2016 Annual Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Managing Blackleg & Sclerotinia in Canola with Varietal Rotation and Fungicides

(Project #20150397)

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Project Identification

1. **Project Title:** Managing Blackleg and Sclerotinia in Canola with Varietal Rotation and Fungicides
2. **Project Number:** 20150397
3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156
5. **Project start and end dates (month & year):** Apr-2016 to Feb-2017
6. **Project contact person & contact details:**

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Objectives and Rationale

7. Project objectives:

While their impacts on yield and subsequent crop responses to fungicide applications are variable, blackleg and sclerotinia stem rot are the two most prominent diseases of canola in Saskatchewan. The objective of this project was to measure the impacts of distinctly timed fungicide applications targeting these diseases on canola yield and to provide a forum for discussion of best management practices for reducing their short-term impact along with the potential for future breakdown of genetic resistance.

8. Project Rationale:

Canola continues to be one of the most lucrative and dominant crops grown in Saskatchewan; however, crop rotations are frequently strained and disease management is becoming increasingly important for protecting the productivity of this crop. The two most widespread diseases affecting canola in western Canada are sclerotinia stem rot and blackleg. While the economics of annual fungicide applications can often be questionable for canola throughout much of Saskatchewan, recent disease levels been relatively high and, in some years (i.e. 2012 and 2016) have resulted in substantial and widespread yield loss.

Blackleg is a wide-spread disease that has potential to affect canola growers throughout the Prairies; however, genetic resistance and crop rotations have traditionally been relatively effective for keeping this disease in check. That said, many growers are tightening rotations and, with the adaptability of the blackleg pathogen and lack of common knowledge about variation in the resistance mechanisms amongst varieties, incidence has been on the rise in recent years, particularly in Alberta. In 2016, 61% of the Saskatchewan fields surveyed had at least trace levels of blackleg (59% in 2015 and 55% in 2014). Of the affected fields, 12% of the plants surveyed had symptoms of blackleg, down slightly from 15% in 2014 and 2015. While most modern canola hybrids have genetic resistance, the genes and mechanisms responsible for this resistance vary and there is evidence that it can be overcome by virulent strains of the blackleg pathogen, particularly in short rotations. Left unchecked, the loss of genetic resistance to blackleg infection could result in significant loss of yield and canola markets for western Canadian farmers. Currently, the best methods for preventing the breakdown of blackleg resistance are to increase the length of time between canola crops and to rotate varieties so that different mechanisms of variety resistance are being utilized. Foliar fungicides can also reduce the impact of this disease and help slow the development of resistant strains; however, it is not advisable to rely too heavily on a single tool for managing crop pests and the economic returns of using fungicide to control blackleg under normal circumstances are often negligible.

In the case of sclerotinia stem rot, foliar fungicide applications are the most consistent and effective method of control; however, a few cultivars with improved tolerance to this diseases are also commercially available. Prior to 2012, when sclerotinia devastated canola yields throughout much of Saskatchewan, most canola in the Indian Head area did not receive a fungicide application. Since that time, however, spraying for sclerotinia has become common practice as wet conditions have generally prevailed and most growers do not want to risk the yield loss that can occur under favourable conditions for disease. That said, IHARF fungicide trials (field-scale and small plot) over the years have shown that economic responses to fungicide are relatively rare for canola compared to many other crops in the region. In 2016, sclerotinia stem rot pressure was again relatively high with 92% of fields surveyed in Saskatchewan having at leave trace levels (66% in 2015 and 79% in 2014) and an average incidence of 26% in affected crops, up from 11% in 2015 and 18% in 2014. Unfortunately, sclerotinia continues to be a difficult disease for producers to predict at the early-mid bloom stage when fungicides must be applied. Unlike most leaf diseases for cereals and pulse crops, symptoms of this disease do not normally appear until well after the optimal fungicide timing and decisions must be based on predictive tools as opposed to in response to the appearance of disease symptoms. While important advances are being made for identifying the presence of inoculum in the fields, the weather / environmental conditions that occur after fungicide is applied are major determinants of whether (and to what extent) infection will occur and these conditions are difficult to predict.

The proposed demonstration was initiated to inform growers about options for managing blackleg and sclerotinia in canola and to provide regional information on disease levels and crop response to fungicide applications. The project incorporated two hybrids from distinct breeding programs to encourage varietal rotation as a blackleg resistance management strategy and four separate fungicide treatments to demonstrate foliar fungicide options for managing these diseases in canola.

Methodology and Results

9. Methodology:

A field trial with canola was established near Indian Head, Saskatchewan (50.55º -103.58º) in the spring of 2016. The treatments were a factorial combination of two canola hybrids and four fungicide treatments arranged in a four replicate split plot design with hybrid as the main plot. The hybrids chosen were InVigor L140P (Liberty Link®, Bayer CropScience) and 46M34 (Roundup Ready®, Dupont-Pioneer) and the fungicide treatments were:

1. Untreated (no fungicide applied)
2. 0.18 l Priaxor/ac (74 g fluxapyroxad/ha + 148 g pyraclostrobin/ha) at 2-4 leaf stage [Z]
3. 142 g Lance WDG/ac (246 g boscolid/ha) at 20-50% bloom [Y]

[Z] Targeting blackleg
[Y] Targeting sclerotinia stem rot

Pertinent agronomic information is provided in Table 1. Canola was direct-seeded into barley stubble on May 19 with all fertilizer applied during planting. The field is on a four year cereal-oilseed-cereal-pulse rotation and the last canola crop on the site was in 2012. Seeds were planted somewhat deeper than desired (>1”), which slowed down and reduced emergence; however, with the high seeding rate and favourable conditions for emergence, final plant stands were considered adequate. Weeds were controlled using registered herbicides and fungicides were applied as per protocol on June 15 (T1 – blackleg) and July 8 (T2 – sclerotinia). All fungicide treatments were applied using a field sprayer, flat fan nozzles and 220 l/ha (20 imp. gal/ac) solution volume. Timing of the fungicide applications was somewhat difficult because of the variable emergence / crop stages; however, the varieties were similar enough in development that they could both be sprayed on the same dates. The T1 fungicide treatments were not tank-mixed with the herbicides; however, they were applied at approximately the same time. The plots were terminated with pre-harvest glyphosate plus saflufenacil and the centre 5 rows of each plot were straight-combined on September 20 (L140P) and 21 (46M34). The crop rows affected by wheel tracks during the treatment applications were purposely excluded during harvest.

Table 1. Selected agronomic information for canola preharvest options for straight-combining demonstration at Indian Head, Saskatchewan.

Factor / Field Operation	Details / Date
Previous Crop	Barley
Pre-emergent herbicide	890 g glyphosate/ha (15-May-2016)
Cultivar	L140P (Liberty Link®) 46M34 (Roundup Ready®)
Seeding Rate	125 seeds/m^2 (6.3-6.6 kg/ha)
Seeding Date	19-May-2016
Row spacing	30 cm
kg N-P_2O_5-K_2O-S ha^{-1}	140-30-15-15
In-crop herbicide (LL)	593 g glufosinate ammonium/ha + 30 g clethodim/ha (15-Jun-2016)
In-crop herbicide (RR)	890 g glyphosate/ha (17-Jun-2016)
Fungicide (T1)	74 g fluxapyroxad/ha + 148 g pyraclostrobin/ha (Jun-15) Applied as per protocol
Fungicide (T2)	246 g boscalid/ac (8-Jul-2016) Applied as per protocol
Pre-harvest herbicide	890 g glyphosate/ha + 50 g saflufenacil/ha (Sep-8-2016)
Harvest date	20-Sep-2016 (L140P) 21-Sep-2016 (46M34)

Intensive, destructive disease ratings were completed for all plots on 26, 27 & 28 – the measurements were spread over multiple days due to the length of time required to do the work. For each plot, 25 plants were removed (from outside the harvest area) and rated on a scale of 0-5 for both blackleg and sclerotinia (Table 6, Appendices). Percent incidence (the percentage of individual plants affected) and overall plot severity (the average severity across all 25 plants) were calculated for both diseases in each plot. Yields were determined from the harvested grain samples which were cleaned and corrected to 10% seed moisture content. Dockage (for correcting yields) and test weights were determined using CGC methodology and test weights are expressed as g 0.5 L^{-1}. Seed size was determined by mechanically counting and weighing a approximately 1500 seeds per plot and calculating g 1000 $seeds^{-1}$ (TKW). Weather data were estimated from a private weather station located on the site.

Data was statistically analysed using the GLM procedure of SAS with variety and fungicide effects along with their interaction considered fixed and rep effects considered random. Fisher's protected LSD test was used to separate individual treatment means. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

10. Results:

Growing season weather conditions

Mean monthly temperatures and precipitation amounts are presented with the long-term averages for the 2016 growing season at Indian Head in Table 2. While May was initially warm and dry, large amounts of precipitation were received late in the month and the total amounted to 140% of the 20 year (1981-2010) average. Total precipitation for June was 81% of average while July was wet (177%) and August was relatively dry (58%). The total amount of precipitation from April 1 through August 31 was 292 mm (11.7"), approximately 9% above the long-term average. Temperatures were substantially higher than normal for May and June and then approximately normal in July and August. Despite the slower emergence that resulted from seeding too deep, with abundant but generally not excessive precipitation and adequate overall plant populations the yield potential of the canola was above average. The plots were lightly damaged by hail on July 18 (late bloom) however effects on yield were negligible (<5%). While high levels of blackleg were not necessarily expected given the four-year crop rotation, sclerotinia pressure was high with a heavy crop and wet conditions through flowering and pod filling.

Table 2. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) averages for the 2016 growing season at Indian Head, SK.

Year	May	June	July	August	Avg. / Total
	---------- Mean Temperature (°C) ----------				
2016	14.0	17.5	18.5	17.2	16.8
Long-term	10.8	15.8	18.2	17.4	15.6
	---------- Precipitation (mm) ----------				
2016	72.6	63	112.8	29.8	278.2
Long-term	51.8	77.4	63.8	51.2	244

Effects on Disease Incidence & Severity

Treatment effects on blackleg incidence and severity along with the main effect means are presented in Table 3. Neither of these variables was affected by variety, fungicide or the VAR × FUNG interaction (P = 0.38-0.83) and overall blackleg levels were low, averaging 3% incidence and with an overall plot severity of 0.04. Again, the low levels of blackleg were not necessarily unexpected considering that there had been no canola grown on the site since 2012.

Table 3. Overall F-test results and treatment means for blackleg incidence and severity in the canola disease management demonstration at Indian Head 2016. Means within a group followed by the same letter do not significantly differ (Fisher's protected LSD test, $P \leq 0.05$).

Main Effect	Blackleg Incidence	Blackleg Plot Severity
Variety (VAR)	------------------- % -------------------	------------------ 0-5 ------------------
1) L140P LL	2.6 a	0.03 a
2) 46M34 RR	3.3 a	0.04 a
S.E.M.	0.94	0.011
Fungicide (FUNG)		
1) Control	3.0 a	0.04 a
2) T1 – Blackleg [Z]	4.1 a	0.04 a
3) T2 – Sclerotinia [Y]	3.0 a	0.04 a
4) Dual (T1 + T2)	1.5 a	0.03 a
S.E.M.	1.33	0.016
C.V. (%)	123.8	115.0
Overall F-Test	--------------------------------- Pr > F (p-value)	---------------------------------
Variety (VAR)	0.609	0.630
Fungicide (FUNG)	0.600	0.831
VAR × FUNG	0.426	0.379

[Z] 0.18 l Priaxor/ac at 2-4 leaf stage [Y] 142 g Lance WDG/ac at 20-50% bloom

Overall F-test results for treatment effects on sclerotinia incidence and average plot severity are provided along with main effect means in Table 4. Sclerotinia infection was similar for both varieties (P = 0.34-0.57) but varied with fungicide treatment (P < 0.001). No interaction between variety and fungicide treatment was detected for either percent incidence (P = 0.509) or severity (P = 0.391). Averaged across all treatments, the overall percent sclerotinia incidence was 21% and the overall plot severity was 0.79. Averaged across both varieties, sclerotinia incidence was 29-31% in the treatments (Trt. 1-2) which were not sprayed during flowering and 12-14% in the sprayed treatments (Trt. 3-4). The results clearly showed a significant reduction in disease with an appropriately timed fungicide application but, not unexpectedly, the fungicide did not eliminate the disease. While better control may have been possible with a less variable crop (and consequently better application timing), fungicide applications cannot be expected to completely eliminate disease (especially under high pressure) and the level of control was considered satisfactory. In 2012, under extreme heavy pressure, percent incidence in the untreated control was 65% and, averaged across the products evaluated, was reduced to 37% with a single foliar fungicide application. The lack of a variety effect or interaction indicated that both the overall sclerotinia infection levels and effects of fungicide applications were similar for both varieties.

Table 4. Overall F-test results and treatment means for sclerotinia incidence and severity in the canola disease management demonstration at Indian Head 2016. Means within a group followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Main Effect	Sclerotinia Incidence	Sclerotinia Plot Severity
Variety	-------------------- % --------------------	------------------- 0-5 -------------------
1) L140P LL	20.2 a	0.82 a
2) 46M34 RR	22.3 a	0.75 a
S.E.M.	1.50	0.089
Fungicide		
1) Control	28.5 a	1.12 a
2) T1 – Blackleg [Z]	31.4 a	1.29 a
3) T2 – Sclerotinia [Y]	11.5 b	0.37 b
4) Dual (T1 + T2)	13.5 b	0.37 b
S.E.M.	2.12	0.126
C.V. (%)	28.0	45.6
Overall F-Test	Pr > *F* (p-value)	
Variety (VAR)	0.340	0.567
Fungicide (FUNG)	< 0.001	< 0.001
VAR × FUNG	0.509	0.391

[Z] 0.18 l Priaxor/ac at 2-4 leaf stage [Y] 142 g Lance WDG/ac at 20-50% bloom

Effects on Seed Yield and Quality

Treatment effects on seed yield, thousand kernel weights (TKW) and test weight along with main effect means are presented in Table 5.

Averaging 3330 kg/ha (59 bu/ac), yields were above average overall and similar for both varieties (P=0.584) but the effect of fungicide was significant (P = 0.018). To a large extent, treatment effects on seed yield were consistent with the observed effects on sclerotinia infection whereby the treatments with the lowest disease levels also yielded the highest. Yields in the control were numerically slightly higher than those which were only sprayed at herbicide timing (Trt. 2) but did not significantly differ from any other treatments. That said, there was a clear tendency for slightly higher yields in the treatments sprayed at 20-50% (Trts. 3 & 4) and both were significantly higher than Trt. 2 which was only sprayed for blackleg at the 2-4 leaf stage. On average, yields in the plots sprayed for sclerotinia were 3426 kg/ha (61.0 bu/ac), 6% higher than those which were not (3234 kg/ha or 57.6 bu/ac). The lack of a VAR × FUNG interaction indicated that fungicide effects on seed yield were consistent regardless of variety.

Seed size was 9.6% higher for 46M34 (3.4 g/1000 seeds) than for L140P (3.10 g/1000 seeds) and was affected by fungicide treatment in a similar manner as seed yield. The two treatments which were not sprayed for sclerotinia had an average seed size of 3.18 g/1000 seeds while those which were averaged 3.32 g/1000 seeds, or 4.4% higher. Similar to the other variables, there was no significant VAR × FUNG interaction for seed size (P = 0.838).

Table 5. Overall F-test results and treatment means for seed yield, thousand kernel weight (TKW) and test weight in the canola disease management demonstration at Indian Head 2016. Means within a group followed by the same letter do not significantly differ (Fisher's protected LSD test, $P \leq 0.05$).

Main Effect	Seed Yield	TKW	Test Weight
Variety	--------- kg/ha ---------	---- g/1000 seeds ----	--------- g/0.5 l ---------
L140P LL	3313 a	3.10 b	322.3 b
46M34 RR	3346 a	3.40 a	327.9 a
S.E.M.	41.6	0.024	0.37
Fungicide			
Control	3297 ab	3.16 b	325.9 a
T1 – Blackleg [Z]	3171 b	3.19 b	326.1 a
T2 – Sclerotinia [Y]	3451 a	3.29 a	324.8 ab
Dual (T1 + T2)	3400 a	3.35 a	323.5 b
S.E.M.	58.7	0.034	0.52
C.V. (%)	4.9	2.9	0.4
Overall F-Test		Pr > *F* (p-value)	
Variety (VAR)	0.584	< 0.001	< 0.001
Fungicide (FUNG)	0.018	0.002	0.008
VAR × FUNG	0.969	0.838	0.969

[Z] 0.18 l Priaxor/ac at 2-4 leaf stage [Y] 142 g Lance WDG/ac at 20-50% bloom

Test weight was affected by variety ($P < 0.001$) and fungicide treatment ($P = 0.008$) with no interaction between the two factors. At 327.9 g/0.5 l (50.9 lb/W bu) test weight for 46M34 was slightly but significantly higher than that of L140P (322.3 g/0.5 l or 50.0 lb/W bu). Unlike yield and TKW, test weight tended to be slightly lower for the treatments sprayed for sclerotinia. On average, test weight in the plots that were not sprayed during flowering (Trt. 3-4) was 324 g /0.5 l (50.3 lb/W bu) while those that were sprayed averaged 326 g/0.5 l (50.6 lb/W bu). Test weight is a function of both kernel density and how well individual seeds pack in together, therefore it is conceivable that larger seeds (assuming similar density) could result in lower test weight.

Extension and Acknowledgement

Due to logistic / location considerations, this project was not shown as part of the Indian Head Crop Management Field Day in 2016. However, it was highlighted on tour coordinated by Seed Hawk during the Farm Progress where 15-20 Australian producers and agronomists (June 16, 2016) and on another co-hosted with Richardson Pioneer (July 27, 33 guests). In addition to these more formal tours, the site was visited by numerous growers, agronomists and researchers over the season. A summary of this work will be included in the 2016 IHARF Annual Report which, in addition to the full report, will be available online. Results will also be made available through a variety of other media (i.e. oral presentations, popular agriculture press, social media, fact sheets, etc.) as opportunities arise.

11. Conclusions and Recommendations

Overall, this project has demonstrated that blackleg incidence and severity will generally be acceptably low when varieties with genetic resistance are combined with agronomically sound crop rotations (i.e.

adequate time between canola crops). In the current case, percent blackleg incidence averaged 2.9% and few individual plants ever scored higher than a 1 on a scale of 0-5. Under such conditions, there was no benefit to applying foliar fungicide at the 2-4 leaf stage as recommended for controlling blackleg. While longer and diverse crop rotations are ideal, rotating varieties is also believed to be an effective way to reduce the potential for varietal resistance to be overcome. Fortunately, the industry is moving towards a resistance labelling system which will make it easier for growers to effectively rotate and select varieties which are well suited for their farms based on field history and the actual pathogen races present.

In contrast, sclerotinia stem rot pressure was relatively high in 2016 and modest but significant benefits were detected when foliar fungicide applications targeted this disease. Because of the wide range of host crops and weed species, crop rotations are relatively ineffective for minimizing sclerotinia stem rot and foliar fungicides are generally the best management tool when pressure is high. Under the conditions encountered, average sclerotinia incidence was reduced from 30% to 13% with foliar fungicide applied at 20-50% bloom and yields were 6%, or 190 kg/ha (3.4 bu/ac) higher in sprayed plots. While the probability of response to sclerotinia fungicide applications in canola remains difficult to predict, tools are available to assess risk (i.e. sclerotinia checklists, petal tests, etc.) and, when conditions for disease exist and yield potential is high, foliar fungicide applications are generally recommended.

Supporting Information

12. Acknowledgements:

This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Acknowledgement of the Saskatchewan Ministry of Agriculture’s support for this demonstration will be included as part of all written reports and oral presentations that arise from this work. Many of the crop inputs were provided in-kind by Bayer CropScience, Dupont-Pioneer and BASF. The technical, administrative and professional support of Danny Petty, Dan Walker, Karter Kattler, Carly Miller, Andrea De Roo and Christiane Catellier is appreciated.

13. Appendices

Table 6. Rating scales used to assess sclerotinia stem rot and blackleg infection levels.

Disease Score	Blackleg Scale	Sclerotinia Scale
0	No disease symptoms	No disease symptoms
1	Diseased tissue occupies 25% or less of cross section	Infection of pods only
2	Diseased tissue occupies 26-50% or less of cross section	Main stem or branch infection with potential to affect up to 25% of the plant
3	Disease tissue occupies 51-75% of cross section	Main stem or branch infection with potential to affect 26-50% of the plant
4	Diseased tissue occupies > 75% of cross section	Main stem or branch infection with potential to affect 51-75% of the plant
5	Diseased tissue occupies 100% of cross section with significant constriction of affected tissues; tissues dry and brittle, plant dead	Main, lower stem infection with potential to affect the entire plant

Table 7. Individual treatment means for blackleg incidence and severity in the canola disease management demonstration at Indian Head 2016. Means within a group followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Treatment	Blackleg Incidence	Blackleg Plot Severity
Variety – Fungicide	------------------- % -------------------	------------------ 0-5 ------------------
L140P – control	2.0 a	0.04 a
L140P – T1	2.2 a	0.02 a
L140P – T2	4.0 a	0.05 a
L140P – Dual	2.0 a	0.02 a
46M34 – control	4.0 a	0.04 a
46M34– T1	6.0 a	0.07 a
46M34 – T2	2.0 a	0.02 a
46M34 – Dual	1.0 a	0.03 a
S.E.M.	1.88	0.022

[Z] 0.18 l Priaxor/ac at 2-4 leaf stage [Y]142 g Lance WDG/ac at 20-50% bloom

Table 8. Individual treatment means for sclerotinia incidence and severity in the canola disease management demonstration at Indian Head 2016. Means within a group followed by the same letter do not significantly differ (Fisher's protected LSD test, *P* ≤ 0.05).

Treatment	Sclerotinia Incidence	Sclerotinia Plot Severity
Variety – Fungicide	------------------- % -------------------	------------------ 0-5 ------------------
L140P – control	29.0 a	1.13 a
L140P – T1	31.7 a	1.42 a
L140P – T2	10.0 b	0.25 b
L140P – Dual	10.0 b	0.20 b
46M34 – control	28.0 a	1.11 a
46M34– T1	31.0 a	1.16 a
46M34 – T2	13.0 b	0.49 b
46M34 – Dual	17.0 b	0.53 b
S.E.M.	3.00	0.178

[Z] 0.18 l Priaxor/ac at 2-4 leaf stage [Y] 142 g Lance WDG/ac at 20-50% bloom

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Abstract

14. Abstract/Summary:

A field trial was initiated with canola at Indian Head in 2016 to demonstrate the response of two canola varieties to fungicide applications targeting either blackleg, sclerotinia stem rot, or both. InVigor L140P and 46M36 canola hybrids were established on barley stubble where the last canola crop was grown in 2012. Four fungicide treatments were evaluated for each variety which included a control (no foliar fungicide), Priaxor at 2-4 leaf stage (blackleg), Lance WDG at 20-50% bloom (sclerotinia) and a dual application. Growing season precipitation along with overall yield potential was high and, across varieties and fungicide treatments, the canola yielded 3330 kg/ha (59 bu/ac). Under the specific field conditions encountered, blackleg incidence was low (<3%) and there was no benefit (for either disease levels, yield or seed quality) to spraying for this disease. In contrast, sclerotinia stem rot pressure was relatively high and percent sclerotinia incidence averaged 30% in the unsprayed plots. Spraying fungicide at 20-50% bloom reduced sclerotinia incidence to 13% and resulted in 6%, or 3.4 bu/ac, higher yields. Spraying for sclerotinia also tended to result in larger seeds but slightly lower test weight. Disease levels, response to fungicide and overall seed yields were similar for both varieties. Overall, the project demonstrated that varietal resistance but diverse crop rotations can be sufficient to keep blackleg levels low and under such conditions fungicides are not likely required or beneficial. Sclerotinia, however, depends primarily on environmental conditions and its severity can vary widely from year-to-year. Fungicides are effective for minimizing the impact of sclerotinia stem but the challenge continues to be predicting the risk of disease since fungicides must be applied well before any symptoms appear. Tools such as risk assessment checklists, petal tests and sclerotinia depots are available to assist with decisions and generally, if the likelihood of disease and yield potential is high, spraying is advised.
