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report on
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CROWN RUST OF OATS

Crown rust (or leaf rust) of oats is caused by the fungus *Puccinia coronata* var. *avenae*. It infects the Illinois oat crop almost every year (Figure 1). Several specialized varieties of the fungus attack many related grasses. The amount and severity of infection varies greatly from year to year, depending on weather conditions, the amount of rust inoculum (spores) present, and the acreage of susceptible varieties.

Figure 1. Oat field severely infested with crown rust (S.G. Jensen).

In a year of heavy attack by crown rust, 90 to 100 percent of all oat plants growing in Illinois become diseased, and the rust reduces the food-manufacturing ability of the leaves by up to 30 percent. Dry weather and/or cool or hot weather is unfavorable for rust infection, resulting in little or no crown rust developing in the state.

Over a 25-year period in Illinois, the annual loss from crown rust has ranged from a trace to 20 percent of the potential yield. In some years crown rust causes a greater loss in terms of yield and grain quality than any other oat disease. Heavily rusted plants are prone to have extreme water loss from hot dry winds, due to rupturing of plant tissues by the rust pustules. This water stress can result in premature ripening, lower yield, shriveled grain, lower test weight, and lodging.

SYMPTOMS

Rust may appear on oats in southern Illinois as early as late April. Small, scattered, oval-to-oblong, bright orange-yellow pustules (uredia) develop–principally on the leaves. Similar pustules may occur on the leaf sheaths, stems (culms), and panicles. The uredia soon burst through the epidermis to release a dusty mass containing many thousands of microscopic, orange-yellow summer spores (urediospores).

Crown rust is distinguished from stem rust of oats by the bright, orange-yellow color, the smaller size of the pustules, plus the lack of conspicuous, jagged fragments of oat epidermis adhering to the sides and ends of the pustules.

The number and size of the crown rust uredia vary greatly, depending on the susceptibility of the oat variety and the severity of infection. If the weather is favorable for infection–high humidity, fogs,

frequent heavy dews or light rains, and a temperature of 70°F or above–the pustules become numerous and may merge as the season progresses. A new generation of urediospores may be produced every 7 to 10 days depending on the weather. These spores, in turn, are blown about by air currents–spreading the disease from plant to plant and from field to field as long as growing oat plants are available.

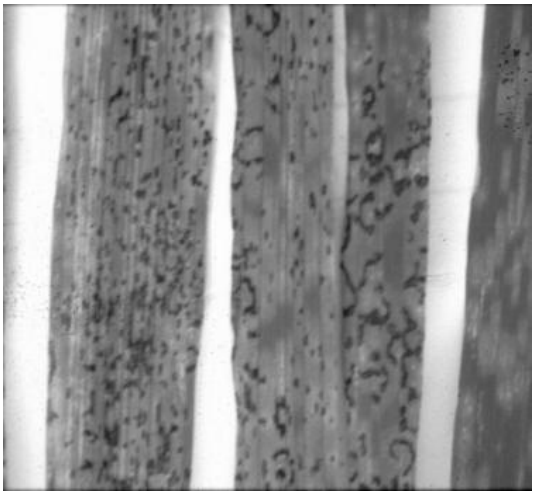

Figure 2. Close-up of crown rust on oat leaves.

As the oat plants begin to ripen, the black overwintering spores (teliospores) are formed in telia (Figure 2). These spores also may form earlier in the season during periods of adverse weather, such as extreme drought, excessive moisture, or very high temperatures. Teliospores, seen under the microscope, have crownlike appendages at their apex and it is this feature that gives the disease its name. The teliospore stage does not rupture the epidermis. The telia are grayish-black to black, oblong, slightly raised, and most abundant on the leaf sheaths. Many telia may be arranged in rings around the pustules of the urediospore stage.

DISEASE CYCLE (Figure 3)

In many aspects, the disease cycle of the crown rust fungus is similar to that of stem rust. The thick-walled, black teliospores (Figure 3E) germinate in the early spring to produce other minute, delicate spores (sporidia or basidiospores) that are carried by the wind in a viable state up to about a half mile, infecting only the young leaves of rust-susceptible buckthorns (*Rhamnus* spp). On buckthorn, bright yellow-to-orange spots appear on the upper leaf surface in April (southern Illinois) or May (northern Illinois) which contain pycnia (Figure 3A). Each pycnium produces pycniospores and special aerial mycelium called receptive hyphae. The pycniospores are exuded from the pycnia in a thick, sweet liquid which attracts insects. Pycniospores ar carried by insects or splashed by water from one pycnium to another, where they become attached to the receptive hyphae. The nuclei from the pycniospores enter the receptive hyphae and fuse. This later results in the formation of an aecium (Figure 3A) opposite the pycnia (usually on the lower leaf surface) which are seen as raised, round to somewhat irregular, orange-yellow "cluster cups" (Figure 4). Aeciospores formed in the aecia may differ genetically from either pycniospores or receptive hyphae. This exchange of genetic material may result in the formation of new races of the pathogen. The aeciospores are carried by air currents and infect only oats. Each infection gives rise to a uredium (Figure B) 7 to 10 days later in which urediospores (Figure

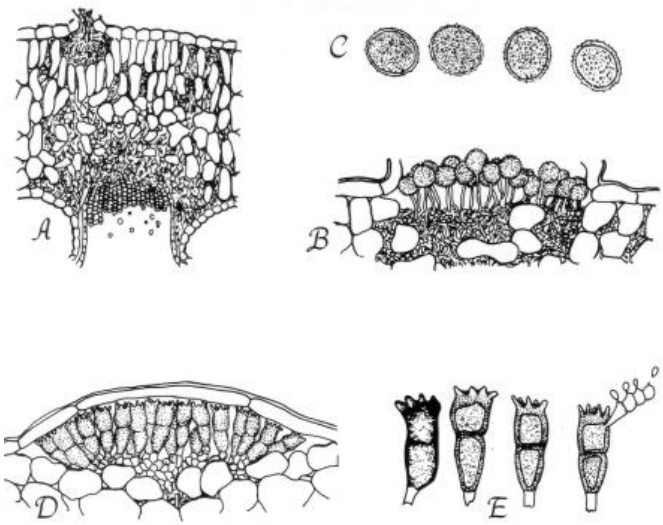

Figure 3. Disease cycle of Puccinia coronata, the crown rust fungus, as it appears under a microscope. A, vertical section through a common buckthorn leaf showing a flask-shaped pycnium with receptive hyphae on the upper surface and on aecium or "cluster-cup" (with chains of aeciospores, some being released) on the lower surface; B, section through a uredium on an oat plant with a layer of stalked urediospores which have ruptured the epidermis; C, four urediospores; D, section through a telium on an oat plant with a layer of teliospores which has raised the epidermis; E, four teliospores with crownlike appendages at their apex. The teliospore to the right has germinated to produce four basidiospores or sporidia.

Figure 4. Close-up of 'cluster-cup" stage of crown rust on the underleaf surface of buckthorn.

3C) are formed. Generally, new generations of urediospores reinfect oats until the crop matures and the black teliospores are formed again.

Urediospores produced on oats and grasses in Illinois and other northern states are blown south in the autumn, where they infect winter oats and grasses grown for grain and pasture in northern Mexico and the southern United States. In southern oat-producing areas, the rust fungus recycles continuously in the urediospore stage. In the spring, the spores produced on oats and grasses in the south are carried northward by the wind, sometimes hundreds of miles, to infect oats in Illinois and other northern states as the crop begins to grow. In this case, the rust fungus does not require buckthorn as an alternate host. The damage caused in Illinois by wind-blown rust from the south varies from year to year. The losses depend on the amount of rust that overwinters in the south, the northern extent of the overwintering areas, the weather conditions, and the susceptibility and stage of growth of the Illinois oat crop when the spores arrive.

Crown rust usually appears on oats near buckthorn plantings 3 to 4 weeks before crown rust urediospores are blown into Illinois from the south. These early infections commonly result in the worst damage.

Rust-Spreading Buckthorns

There are two principal species of rust-spreading buckthorns in Illinois: the common buckthorn and the lance-leaves buckthorn. These two buckthorn species are on the noxious weed list in Iowa.

Common Buckthorn (*Rhamnus cathartica*). A treelike shrub introduced into the United States from Europe, the common buckthorn has been widely planted for windbreak, hedge, and ornamental purposes. Birds spread the seed. In many counties, common buckthorn can be found growing in fence rows, wood lots, and timbered areas, and along roadsides. Common buckthorn ranges in height from 5 to 25 feet. It has glossy, dark-green leaves with 3 to 5 pairs of veins. Small, single thorns are usually found on the branch tips and in the crotches. Common buckthorn has round, pea-sized berries that are green in sumemr and black in autumn and winter. The bark is black, usually quite smooth, and yellow inside.

Lance-Leaved Buckthorn (*R. lanceolata*). The native lance-leaved buckthorn differs from the common species by having lance-shaped leaves with 6 to 8 pairs of veins. The berries are egg-shaped.

Physiologic Races

Several hundred distinct pathogenic strains or races of the crown rust fungus are known to attack oats. These races differ only in their ability or inability to attack different oat varieties. No cultivated variety is immune to all races. Fortunately, only a few races are usually present in large numbers during any one year in Illinois. When virulent races to which the varieties being grown are susceptible begin to build up, a switch to other varieties becomes necessary. Consequently, the recommendations on oat varieties are in a state of flux, depending on the prevalent rust races. Since about 1930, oat breeders and plant pathologists have constantly been developing and releasing new varieties that are resistant to more and more races of crown rust. The battle is a never-ending one.

Like barberry for the stem rust fungus, buckthorn serves as a source of development for new races of crown rust. As far as is known, new races of crown rust originate only on buckthorn by cross-fertilization of existing races.

CONTROL

1. Grow the crown rust-resistant and early maturing varieties currently recommended by University of Illinois Extension Agronomists and your nearest Extension adviser as adapted to your locality. Refer to the Illinois Agricultural Pest Management Handbook which is revised annually and should be available in your nearest Extension office. Oat varieties that mature early frequently escape moderate to severe damage by crown rust. Research is under way to develop new and improved varieties that will be more resistant to or tolerant of crown rust.

2. Plant oats as early as practical in the spring. This helps the crop escape infection by rust.

3. Whenever possible, eradicate rust-spreading buckthorn shrubs growing within a mile of oat fields. The following methods are the best ones for eradication:

    a. Dig or pull out the plants with a bulldozer or tractor and chain. If regrowth occurs, spray it to runoff with a herbicide suggested by University of Illinois Extension Agronomists and your Extension adviser.

    b. Kill standing buckthorn shrubs or trees with a basal herbicide spray treatment at any time during the year. Spray the basal 15 inches around the trunk to runoff. This treatment is not desirable around farm buildings, because it leaves dead plant material standing.

    c. Cut the buckthorn plants off near the ground level. Apply a suggested herbicide to the cut stumps.

4. If crown rust is building up rapidly–particularly on late plantings or late-maturing oat varieties–it may be wise to harvest the crop for silage to maximize the feed value of the crop. Cutting the crop when it is in the soft-dough stage usually makes silage of the best quality.

5. Aerial application of a foliage-protecting fungicide may be warranted. These conditions would apply if:

    a. The yield potential and value of the crop are high.

    b. The oat variety is susceptible to crown rust and/or Septoria disease and to Helminthosporium leaf blotch.

    c. Leaf diseases have an early start.

    d. The long-range weather forecast is for continued moist weather.

The EPA-approved fungicides are largely protective, and should be applied to oat foliage when disease is first seen and before it destroys the leaf, leaf sheath, culm, and panicle tissues.

Using a properly equipped aircraft–fixed wing or helicopter–is the best way of applying a fungicide to the crop. Select an aerial operator who is familiar with disease control and whose aircraft has been properly

calibrated for uniform, thorough coverage of all aboveground plant parts. A proper application requires a minimum of 5 gallons of water per acre in order to cover the foliage uniformly. For further information refer to Illinois Agricultural Pest Management Handbook. Be sure to read the fungicide label and follow all directions carefully. It is advisable to add a commercial spray adjuvant (surfactant) to the spray mix to help disperse the fungicide and improve coverage.

The time of application is critical, and will vary from area to area and season to season. Normally, the first application on oats is made between the time the panicle emerges from the boot and the early milk stage. The second spray should follow 9 or 10 days later. If crown rust, Septoria disease, or Helminthosporium leaf blotch appears before the panicle emerges, move the first spray up about a week to 10 days. Keep the flag leaf as disease-free as possible until after the kernels have filled. Follow label directions as regards the interval between the last fungicide spray and harvest.

When spraying oats with a foliar fungicide the first year, spray only half the acreage. Measure the acreage treated and record the yield and bushel weight from this area. Measure an adjacent area and leave it unsprayed. Record the yield and test weight from the unsprayed plots and compare the figures with those from the sprayed area.

For Successful Fungicide Application

1. Grow only the best oat varieties. These also should be resistant to the barley yellow dwarf virus.

2. Watch the stage of growth and check for early disease symptoms.

3. Spray where high yields are expected.

4. Make arrangements with your aerial applicator as early as possible.

5. Be sure the aircraft can apply 5 gallons of water per acre in a uniform spray pattern.

6. Protect the crop before disease destroys the leaves. Spray on time.

7. Make two applications of a recommended fungicide plus a spray adjuvant. Normally, the first spray would be applied sometime from the early heading stage (when the panicle is beginning to emerge from the boot on 25 percent of the plants) to the early milk stage–with the second application (if needed) 9 or 10 days later.

8. Be sure to measure and compare the yields and bushel weights of both the sprayed and unsprayed areas.