Demonstration of Fungicides for the Control of Neck Rot in Stored Onions

Botrytis neck rot is a common problem in stored onions in Saskatchewan. Sweet and white onions are most susceptible to neck rot, followed by the reds, with the yellow storage types showing the greatest resistance to the disease. There is no genetic resistance to botrytis neck rot, but for reasons of growth habit cultivars do show differing degrees of sensitivity to neck rot. The initial inoculum for neck rot arises from infected crop residue left in the soil or from cull piles. During cool, moist weather these disease sources produce air-borne spores which blow onto the foliage of onion crops developing in adjacent fields. If field conditions are suitable some species of botrytis (*ie; B. squamosa*) may produce lesions on the onion leaves but in dry environments like Saskatchewan the resulting damage to the foliage is rarely sufficient to jeopardize yields. The real damage is done when the fungus invades the bulb via the wound created when the onion top is removed at harvest. Several Botrytis species are capable of invading the neck and causing rot during subsequent storage – but *B. allii* tends to be the most prevalent and aggressive. Following harvest the botrytis grows into the bulb, starting at the neck and moving towards the base of the bulb. Infected tissues turn soft and brown. The disease is typically well advanced before any symptoms become apparent on the outside of the bulb. Occasionally the botrytis will produce small hard black sclerotia between the layers of the infected onion bulb. These sclerotia serve as a long lasting resting body of the disease. While botrytis infected tissues typically do not smell they are prone to invasion by soft rot bacteria which results in a foul smelling decay.

Management

- Fields should be planted to onions or related species no more than once every 3 years
- Clean up cull piles and equipment that may have come into contact with diseased onions
- Select cultivars that mature within the available growing season.
- Use production practices that promote early maturity of the crop. Avoid excessive applications of nitrogen fertilizers and cut back on irrigation well ahead of harvest
- Lift and top onions at least 10 days prior to harvest to promote dry down of the necks. Hot dry weather during this curing period speeds dehydration of the neck tissues, effectively sealing out the disease.
- Avoid damage to the bulbs during harvest
- Cure the bulbs by pushing warm, dry air (25-35^{o}C and 50% RH) air through the onion piles for about 10 days after harvest
- Drop the storage temperature by 2^{o}C/day to a final holding temperature of 0^{o}C with 50% RH.

In Saskatchewan the growing season is often too short to allow onions to fully mature prior to harvest. Conditions at harvest are often too cool and wet to allow for good curing of the necks, either in the field or in storage. For these reasons neck rot is a common problem in stored onions in Saskatchewan.

This ADOPT funded project demonstrated the potential to use fungicides as part of an integrated management program for neck rot in onions.

Procedures

The project was conducted at the University of Saskatchewan Horticulture Field Research Facility in Saskatoon. This site has a long history of onion production and problems with neck rot are common – suggesting that there is sufficient inoculum present at the site to reliably create a disease problem. The field was prepared in the spring of 2011 by fertilizing to recommended levels and then rotovating. In mid-May four cultivars of yellow onions (Norstar, Copra, Alpine and Fortress) were seeded. These cultivars were selected as they performed well in yield and storage trials conducted by the UofS. They were also selected to represent a range in growth habit, times to maturity and potential susceptibility to neck rot. The plots were seeded with a small plot seeder in rows that were 5 m long with 0.5 m between rows and 20 rows/plot. Weather conditions after seeding were favourable for germination of the crop. Weeds were controlled using herbicides and hand weeding. The plot was irrigated as required. In the last week of July the trial was damaged by a heavy rain/hail event. There were some indications of botrytis invading the leaves and bulbs damaged by this weather event. This development represented the trigger for the onset of the fungicide program.

The fungicides demonstrated in this trial were;

Pristine (pyraclostrobin + boscalid) – this BASF product is reported to provide exceptional control of a range of foliar diseases of onion – including the botrytis species responsible for onion leaf blotch *(B. squamosa*). Evidence for its efficacy as a tool for management of neck rot is lacking. Pristine is approved for multiple applications over the course of the growing season – with the final application to occur not later than 7 days prior to harvest.

Dithane (mancozeb) – is an older product with broad spectrum activity against a range of plant diseases, including botrytis. Dithane is approved for multiple applications over the course of a single growing season and has a 3 day pre-harvest interval.

The fungicides were applied three times at 14 day intervals, beginning in early August, with the final application occurring 3 days prior to the crop being topped. The products were applied at the label recommended rates (1 kg/ha for Pristine and 2 kg/ha for Dithane). The sprays were applied using a CO2-powered small plot sprayer equipped with 80-02 nozzles operating at 270 KPa pressure. The spray was applied in the label recommended equivalent of 100 L water/ha which resulted in excellent coverage of the foliage. The untreated control treatments were sprayed with an equivalent amount of water. At the time of the 1st fungicide application all cultivars were growing vigorously. At the 2nd and 3rd application cv. Copra was still growing vigorously but cv. Norstar, Fortress and Alpine had begun to dieback indicating they were beginning to mature.

None of the fungicide treatments had any obvious impact on the appearance or apparent health of the foliage.

In mid-September the crop was lifted and topped. The bulbs were allowed to field cure for a further 2 weeks during which time record high temperatures occurred, along with no rainfall. These conditions were very favourable for curing the necks of harvested onions. The number and weight of bulbs in each row was determined after the 2 week curing period. A sample of visually sound bulbs from each treatment was then gathered into mesh onion bags and the bags were weighed prior to being transferred into a cold storage (3^{o}C and 50% RH).

After 60 and 200 days in cold storage a sample of 20 bulbs was randomly selected from each treatment. The bulbs were cut in half longitudinally to allow visual examination for the presence of any neck rot (see Figure 1). No attempt was made to rate the severity of the infection within a damaged bulb.

Results

The fungicide treatments had no impact on the number, size or weights of the onions harvested.

The onions stored very well. This was not surprising as the study involved holding mature, well-cured bulbs of locally adapted onion cultivars under near-ideal cold storage conditions. After 60 days of cold storage there were no indications of neck rot on any of the bulbs sampled. Neck rot takes time to develop – especially under recommended cold storage temperatures.

The crop was evaluated again after 200 days of cold storage. This represents about the maximum duration of cold storage for onions in Saskatchewan, as losses to dehydration, disease and sprouting typically become excessive beyond this storage period.

Cultivar	**Fungicide**	**Grade out to Neck Rot (%)**
Alpine	Control	9
	Dithane	6
	Pristine	5
Avg		**7**
Copra	Control	1
	Dithane	1
	Pristine	0
Avg		**1**
Fortress	Control	15
	Dithane	2
	Pristine	1
Avg		**6**
Norstar	Control	37
	Dithane	12
	Pristine	2
Avg		**17**
Overall avg.	**Control**	**15**
	Dithane	**5**
	Pristine	**3**

For cv. Copra, all the treatments, including the control, remained in excellent disease-free condition through the full 200 day storage period. All the other cultivars showed more substantial losses to neck rot after 200 days of cold storage – with the cv. Norstar appearing to be most susceptible. Copra was also the most vigorous and highest yielding cultivar tested in this trial, while Norstar had produced the lowest yields. This suggests a potential linkage between vigor in the field and losses to neck rot during subsequent cold storage. If the plants had been invaded by the Botrytis relatively early in the growing season this may explain the low yields as well as the substantial losses to neck rot during storage.

Treatment of the foliage of the onion crop with fungicides prior to harvest appeared to provide a significant degree of protection against neck rot during subsequent cold storage. While Pristine fungicide appeared to be marginally more effective at preventing neck rot, Dithane was less costly. The cost of both products would be minimal relative to the potential losses to neck rot seen over an extended storage period (avg. 15% grade out after 200 days in control treatments). Growers should consider rotating between these chemicals in order to minimize the risk of selecting for resistant strains of the Botrytis.

Conclusion – this study demonstrated that;

a) neck rot is potentially serious issue during long-term storage of onions
b) onion cultivars differ substantially in their susceptibility to neck rot
c) a high level of protection against neck rot of onions can be obtained by foliar applications of Dithane and/or Pristine fungicides.

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