Medicinal and Aromatic Plant Research

Objective 2. Pathology support to reduce losses to disease in cumin.

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Program Background

Production and processing of spice crops and medicinal herbs represents a potential bright spot in the future of Saskatchewan's agricultural sector. Saskatchewan growers have established a worldwide reputation as cost-competitive suppliers of superior quality medicinal plants and spices. Based on present growth rates, the Saskatchewan Herb and Spice Association (SHSA) projects the value of primary production of Saskatchewan-grown herb and spice products will approach $200 million annually by 2010. Numerous opportunities are available to add further value to these crops through processing, blending, preservation, extraction, encapsulation and packaging. A number of Saskatchewan companies have seized these opportunities, resulting in significant employment and economic activity in both urban and small town settings.

The marketplace for medicinals and spices is demanding, rapidly changing and highly competitive. To stay viable, Saskatchewan's herb and spice sector must focus on the best crops, varieties and production practices available. Emerging threats such as disease must be identified and dealt with effectively, but in a manner that does not jeopardise Saskatchewan's reputation for producing a safe, quality product.

This project takes a multi-disciplined approach to address the key production challenges for cumin and milk thistle under the relatively short and cool growing conditions in Saskatchewan. Production of these crops in Saskatchewan is presently limited by challenging growing conditions and specific agronomic problems. This project aims to alleviate these problems by crop improvement and development of superior agronomic practices.

Although improvement of spice/medicinal crops is possible utilizing standard plant breeding methods - the process is slow and consequently expensive. Double haploid technology allows the creation of a genetically homogeneous population without the need for multiple generations of selfing. This has the potential to greatly accelerate progress in improvement of medicinal/aromatic plants.

Program Objectives

1) Introduction/development of new/improved lines of cumin and milk thistle by:
   a) accessing and evaluating potentially suitable material from public and private sources.
   b) working with breeders from the Crop Development Center of the University of Saskatchewan to further develop adapted crop lines.

2) Pathology support to reduce losses to disease in cumin:
   Blossom blight has decimated previous plantings of cumin in Saskatchewan.
   a) Agronomically superior lines of cumin identified under Objective #1 will be evaluated for disease sensitivity in a disease nursery previously established by the Dept of Plant Sciences.
   b) An integrated disease management approach will be developed, involving selection of resistant lines, identification of preventative production practices and evaluation of chemical control options.

3) Agronomy of Milk Thistle:
   a) Time of seeding, seeding rate and row spacing effects on growth, yield and quality characteristics.
   b) Optimizing nitrogen and phosphorus application rates.
   c) Comparing organic products to standard chemicals for desiccation of the crop.

4) Field performance of new lines of spice/medicinal crops created using double haploid technology:
   a) To evaluate lines of dill, fennel, anise, and cowcockle created by PBI/NRC using double haploid technology.
   b) to compare the performance of the double haploid lines to parental lines.
Objective 2. Pathology support for New Crops

Efficacy and Crop Tolerance Trials for Azoxystrobin for Control of Blossom Blight in Coriander (*Coriandrum sativum*)

Introduction
Blossom blight appears to be a common problem in coriander. The causal organism for blossom blight of coriander appears to vary from region to region. In Saskatchewan Duczek (2002) isolated a range of potentially pathogenic fungi from affected plants, but identified *Aureobasidium* sp. as the primary pathogen in a series of controlled environment trials.

As the name implies, blossom blight typically attacks the flowers, although in severe cases leaves and stems adjacent to heavily infested flowers may also be damaged. Infected flowers fail to set seed resulting in substantial yield loss. The primary inoculum source for blossom blight is likely wind or water borne spores from infected crop residues from the previous season. Establishment and spread of blossom blight is promoted by rain and/or irrigation but in dense canopies dew may be sufficient to allow establishment and localized spread. Commercially available germplasm appears susceptible to blossom blight. Chemical control therefore represents the next line of defence. In preliminary trials conducted by Duczek (2002) and Waterer (2003) a range of foliar applied fungicides appeared to provide at least some protection against blossom blight of coriander and other spice crops. Azoxystrobin (PCP # 256153) applied at first flowering appeared to be one of the more promising products.

This trial is designed to provide crop tolerance and efficacy data in support of minor use registration for azoxystrobin for control of blossom blight in coriander. In addition to the treatments stipulated by the minor use testing program a range of other treatment combinations were evaluated.

Materials and Methods
The trial was conducted at the University of Saskatchewan, Horticulture Field Research Center in Saskatoon, SK. This site features a Sutherland series clay soil, (pH 8.0, EC < 1.0 dS, CEC 41 meq/100g, 4.4% organic matter, 65% clay, 25% silt, 10% sand). This site has been used in for varietal development and disease screening on a range of spice crops including coriander for the past three growing seasons. In both 2002 and 2003 blossom blight had been observed in coriander planted at this site.

The plot area was disked and harrowed prior to planting. The registered herbicide Treflan (trifluralin @ 1L ai/a) was applied prior to the field preparation step. No fertilizers were applied as soil tests indicated the plot area had adequate levels of all nutrients (110 kg N/ha, 175 kg P2O5/ha, >1000 kg K2O/ha). Coriander seed (cv. CDC Major) to plant this trial was obtained from Schweitzer’s Seed (Gary Schweitzer) of Eston SK. The supplier had not observed any problems with disease in the year the seed was produced. The plot was seeded on May 5 using a John Deere disk drill. The seed was planted to a depth of 4 cm with 20 cm between drill rows. The seeding rate was relatively high (25 kg/ha), as a complete/thick stand tends to promote development and spread of disease in caraway.

In the last week of June we implemented a supplemental irrigation program in an effort to promote both crop development and the onset of conditions conducive to disease. Each week the
The plot was irrigated for a minimum of 1 hour (1 cm water applied) utilizing a wheel-move type irrigation system. On June 30, the registered herbicide Afolan F (linuron @ 0.5 L ai/a) was applied to control emerged broadleaf weeds. The herbicide program provided a good level of weed control – and weed competition was not an issue in this trial.

In early July, individual treatment plots were created by tilling out 0.6 m strips in the main plot. Each individual treatment plot measured 10 m * 1.5 m. A randomized complete block design was utilized with four replicates.

**Fungicide treatments**

The treatments tested in this project were:

1. Quadris (Syngenta) at 55, 109 or 280 g ai (azoxystrobin)/ha, single application, applied at early bloom. This combination of rates and time of application reflects the protocol specified in the minor use testing program.
2. Bravo (Syngenta) applied at 1250 g ai (chlorothalonil)/ha, single application, at early bloom – represents the treated check. This application rate was based on recommendations from the manufacturer for control of similar foliar disease problems in similar stature crops.
3. Quadris applied at 250 g ai/ha at two week intervals beginning at bloom
4. Dithane (mancozeb, Rohn & Haas) applied at 1800 g ai /ha beginning at bloom and repeated on Aug 17 + Bravo applied at 1250 g ai/ha on Aug 1
5. Headline (pyraclostrobin BASF Canada) applied at 100 g ai /ha beginning at bloom and again two weeks later + Lance (boscalid, BASF Canada) applied at 300 g ai/ha (Aug 17)
6. Lance applied at 300 g a.i./ha at two week intervals beginning at bloom and running through Aug 17.
7. Control - no chemical applied – represents the untreated check.

The spray program was initiated on July 26th at which time the crop was just beginning to come into bloom. The sprays were applied using a CO2 powered backpack sprayer (276 kPa) utilizing cone-type nozzles. The fungicides were applied in the equivalent of 200 l water/ha.

**Disease Evaluation**

The first disease rating was conducted on August 6th, 11 days after the fungicide treatments were applied and 7 days after symptoms of disease were first observed. Disease incidence was assessed by examining 10 randomly chosen locations per plot for presence/absence (+/-) of blossom blight. The number of infected areas per plot was evaluated again on Aug 19 and 26. The final disease assessment was conducted on September 9. At that time, the % of each plot affected by blossom blight was evaluated.

**Harvest**

Each plot was individually harvested by direct combining on October 7. Recovery of the coriander fruit (seeds + associated ovary elements) was excellent. The fruit were dried at 30°C for 48 hours and then were run through a dockage tester (Carter and Day – Model # XT3) to remove debris and to segregate out the fruit that had failed to set seed. Yield of both empty and full fruit balls was determined for each plot. The 1000 seed (fruit) weight was determined for each treatment replicate.
Results

Weather Conditions and Crop Observation
Below normal temperatures delayed emergence of the coriander crop until the 2nd week of June (5 weeks after seeding). The cool conditions also resulted in a staggered emergence pattern – with plants continuing to emerge through early July. This resulted in non-uniformity of crop staging for the duration of the growing season. Replicates 2 and 4 were clearly more developmentally advanced than the other replicates. This contributed to the significant block effects seen in all statistical analyses.

By late June weather conditions were more favorable and the crop showed decent vegetative growth. However, the remainder of the 2004 cropping season was abnormally cool and cloudy and crop development was slow. The crop had begun to bolt by the 2nd week of July, with the first flowers opening a week later. By the 2nd week of August, the coriander plot was in full bloom and because of the cool, moist conditions it continued to bloom until early September. On August 19th the plots were hit by a light frost (-2C) but no crop damage was observed. A killing frost occurred in the last week of September.

No insect pests were observed. Sclerotinia and aster yellow diseases were observed at low levels late in the season – but these diseases were of limited severity relative to the blossom blight. There was some lodging, but this did not interfere with crop recovery at harvest.

Weather conditions at the time of spraying (July 26th - 7 am ) were calm and 15C. At 12:30 pm that day a brief rain shower occurred. There were also light showers on the 27th and 28th … but the total accumulated moisture was minimal (0.10 cm) and should have not compromised product efficacy.

Disease Development
The first signs of blossom blight were observed on July 29, with plants in one area of the plot showing the characteristics symptoms of browning of the developing flowers and associated leaves. This affected area slowly increased in size, eventually covering ca. 10 m2. Additional diseased areas appeared in the plots daily and these disease zones also increased in size.

August 6 – the disease was just getting established in the plots at this time. Disease distribution was non-uniform both within blocks and across treatments. There were no significant differences between disease incidence in the controls versus any of the spray treatments at this time.

August 19 – disease levels had increased relative to the previous sampling date, but the disease distribution continued to be non-uniform across both treatments and blocks. There were no significant differences between disease incidence in the controls versus any of the spray treatments at this time.

August 26 – averaged over the entire trial area, disease was found in over 75% of all sites examined. There were no significant differences between disease incidence in the controls versus any of the spray treatments at this time.

September 9 – the plots were rated as to the % of the total plot showing browning and blighting of flowers – no differences were observed between any of the fungicide treatments and the control. On average 36% of the plot area was affected by disease at this time.
Table 2.1. Means and analyses of variance for fungicide effects on coriander disease ratings at various points in the growing season.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average number of infected spots (out of 10)</th>
<th>% plot area infected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aug 6</td>
<td>Aug 19</td>
</tr>
<tr>
<td>Quadris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 g ai/ha</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>109 g ai/ha</td>
<td>0.25</td>
<td>1</td>
</tr>
<tr>
<td>280 g ai/ha</td>
<td>0.25</td>
<td>1.25</td>
</tr>
<tr>
<td>Bravo (1 applic)</td>
<td>0</td>
<td>0.25</td>
</tr>
<tr>
<td>Quadris (3 applic)</td>
<td>0.25</td>
<td>1.75</td>
</tr>
<tr>
<td>Dithane/Bravo/Dithane</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Headline/Headline/Lance</td>
<td>2.3</td>
<td>0</td>
</tr>
<tr>
<td>Lance (3 applic)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>1.8</td>
</tr>
<tr>
<td>P values for Treatment</td>
<td>0.44</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Yields

There were no significant treatment effects for any of the yield parameters measured. Block to block variability in yields was high … in part due to uneven crop development and in part due to the uneven distribution of disease within the plots. Many of the fruit balls failed to form seed, particularly in areas hardest hit by the blossom blight. Dockage rates exceeded 40% for all treatments.

There were no indications (visual or yields) of any of the fungicide treatments exerting phytotoxic effects on the crop.

Conclusion

None of the fungicide treatments tested resulted in disease levels that differed significantly from untreated check areas. Coriander is an indeterminate type plant with an extended bloom period. Based on the results form this single year of testing, it does not appear that a single application of a protectant type fungicide such as Quadris has much potential to protect the crop from blossom blight. Although multiple applications would likely be required - none of the treatment combinations tested in 2004 provided a significant degree of control of the disease problem.