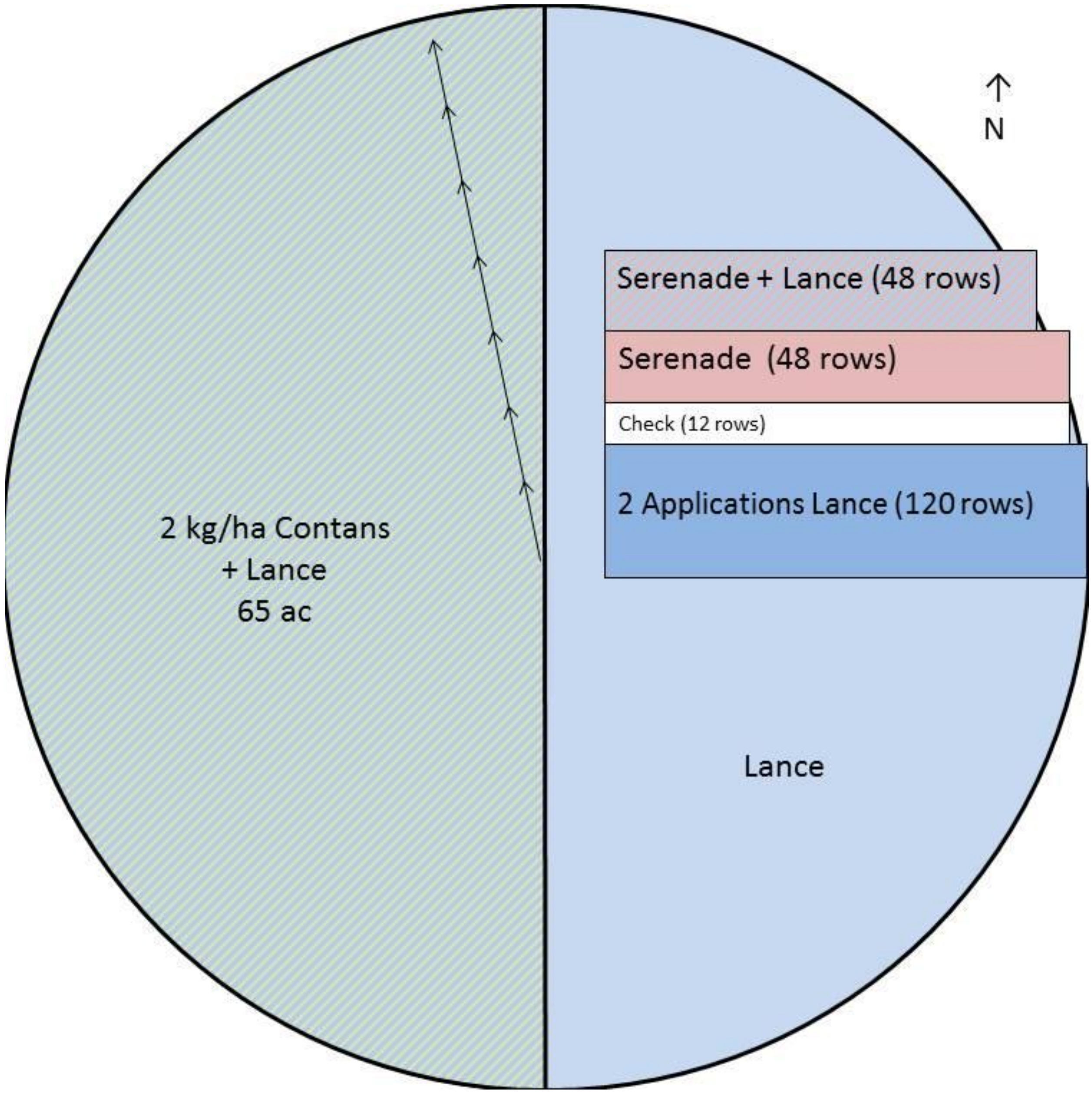


Figure 38. Field Trial Plot Plan, Co-operator 11, Contans & Serenade

Appendix D – Extension

Canada to approve mould inhibitor for canola, beans

By Ric Swihart
Freelance writer

AGRONOMICS

LETHBRIDGE — Canada will become the 20th nation to register Contans, a killer of biological sclerotinia and white mould that could be a boon for canola and bean growers.

Ken Coles, manager of the Southern Applied Research Association, has 10 large field-scale plots across southern Alberta sprayed with the new product from Prophyta.

Coles said next fall will be the prime time for canola and bean growers to consider using the product to protect their crops from the two yield-robbing plant diseases.

Matthias von Erffa, manager for marketing for Contans, said the final stamp of approval is expected soon so the company can begin selling in Canada.

Coles said trials in other countries indicate Contans fights sclerochia, the odd-shaped black particles of varying lengths that the disease produces in an affected field. The sclerochia are the seeds for the tiny mushroom-like growths that produce the disease. Contans reduced the pathogen's ability to inoculate and therefore, reduced the disease incidence.

Contans should be sprayed on the land, either in a field that had sclerotinia that year or a field on which canola or beans are planned the following year.

"This is the only product which has a direct action on the pathogen (of sclerotinia or white mould)," said Coles. "Spraying it on the land in the fall gives Contans time to work on the schlerochia."

Prophyta said a second benefit of Contans is reducing the use of pesticide in Canada and it works well with an integrated pest management program.

Coles said he hopes to have a plot with Contans next summer in his annual Diagnostic Field School in Lethbridge.

The field-scale work this fall is important to tailor use of Contans to Canadian farming conditions, said Coles.

"At this point, we can't tell Canadian farmers the best management practices for using Contans."

The Western Producer", October 31, 2008

Contans may help area productivity

Ric Swihart
LETHBRIDGE HERALD
rswihart@lethbridgeherald.com

Canada will become the 20th nation to register Contans, biological schlerotinia and white mould killer that could be a boon for canola and bean growers.

Ken Coles of Lethbridge, the manager of the Southern Applied Research Association, has 10 large field-scale plots across southern Alberta sprayed with the new product from Prophyta.

Matthias von Erffa

Coles said next fall will be the prime time for canola and bean growers to consider using the product to protect their crops from the two yield-robbing plant diseases.

Matthias von Erffa of Poel, Germany, manager for marketing and distribution for Contans, said only the final stamp of approval, expected very soon, remains to clear the new product for marketing in Canada.

Coles said trials in other nations indicates Contans fights the schlerochia, odd-shaped black particles of varying lengths the disease produces in an affected field. The schlerochia is the seed for the tiny mushroom-like growths which produce the disease. Contans reduced the inoculation of the pathogen and therefore, reduces the disease incidence.

Contans should be sprayed on the land, either in a field which exhibited schlerotinia that year or a field on which canola or beans are planned the following year.

"This is the only product which has a direct action on the pathogen (of schlerotinia or white mould)," said Coles. "Spraying it on the land in the fall gives Contans time to work on the schlerochia."

Coles said the Lethbridge Research Centre did some work on a similar product, but it didn't progress. Prophyta feels a second benefit of Contans is reducing pesticide risk in Canada and it works well with an integrated pest management program.

As Contans gains more registrations around the world, Prophyta continues to boost it production. Since 2000, the production plant hit 160 tonnes of Contans a year. This year, production will hit 380 tonnes and in February, plant upgrades will boost production capacity to 600 tonnes a year.

Coles said he hopes to have a plot in his annual Diagnostic Field School, located just east of the Lethbridge College research barn east of the Lethbridge Agriculture Centre along Goal Road, next summer.

The field-scale work this fall is important to tailor use of Contans to Canadian farming conditions, said Coles. "At this point, we can't tell Canadian farmers the best management practices for using Contans. We expect to find ways to make Contans work most efficiently in Canadian farming conditions."

Lethbridge Herald, October 31, 2008

Partnership Researching New Fungus Control

by Ric Swihart

Sclerotinia and white mold continue to create problems for canola and bean growers, but help appears to be on the way.

Working through the Pest Management Centre of Agriculture and Agri-Food Canada, two co-operating research agencies have won approval for a major field trial project to test Constans WG. It is a biological fungicide that controls sclerotinia diseases by attacking the disease-causing fungus in the soil before it can infect a susceptible plant.

The commercial formulation of Constans contains 1 X 109 active spores per gram of the naturally occurring soil fungus Coniothyrium Minitans and easily mixes with water.

Once applied into the soil, it attacks the black sclerotia that spreads the disease and destroys it within two months of contact.

This action breaks the cycle of disease by reducing or eliminating the disease-causing fungus from treated soil.

Ken Coles, agronomist for the Southern Applied Research Association, will head the largest test and include the plots in SARA's 2009 Diagnostic Field School held each summer at the Lethbridge Research Centre.

Co-operators for that demonstration protocol include Ron Howard of Brooks' provincial Crop Diversification Centre South, Matthias von Erffa with Prophyta, Tobias Langle with Ag Canada's Pest Management Centre and Ty Faechner with the Agricultural Research and Extension Council of Alberta.

Coles said there should be nothing to stand in the way of registering the research project this year.

The objective of the protocol is to introduce Constans as a safe alternate control option for Canadian producers and to demonstrate efficacy for the control of sclerotinia in canola and white mold in beans.

A plot will be established with canola seeding May 1 and beans May 15. Canola will be seeded at the rate of five kilograms per hectare; beans at 75 kilograms per hectare. It will contain 13 plots with a variety of variables.

"We will attempt to inoculate this disease by spreading sclerotia bodies collected from a bean plant spread with a small hand-pushed fertilizer spreader.

Three deposits will be made at one to two centimeters deep in the spring, each with 10 sclerotia per treatment.

Barley will be seeded on plot borders in the spring to help block the spread of ascopores from plot to plot.

Canola will be seeded on the back half and beans on the front half in the spring and irrigated often to ensure disease incidence.

Some of the plots will be cultivated after spreading the sclerotia treatments and two will be cultivated again after applying Constans.

The field scale work will afford on-farm field demonstrations of the use of Constans within an integrated approach.

Work started in fall 2008 by identifying potential farmer demonstrators chosen due to an elevated risk of sclerotinia in canola and white mold in beans. Also, growers who farm with global positioning systems and yield monitors were selected. A good range of soil types, farming practices and incorporation practices are employed among co-operators to help determine the most effective use of Constans in southern Alberta conditions.

With the 10 fields selected, Constans was applied using field sprayers equipped with low-drift nozzles at 50 to 100 litres per hectare water volume. Constans was incorporated as soon as possible after application.

Those demonstration sites are located near Enchant, Nobleford, two each at Grassy Lake and Bow Island, Tempest, Vauxhall and Lethbridge.

Coles said the work plan and timetable for the field demonstrations appears to be satisfactory. With excellent communications between SARA and the Pest Management Centre staff, most of the barriers have been resolved.

Farming Smarter Magazine, 2009

Biological fungicide may be a tool against Sclerotinia

Research on a European product that may effectively control the disease

By Lee Hart

An on-going southern Alberta research project hopes to determine over the next couple years if a European product, based on a beneficial soil fungus, can effectively control sclerotinia — one of the most costly diseases facing canola and pulse crop growers.

Preliminary work with Contans WG, a biological fungicide shows promise, but isn't an overnight silver bullet for controlling sclerotinia, says Ken Coles, with the Southern Applied Research Association (SARA).

Contans, developed by the German company Prophyta, is now registered for use in some 20 countries. It is a fungus that farmers soil apply and then incorporate and has been effective in controlling sclerotinia in a wide range of field and vegetable crops susceptible to the disease. In zero till irrigation systems, users may be able to apply the product through the irrigation water.

The Pest Management Centre of Agriculture Canada contracted the Southern Applied Research Association (SARA) and the Agricultural Research and Extension Council of Alberta (ARECA) to study the potential of Contans in southern Alberta.

"From our limited experience with the product, it is too early to say whether it will be effective or not," says Coles. "I feel the benefit will be something we will see over a period of time. The idea, is after a few years of using Contans, we will hopefully see a decline in the amount of the disease in the field."

Sclerotinia, as it is known to most canola growers, or white mould as it is known to dry field bean producers, can cause heavy economic yield losses in crops if not controlled. While there are a number of commercial fungicides registered for use in canola and beans to control the disease, it is hoped that a biological control agent in the soil will reduce disease pressure and potentially drop it to levels that wouldn't affect yields.

Sclerotinia in canola, caused by a soil borne fungus Sclerotinia sclerotiorium, survives in the soil for up to four years as irregular-shaped fungal bodies, called sclerotia. The sclerotia germinate in the summer, producing mushroom-like structures. These release wind-borne spores that travel up to one kilometre. The disease is favoured by moist soil conditions and temperatures of 15-25°C, prior to and during canola flowering. The spores cannot infect leaves and stems directly. They must first land on flowers, fallen petals, and pollen on the stems and leaves. These provide the food necessary for the spores to germinate, grow and infect the canola plant.

In field beans, Sclerotinia can attack all parts of the plant via ascospores or via direct infection from germination of sclerotia on the roots or next to leaves at the soil surface. In wet humid growing conditions, losses in yield and quality in the bean crop can be huge.

Pods, when they touch the soil, may be infected directly by germinating sclerotia or pod infection may result from ascospore infection of the dead flower on the tip of the pod. Following main stem infection by sclerotinia, the whole bean plant may collapse and yield loss could be total for that plant. Under very humid conditions, the white mold of the fungus can be seen growing on the outside of the pod.

The Contans fungus, Coniothyrium minitans attacks the black sclerotia (the resting survival structures of the sclerotinia fungus) and destroys them. When the Contans fungus is well established, it can control sclerotinia fungus within a few months.

Along with the Contans study, the study is evaluating another biofungicide potentially effective for controlling foliar and bacterial diseases including botrytis and powdery mildew common in a number of field and vegetable crops. Serenade Max, developed by AgraQuest Inc. of California and currently distributed in Canada by United Agri Products.

SARA began its evaluation of Contans WG with a late fall application of the product in 2008. Most testing is done on a field scale basis working with nine southern Alberta farmer cooperators and one demonstration plot at SARA’s research and development site near Lethbridge.

They made a second application of Contans in the fall of 2009 with a conventional field sprayer, equipped with low drift nozzles was used to apply Contans to the soil in late fall. The product was incorporated soon after.

Temperature and moisture conditions over the first couple seasons of the study have not worked in favour of the beneficial fungus, says Coles. Soil conditions in the fall of 2008 were very dry; which inhibited optimum soil mixing and effective inoculation of Contans on the sclerotia bodies in the soil.

The fall of 2008 and winter 2009 were particularly cold and dry; which may have been a limiting factor for survival and development of the beneficial fungus C. minitains. Several warming and cooling cycles also occurred including an extremely cold May (2009) with many frosty days.

Weather conditions during the 2009 growing season were cool with frequent rain; which resulted in optimal disease onset during crop flowering. Severe disease robbed fields of yield potential.

“Considering those conditions I don’t think we can say the product doesn’t work,” says Coles. “The ability of the beneficial fungus to survive in our climate is certainly a factor. But it may take several years for the benefits to be more obvious.

“We see it as working as part of an integrated disease management strategy, that includes Contans and commercial fungicides as well as a wide range of cultural practices. We’re hoping, over the next couple years, to see a disease reduction in the fields; which will help reduce the risk and economic losses from the disease.”

Farming Smarter Magazine 2010

Contans Cleans Up Sclerotinia

Monday, February 28, 2011 |
By Patty Milligan

1Sclerotinia apothecia from a sclerotia body

Sclerotinia, that nasty fungus that can cause as much as 50 per cent yield loss in a tough year, poses a particular problem for many farmers. Not only is it found across the Prairies, several common crops are susceptible making crop rotations nearly useless for control. Capable of knocking back canola, dry bean, lentil, soybean, sunflower and alfalfa, sclerotinia levels in some fields have drastically reduced cropping options.

That is, until now. Last year a novel disease control product was rolled out for Western Canada. Contans is a pre-emergent biofungicide — a parasitic fungus — that actually feeds on and destroys sclerotia. Sclerotia are dark, hard, resting bodies of the fungi that overwinter in the crop residue and the soil. Each sclerotia body can release millions of spores in the growing season.

United Agri-Products (UAP) introduced Contans in 2010. The active ingredient in Contans, *Coniothyrium minitans,* is a natural predator of sclerotia bodies, says Ken Coles, general manager at the Southern Applied Research Association (SARA) at Lethbridge, Alberta, who has headed up research on the product.

Because of its novel nature — Contans is applied prior to the susceptible crop being grown and needs up to 90 days to clean up a field — Coles and his colleagues have been working identify best management practices to prevent sclerotinia on canola and white mould on dry beans. So far, he says, the research has hinted at positive results in some fields — particularly in dry beans.

SPECIAL HANDLING

Work at SARA seeks to pin down when and how Contans is best applied to the soil for best control. Incorporation methods are important, as Contans must come into contact with the sclerotia in the soil in order to be effective. It's also a living organism so it must be incorporated quickly, or the fungus can die from sunlight exposure or by drying out.

"Under zero-tillage systems, farmers can use moisture as an incorporation method," Coles says, "either by spraying on Contans or by timing its application with rainfall." Contans is available as a water-dispersible granular formulation that can be tank-mixed with several different herbicides. Contans is active between 5 C and 30 C. Outside of this range, the fungus goes dormant.

Coles says farmers using minimum or conventional tillage must pay close attention to moisture levels. "If a tilled field is dry and lumpy, Contans won't come into contact with the sclerotia nor will it survive," he says. "Contans is little more management intensive than your typical silver-bullet chemical fungicide."

WORKING WINDOW

Brodie Blair, western product manager for UAP, says that handling Contans is going to take a bit of getting used to for farmers. Because it's live, Contans is kept frozen in order to keep it dormant until it's in the field. As a result, it has to be applied quickly.

Nor does Contans work instantly. Temperature-dependent, Contans requires time to to render sclerotial bodies unviable. Depending on the weather, cleaning up a field could take up to 90 days.

Blair says that, depending on infection levels and planned crop rotation, a fall application may be best to "allow it a little more time to start working." Blair says spring applications are more expensive, requiring the higher rate of product (0.8 kg/acre and $26 per acre) to ensure enough parasitism to make a difference. A fall application requires only 0.6 kg/acre ($18 per acre), because of the longer timeframe for the fungus to work at eating up sclerotia.

In trials at SARA so far, the fall weather has made it difficult to get the product on and as a result, the fall application results haven't impressed Coles. He thinks fall conditions on the Prairies might be "too tight and too tough" to apply Contans properly. He says that a spring application following a susceptible crop might work best.

Contans reduces the sclerotia loads over the long term so farmers may not see benefits for a couple of years. Because Contans is applied to the residue of an infected crop, the grower sprays it on a field that is going into a non-susceptible crop, such as wheat. Essentially the grower is investing in the next susceptible crop that'll be grown in that field a year or two down the road. Coles admits this approach can be a tough sell to farmers.

But Blair says that because Contans continues to work in the fall, spring and through the growing season, "an application of Contans is never wasted." Even if a farmer doesn't see immediate results, it will help decrease sclerotia levels over time. Blair recommends that growers build a base of Contans in their fields. Once it has been established, they can move into maintenance mode, applying about .2 kg per acre each year, which would cost less then $10 per acre.

FIELD-SCALE EXPER IENCE

Contans was applied to about 15,000 acres across the Prairies in 2010. Blair says the reaction has been positive from farmers who tried it. He also says field-scale results at a trial at Hudye Farms in Norquay, Sask., were positive. Soybean trials by Vikram Bisht with Manitoba Agriculture Food and Rural Intiatives also yielded positive results.
Both Blair and Coles are fairly optimistic about the continued trials for Contans for the 2011 season. Coles hopes that another year of trial results will point towards clearer best management practices. He does feel, however, that the product will have a tough road ahead because researchers have to not only demonstrate that Contans works, but that it "makes sense economically."

Bean growers may be keen to try Contans, since white mould is their primary limiting factor, but canola growers might be more hesitant. According to Coles, using a biofungicide like Contans requires a shift in mentality; farmers have to get used to the idea of investing in a crop that's two years down the road instead of expecting immediate results. Though he thinks it'll be a few years before we figure out the full benefits of Contans. "If we want to make progress in the industry, producers will have to take the time," Coles says.†

Patty Milligan writes from Bon Accord, Alta.

Grain News, February 28, 2011

Biofungicide shows promise despite low mould year

By Barb Glen, Lethbridge Bureau

Kristina Halma wanted to see more white mould sclerotinia in her beans, but hot, dry July weather in southern Alberta put a stop to most of it.

Halma, a research technician for the Farming Smarter applied research group in Lethbridge, is studying biofungicide applications in beans and canola. More mould would have been useful for her fungicide tests, but she doesn't really begrudge its loss.

Halma told those on an Aug. 18 crop tour that Contans, a biofungicide powder that is applied to soil and incorporated, shows promise in white mould sclerotinia control.

Research plots just outside Lethbridge had little white mould, but nine pulse and canola producers in the region also co-operated in the study by using Contans and another product under test called Serenade.

"So far we have had definitely some positive results with Contans," said Halma, who is in the third year of the study and expects to continue it for another two years.

Yield increases and lower infection rates have been recorded in some canola and bean crops after Contans use. The biofungicide, which can be applied in either fall or spring, acts as a parasite to the sclerotia, invading and destroying them so they can't form spores.

"It's kind of a different approach," she said, one of prevention rather than cure.

Demonstration plots received different rates of Contans and tillage ranging from no till to twice tilled.

Sclerotinia is a fungal disease that spreads via spores. Contans is also a fungus and because it is a living organism, winter survival and proper handling are issues in its use.

As for Serenade, Halma said it hasn't proven more effective than Lance, a commonly used fungicide for sclerotinia control in beans and canola.

Ron Howard, a plant pathology researcher with Alberta Agriculture, said Contans is widely used in Europe but new to Canada. However, other weapons in the arsenal against sclerotinia are needed.

"This is a very important disease to us in southern Alberta," he said, noting sclerotinia attacks most broad-leaf crops.

Sclerotia that carry the disease can live for several years in the soil, and its spores can be carried by wind.

Its adaptability to conditions has prevented development of any “silver bullet” for control.

“It has to be managed over time,” said Howard.

There has been little success in finding genes to introduce resistance to sclerotinia, he added.

Most measures are geared toward avoidance, such as developing more upright bean varieties to limit dense canopies that encourage disease growth.

The Western Producer, September 1, 2011

Figure 39. Contans Project Poster

Presentation Given at Alberta Pulse Growers' Zone 1 AGM – Dec. 14, 2011

On-Farm Demonstration of Biofungicides (Contans WG and Serenade MAX/ASO)

Farming Smarter – Kristina Halma

Agriculture and Agri-Food Canada | ARECA | FARMING SMARTER Growing new ideas

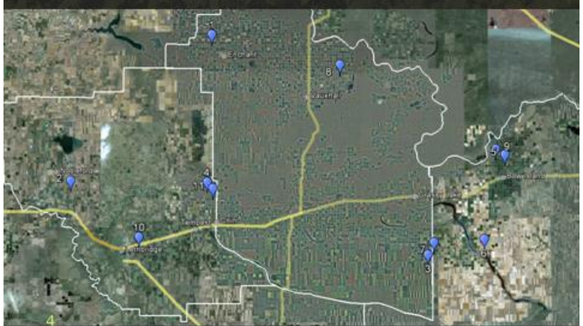
Outline

- Project Overview
- Product Descriptions
- Data Collected
  - Depot Methods and Results
  - Disease Ratings and Yield Methods
  - Disease Ratings and Yield Results
- Costs of Treatments
- Conclusions

Project Overview

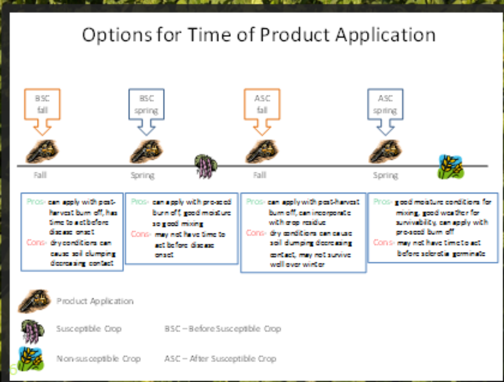
- Funded by the Pest Management Centre of AAFC as part of the Pesticide Risk Reduction Program
- Purpose of project is to demonstrate how two new biofungicides, Contans WG and Serenade MAX/ASO, can be used within an IPM system
- Includes field-scale demonstrations in nine southern Alberta fields and a small plot demo at the Farming Smarter R & D site

Producer Locations



The Products – Contans WG

- Is a preventative, water dispersible granular biofungicide
- Contains the fungus *Coniothyrium minitans*
- Works by attacking sclerotia bodies
- Must be incorporated, and soils must not be disturbed after that to allow it to work in the top layer of soil
- From German company Prophyta, Canadian distributor is UAP



The Products – Serenade

- Is a biological foliar fungicide
- Active ingredient is a by-product of the bacteria *Bacillus subtilis*
- Suppresses Sclerotinia diseases
- Applied the same as conventional fungicides
- Has multiple modes of action
- Produced by Agra Quest, distributed by UAP

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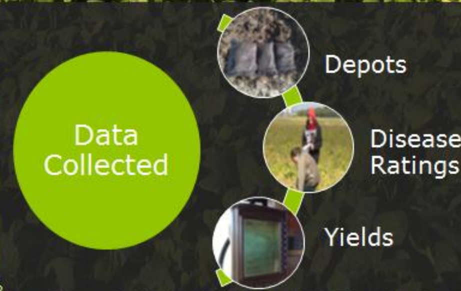
Data



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Depots

- Small bags containing sclerotia mixed with soil from each treatment
- Buried at field edge, then dug up later
- Analyzed in Brooks to see if sclerotia had been colonized by the Contans

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Depots

10

Depots

11

Depot Results

- Depots in 2008 showed few results
- In 2009, 3/8 sites had positive results
- In 2010, 4/7 sites and in 2011, 2/6 sites
- There was no clear trend or determining factor why results were mixed

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Disease Ratings

- Five stops were made in each treatment, with 50 plants for canola and 2 x 5m rows of beans per stop
- Canola and bean crops were rated at the appropriate stage for disease incidence and severity
- Beans were rated on scale going to 3, canola on scale going to 5

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Yield

- Some yields taken by yield maps, some by yield monitors, and some by weighing trucks

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Treatments

- Treatments varied among co-operators to fit their operations
- Contans – 2 and/or 4 kg/ha
- Serenade – 3 or 5 L/ac
- Other treatments included Lance, Allegro, Proline (in canola)
- Untreated checks were also left in three fields over the course of the project

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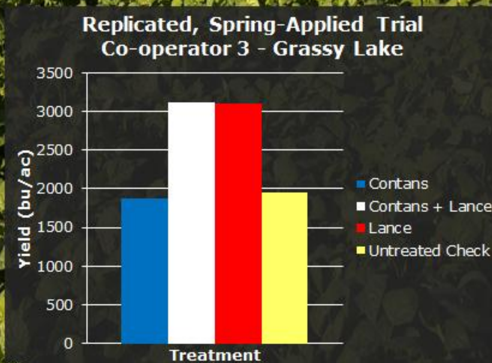

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2009

Co-operator	Crop	Treatment	Severity	% Incidence	Yield (lb/ac)
2	Canola	Proline	1.20	71	N/A
		Contans 2 kg/ha + Proline	1.70	90	N/A
3	Canola	Untreated	1.49	88	N/A
		Contans 2 kg/ha	2.03	99	N/A
		Contans 2 kg/ha + Serenade	1.90	98	N/A
		Serenade	2.16	100	N/A
4	Beans	Lance	1.90	88	3355
		Contans 2 kg/ha + Lance	2.03	94	3341
5	Beans	Untreated	1.90	88	2315
		Contans 2 kg/ha	2.20	94	2709
		Contans 2 kg/ha + Serenade	2.15	93	2426
		Contans 2 kg/ha + Lance	0.88	47	3099
		Serenade	1.23	52	2594
		Lance x2	0.65	28	3439

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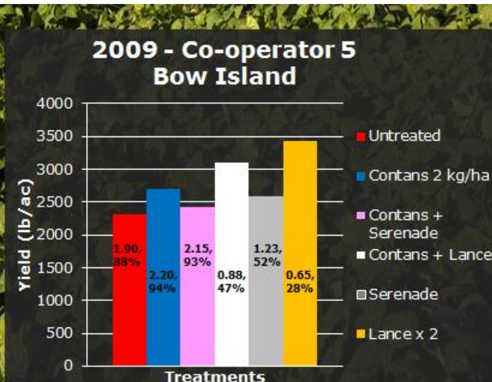

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2009

Co-operator	Crop	Treatment	Severity	% Incidence	Yield (lb/ac)
6	Beans	Serenade	2.69	99	1654
		Lance	1.98	91	2526
		Lance and Serenade	2.06	93	2170
6	Canola	Lance	0.22	17	3369
		Contans 2 kg/ha + Lance	1.00	83	3706
9	Beans	Untreated	2.58	100	1437
		Contans 2 & 4 kg/ha	2.65	100	1497
		Contans 2 & 4 kg/ha + Serenade	2.70	100	1659
		Contans 2 & 4 kg/ha + Lance	2.87	100	2149
		Serenade	2.48	97	1651
		Lance	1.92	93	2111
13	Beans	Untreated	1.85	97	N/A
		Serenade	1.58	93	N/A

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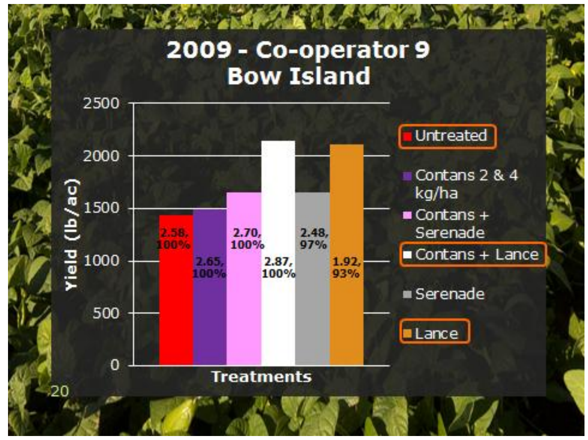

2010

Co-operator	Crop	Treatment	Severity	% Incidence	Yield (lb/ac)
1	Canola	Proline 480SC	0.36	21	N/A
		Contans 2 kg/ha + Proline	0.10	6	N/A
3	Beans	Lance	0.47	28	N/A
		Serenade + 1/2 Rate Lance	0.25	17	N/A
5	Beans	Lance	2.77	98	1684
		Serenade	2.88	98	1886
8	Beans	Lance	0.24	9	2824
		Contans 2 kg/ha + Lance	0.19	8	2744
		Contans 4 kg/ha + Lance	1.00	48	3157 *
		Contans 4 kg/ha + Lance + Serenade	0.87	42	3011 *
12	Beans	Lance	1.00	41	N/A
		Serenade + Lance	1.43	61	N/A

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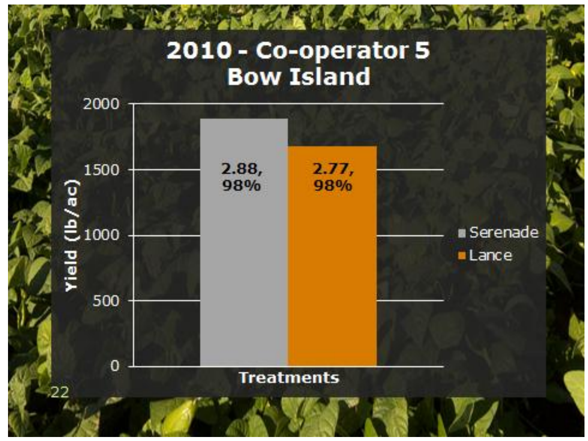

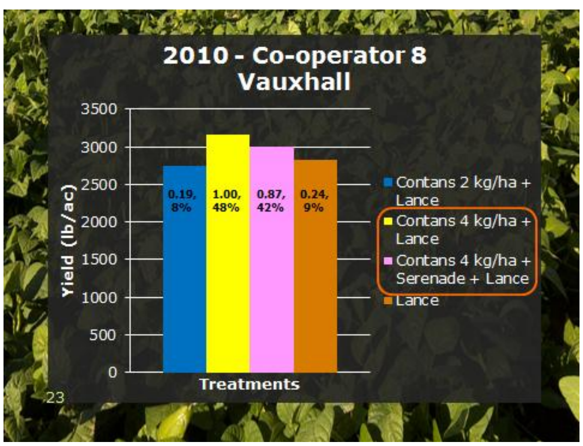

2011

Co-operator	Crop	Treatment	Severity	% Incidence	Yield (lb/ac)
6	Beans	Lance	1.05	100	3245
		Contans 2 kg/ha + Lance	1.18	97	3460
		Contans 4 kg/ha + Lance	1.01	100	3610
		Contans 4 kg/ha (one year)	N/A	N/A	3200
7	Beans	Lance + Allegro	0.01	1	2601
		Contans 2 kg/ha + Lance + Allegro	0.00	0	2356
8B	Beans	Allegro	1.02	100	3300 **
		Allegro + Serenade	1.03	100	3550 **
8C	Beans	Allegro	1.68	82	3400 **
		Allegro + Serenade	2.19	95	3400 **
11	Beans	Untreated	1.35	100	2734
		Contans 4 kg/ha + Lance	1.85	99	2850 ***
		Serenade	1.39	100	2907
		½ rate Serenade & Lance	1.36	99	2792
		Lance	1.48	100	2757
		Lance x2	1.47	100	2813

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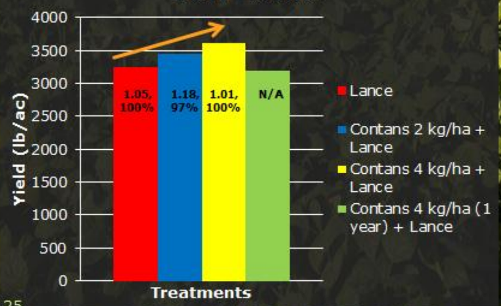
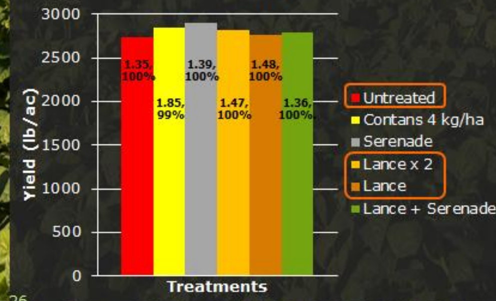
2011 - Co-operator 6 Bow Island



2011 - Co-operator 11 Chin



Costs - based on 2011 MSRP

Treatment	Price	Rate/ac	Price/ac
Contans	$416.84/12 kg	0.2 kg	**$7.04**
		0.4 kg	**$14.07**
		0.8 kg	**$28.14**
		1.6 kg	**$56.27**
Serenade	$265.76/18.92 L	3 L	**$42.14**
		5 L	**$70.23**
Allegro	$2002.7/20 L	0.4 L	**$40.05**
Lance	$480/2.83 kg	283 g	**$48.00**

Conclusions

- Contans applications have yielded positive results, but also some neutral ones
- Want to continue monitoring the fields that have had applications
- Contans is unlikely at this time to replace other fungicides, but may be very useful when applied in conjunction with conventional fungicides to reduce dependence on those products
- Use of Contans may allow for more intensive rotation of susceptible crops

Questions??