

CHANGES IN CROWN RUST PATHOGEN POPULATIONS = CHANGES IN DISEASE RESISTANCE RATINGS FOR OATS

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Crown rust is caused by a fungus, *Puccinia coronata f.sp. avenae*. The crown rust fungus is specific to cultivated oat, wild oat, and a few other wild grasses, but will not infect wheat, barley or rye. Crown rust reduces oat yield and causes thin kernels with low test weight - factors which greatly reduce milling quality. Losses on susceptible varieties due to disease can be substantial if infection is early, and if weather conditions are favourable for the production of fungal spores and their spread.

Races in the Crown Rust Population Always Changing

Within the rust fungal population, there are a number of different "races" that develop and are able to infect oat varieties carrying certain rust resistant genes. The breakdown of genetic resistance may occur over several years depending on the aggressiveness of the new race, favourable environmental conditions for increase of the race, and the presence of susceptible cultivars or wild oats or buckthorn (see Additional Information section below). There are a number of steps to determine if changes are occurring within the crown rust pathogen populations, and then whether changes in variety disease resistance ratings are required.

First Step – Field Surveys

Disease surveys are an important component of determining if there are changes within pathogen populations. In-field assessments over the past few years have seen incidence and severity of crown rust in commercial oat fields increasing. In 2015, the crown rust survey conducted by Dr. Jim Menzies, Dr. Brent McCallum and Dr. Tom Fetch of AAFC saw the incidence of crown rust in commercial oat fields with infected plants range from 0 to 100%, with severities ranging from trace to 5S and 10MS. The more heavily affected commercial oat fields were observed in Manitoba in the Red River Valley and South Central Manitoba areas. Some of the more heavily infected fields were of oat lines which were rated as resistant to crown rust.

Second Step – Analyzing Isolates for Virulence

From field surveys, infected plant material is collected and the frequency of the various rust races is determined. Over the last two years, changes in virulence were found in the crown rust population, with virulence to *Pc91* becoming more common. Pathologists started detecting virulence to *Pc91* in 2012, and in 2014, it was found in 45% of the isolates that underwent virulence assessment. Also of interest, virulence to the *Pc91* gene was also becoming more prevalent in the United States starting a few years ago.

Third Step – Testing Against ‘Check’ Varieties

To provide additional data to supplement field surveys and to determine if changes in crown rust disease resistance ratings for the Seed Manitoba 2016 guide were required, AAFC conducted trials at Morden over the last two years. All the lines tested by MCVET, plus ‘check’ varieties, were grown in a randomized design in the field (hills) with one replicate. The plants were inoculated with crown rust spores composed of the isolates collected in the previous year’s survey. At maturity, the crown rust reactions were noted, with the ratings coming from comparing the lines’ crown rust reaction with the ‘check’ lines of Leggett, CDC Dancer and Morgan (Resistant, Intermediate and Susceptible, respectively).

Note: testing with MCVET entries will continue in 2016.

The End Result? Changes in Crown Rust Resistance Ratings for Some Varieties

The collaboration of AAFC, MCVET and Manitoba Agriculture through field surveys and additional testing has shown changes within the crown rust pathogen populations in Manitoba where virulence has developed on a number of oat varieties. Varieties that contain the *Pc91* gene, including **AAC Justice**, **CDC Morrison**, **HiFi**, **Souris** and **Stainless**, have been redefined for crown rust resistance in Seed Manitoba 2016 (www.seedmb.ca). The variety **Summit**, which is postulated to carry different resistance genes, is also losing its resistance to virulent races in the Eastern Prairies; therefore, it has also been redefined for crown rust resistance.

This is not the first time crown rust resistance ratings has been changed in Seed Manitoba, nor will it be the last. As the pathogen population is highly variable, it can happen quite regularly where genes are defeated and lines once resistance to crown rust can become more susceptible. Therefore, developing crown rust resistant varieties is an ongoing battle for cereal breeders. As soon as new varieties are developed with specific genes for resistance, it puts selection pressure on the rust population which develops new races that overcome this resistance. The goal of cereal breeders is to "pyramid" genes for resistance, meaning that several genes are incorporated into one variety to extend the durability of resistance.

Control Options for Crown Rust

Seeding resistant varieties is normally step one when developing an integrated disease management plan for management of crown rust. The better the disease rating, the less likely a reduction in yield and quality will occur. However, there are other management strategies available including early seeding. With an early seeding date, it is hoped the crop is advanced enough by the time rust is blown in from the United States. Typically with late infections the crop will not suffer significant yield or quality loss.

Another option is the use of a foliar-applied fungicide. There are a number of fungicides registered for control of crown rust in oats. Refer to the Plant Disease Control section of the Guide to Crop Protection for additional information: <http://www.gov.mb.ca/agriculture/crops/guides-and-publications/pubs/crop-protection-guide-disease.pdf>. Scouting will also be important as the crop matures and advances towards flag leaf.

ADDITIONAL INFORMATION:**➤ Symptoms of Crown Rust**

Symptoms of crown rust include orange pustules of spores on the upper and lower surface of leaves. Each pustule contains thousands of spores that can be spread to neighbouring plants and produce a new pustule in only seven to 10 days under ideal conditions. In severe cases, these pustules may also be observed on the sheaths and glumes.

➤ Source of Crown Rust in Manitoba

The main source of crown rust in Manitoba is urediniospores blown in on the “Puccinia Pathway” from the United States. Normally the first inoculum starts arriving at the beginning of June. However, this can vary depending on how much inoculum is present in the United States and when the winds blow from the south. During the growing season, reports on the current rust situation and how it is progressing in the United States are available in the Cereal Rust Bulletins from the USDA at: <http://www.ars.usda.gov/Main/docs.htm?docid=9757>.

Crown rust can also overwinter on stubble and related grasses in Manitoba. The teliospores survive by overwintering and then germinate to form basidiospores which will only infect buckthorn. However, the fungus will undergo sexual reproduction on buckthorn and the products of this sexual reproduction (aeciospores) can then infect nearby oat crops. Buckthorn can be found in Manitoba, especially near rivers, but it is not common.

Sources:

- Leaf Rust In Wheat, Barley, And Oats – Manitoba Agriculture, Food & Rural Development
<http://www.gov.mb.ca/agriculture/crops/plant-diseases/leaf-rust-wheat-barley-oats.html>
- Crown Rust of Oat – FAQs – Saskatchewan Ministry of Agriculture