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Economic Importance

Snow mold costs wheat farmers in southern Idaho from $50,000 in some years to as much as $800,000 in others. In some areas it has caused farmers to abandon winter wheat production in favor of spring grains. Farmers in other areas, would also turn to spring grains if it were possible to do so.

Although low temperatures without snow cover, smothering by too much snow, and heaving on heavy ground are causes of winter kill in fall-sown wheat, by far the most important cause is snow mold. It is one of the major problems in the winter wheat areas of southern Idaho.

What Is Snow Mold?

Snow mold is caused by two fungous diseases and was reported in wheat fields in Idaho's Fremont and Teton Counties as early as 1922. The most common and destructive of the two is called spotted snow mold and is caused by two species of fungi, *Typhula itoana* and *Typhula idahoensis.* This form of the disease is characterized by the very small light to dark brown sclerotia dispersed along and imbedded in the bleached and dead leaves and stems flattened on the ground.

The second and less serious disease is called pink snow mold which is caused by *Fusarium nivale.* This disease is characterized by a salmon-pink colored moldy growth on the affected plants. No sclerotia are produced and the leaves are not flattened against the soil nor are they bleached out.

How Snow Mold Works

The organisms causing snow mold are present in the soil and need only the proper physical conditions to grow and infect the plants. On winter wheat the disease is usually associated with heavy snow cover on ground that is unfrozen. In the case of spotted snow mold the plants seem to be infected under the snow when portions of the

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leaves appear scalded and discolored in spots. In the first stages of the disease, the infected parts are covered with a white moldy growth. Brown sclerotia later appear in abundance throughout the infected tissue.

As the snow disappears, layers of white, moldy growth appear on the soil and infected plants. Soon the infected leaves lose their green color, become dry and matted on the ground. Killing of the plant ranges from dead leaf tissue to invasion and rotting of the culms, crown, and root tissue. With higher temperatures and increased sunshine, the organism disappears.

In the case of the pink snow mold as the snow drifts melt and recede the affected plants are covered with a salmon - pink colored moldy growth. As the mold disappears the infected leaves dry out and assume a dead rusty colored appearance.

Factors Affecting Snow Mold

Temperatures

When the ground freezes before the snow covers it, snow mold damages winter wheat much less. Surface temperatures of frozen soil are too low for the organisms to become active. Remsberg (2) found that optimum temperatures for most of the fungous organisms is from 48° to 51° F. When the temperatures fall much below that, activity ceases. As soon as the temperature rises to 52° F., activity decreases. Sunlight also seems to have a pronounced influence on the growth of this fungous. Little if any disease develops when the wheat plants are exposed to direct sunlight.

Tillage Practices

Due to the increase of this disease over the past few years, many farmers say it is associated with the use of trashy fallow. Experimental work with various types of fallows at the Tetonia station show that trashy fallow does not increase the winter kill in those years when the kill is light. Trashy fallow increased the kill somewhat in years when snow mold was serious. In such a year, however, re-seeding is usually necessary regardless of the type of fallow used.

In many cases of trashy fallow where poor stands of wheat have occurred, drilling in a loose seed bed may be more nearly the cause of the poor stand than the trash itself. The plants do not become well established before winter sets in and are quite susceptible to any type of winter kill. With a good, firm seed bed, on any type of fallow, the wheat plant has a better chance to become well established and is more able to resist snow mold.

Types of Drills

Neither the deep furrow nor the shallow type drill shows a particular advantage so far as winter kill from snow mold is concerned. Seedings from one type will be killed out worse than the other in some winters, but the following winter may quite likely reverse this situation. The advantage of the deep furrow drill would be in a trashy fallow field as it will leave a cleaner furrow with less trash and will seed through heavier trash than the narrow drills. The deep furrow will also seed into moisture in dry years.

Possible Control Measures

Resistant Varieties

To date, none of the commercial varieties of hard red winter wheat has shown any more resistance to snow mold than another. Some Japanese wheats are resistant, but they are not adapted to this area. It is possible that they can be used in a breeding program with Idaho adapted varieties to develop resistance.

Dates of Seeding

The date of seeding fall grain, if sufficient moisture is available, determines the amount of growth the wheat plants make in the fall and its later resistance to snow mold. An early-seeded, well developed wheat plant with a good crown and root system is better able to recover from snow damage. It is also true that a late-seeded plant with little leaf surface is able to escape infection.

Various dates of seeding, starting with August 15 and then every 15 days until the middle of October have been tried at the Tetonia station. The August 15 and the October 1 and 15 dates of seeding give the best control of snow mold. The August 15 date of seeding makes a very thrifty growth, and the leaves show considerable snow mold in the spring; but the crown and roots are well enough developed to recover and make a good wheat crop. The October 1 and 15 dates of seeding are so late that in most years only one leaf is formed and this is not affected by the snow mold. This has also been found to be true at the Washington experiment station by Holton and Sprague (1). Under Tetonia conditions, the September 15 date of seeding always shows the most winter kill from snow mold.

Even though snow mold appears on the leaves of the early seeding, grain yields are about one-third greater from fields seeded before September 1 than from those seeded in October. When seeding from August 15 to September 1, the seeding rate should be reduced to 40 or 50 pounds per acre.

Crop Rotations

Work at the Tetonia station has shown that one of the best methods of controlling snow mold is by use of alfalfa or sweetclover in a crop rotation. When ground produces alfalfa hay for a few years little snow mold occurs on the following wheat crops. This is also true when sweetclover is turned down as a green manure crop. The alfalfa or sweetclover are seeded alone in the spring on fall-plowed stubble. The sweetclover is plowed the following spring, fallowed that summer, and seeded to fall wheat. Alfalfa is fall-plowed, fallowed the next year, and seeded to fall wheat. Alfalfa and sweetclover are beneficial in two ways: The ground is out of wheat and does not have stubble on it for at least 2 years; and when the alfalfa or sweetclover is turned under, the decomposition of the legume probably has some detrimental effect on the snow mold organism.

Serious snow mold damage has occurred in six out of the last ten years at the Tetonia station. In the six years when damage occurred, wheat following alfalfa or sweetclover showed a 95 to 100 per cent stand; wheat on summerfallowed ground showed a 60 to 65 per cent stand. In one year out of the six when grass was planted with the alfalfa or sweetclover the snow mold damage on the following wheat crop was as much as on straight fallow.

The more wheat crops there are following the alfalfa or sweetclover, the more the snow mold increases.

Fertilizers

The effect of sweetclover and alfalfa on snow mold is not entirely a fertility factor. This is evident from the fact that the application of nitrogen fertilizers does not aid in control. Experiments using both nitrate and sulphate at three different dates and four rates of application showed no effect on control of snow mold. It is possible however, that the application of fertilizers will aid recovery of the surviving plants after the snow leaves. This has been found true in Washington experiments. (1)

Chemical Control

Sprague, and Holton (1-3) have done considerable work in Washington on chemical control of snow mold organisms. They found that 80 pounds per acre of Spergon, Phygon, or Paraturf applied in mid-October resulted in 95 to 100 per cent control. However, application costs of these amounts of the chemical were prohibitive.

Later they reported that a more promising control of snow mold was had with 5 pounds per acre of Ceresan-M applied to the young wheat in early November. This was

mixed with 40 lbs. of Nu-Green, a pelleted urea fertilizer and applied by plane. This not only was the best carrier but it also gave 20 lbs. of actual nitrogen per acre for plant growth. The chemicals give control by killing the spores in the fall.

The cost of the Ceresan-M treatment would be from $3.50 to $5.00 per acre plus the cost of the fertilizer and application. While this may seem high, it could very well be used in known winter-kill spots in the field where reseeding is always necessary.

Recommendations To Help Control Snow Mold

The following recommendations are the best snow mold controls available at this date:

1. Use a good alfalfa or sweetclover crop rotation, with no more than three crops of wheat before going back to alfalfa or sweetclover.
2. Follow good tillage methods. Be sure to have a good, firm seed bed.
3. If possible, drill between August 15 and September 1.
4. Apply small amounts of fertilizer. Twenty pounds of actual nitrogen per acre will aid in the recovery from snow mold.
5. In areas where some snow mold occurs but damage is not enough to merit reseeding, use a chemical spray for weed control.
6. In known winter-kill spots, it may be profitable to use Ceresan-M as a chemical control.

The information in this bulletin is of a preliminary nature and should be considered as a progress report. Further research IS under way and additional information will be released as soon as available.

Literature Cited

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