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ROOT ROTS OF SUGAR BEETS

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Two fungi are known to be associated with root rots of sugar beets in Idaho. These belong to the genera *Pythium* and *Rhizoctonia*. Pythium is referred to as a "water mold" because disease in its hosts is closely associated with high soil moisture and slow plant growth.

Both inhabit the soil and are worldwide in distribution. The diseases incited by the fungi occur most commonly in heavy or compact soils, which are low in organic matter and soil fertility, and where the growing season is longest. The fungi which attack beet roots anytime during the growing season, are most frequently observed in the seedling stage, then later in the summer after mid-June. Varying symptoms of the disease are expressed depending upon the plant part attacked and the stage of beet growth.

Seedling Diseases

The diseases of sugar beet seedlings are commonly known as pre and postemergence damping-off, black root, and root rot.

Symptoms of Pre and Postemergence Damping-Off

This disease type results in a reduced stand. The fungi cause symptoms on the host that are very similar under field conditions. The seedling may be killed before emergence or, more commonly, within a few days after emergence. Plants that become infected exhibit a brown water-soaked region at or near the soil surface. They begin to wilt and 24 to 48 hours later, the seedlings are almost completely decayed. The problem often is wrongly diagnosed as death due to frost.

Symptoms on Seedlings (4-10 Leaf Stage)

Beet seedlings that become infected at the 4-10 leaf stage may go unnoticed for awhile. The color of the leaves gives the first indication of disease. The leaves may be merely deeper green in color, but occasionally they are a blue green. Sometimes the stem may be lemon yellow in color. The seedlings grow slowly and, in general, show evidence of low nutrition. By removing seedlings from the soil, you will find the tip of the taproot decayed but the rootlets developed above the decayed region, giving the appearance that the primary root has been replaced by them. Sometimes the plant may appear normal and healthy up to the time of blocking, but when the beet is dug and examined, small black lesions may be present near the end of the main taproot. These lesions often lead to the symptoms found on beets half-grown or older. If such plants survive the summer, the beet roots are "sprangled" and shallow. Consequently, uptake of water and nutrients by the plant is restricted to the upper layer of soil.

A seedling may survive the postemergence damping-off stage, or it may be attacked at or near the soil level in the 4-10 leaf stage. Whatever the case, attack apparently is at the ground level or just below the soil surface. Infection on the stem is characterized by brownish to black (sometimes dry looking) local lesions that extend upward and downward. The lesions may be superficial or the fungi may girdle the stem causing a russeting effect. Should the fungi continue to penetrate the stem inward, the affected portion turns black and the seedling may be killed.

Symptoms on Older Beets

The diseases of older beets are referred to as root rot, black root, and crown rot. The first visible evidence of root rot on older beets is a slight wilting of the leaves which appear to recover temporarily during the cool part of the day. Upon removing such a plant, the roots may be rotted at the basal end. These symptoms may be seen as early as mid-June. Should the condition be extensive in a field, individual plants die throughout the summer, resulting in reduced stands by harvest time and increased tare dockage from rotted roots in the tare sample.

The skilled observer can distinguish root rot due to *Pythium* from rot caused by *Rhizoctonia*.

Pythium root rot is characterized by a progressive rot of the fleshy taproot at about the plow line. The infected root is at first greenish yellow, later light brown, and finally a dark brown, almost black with discoloration. Infected tissues are somewhat soft and watersoaked, but still resist the knife and split rather than tear when cut. When subjected to desiccation, such tissues finally shrivel to a "tassel" of vascular elements. Frequently, the uppermost progress of rot of the taproot is in the zones of lateral root protrusion. This fungus is restricted to the fleshy taproot.

With *Rhizoctonia* root rot, the fleshy taproot may be rotted off at the basal end and large cracks may extend halfway through the root. Wilting during the hot part of the day occurs as with *Pythium* root rot. Wilting is closely followed by a darkening of the bases of the leaf petioles and by rotting of the crown. The leaves may retain their color for a time, but with the rotting of the crown or leaf petioles, the leaves turn yellow, wilt, and the plant dies.

On the other hand, daily wilting may be observed and most of the root appears to be rotted, yet when the root is cut radially, there may be considerable firm, healthy-appearing tissue within. Such beets are commonly observed in the piles at harvest time, and often may serve as the initial source of "pockets" of rotted beets in the pile.

Beet roots appear russet in color at harvest time if Rhizoctonia causes a slight infection in early summer. Repeated destruction of the rootlets during the growing season usually means a smaller beet.

Factors Influencing Seedling Diseases and Root Rots

From planting to harvest, the beet plant is subjected to extensively varied soil and climatic conditions. Generally speaking, any factor that reduces or inhibits rapid growth of the beet plant predisposes the plant to infection by the fungi.

Plants virtually escape infection if soil conditions are optimum for germination and emergence. The soil surface should be warm, friable, and moist with available nutrients and not be low in organic matter. Extensive damping-off can result if the soil becomes wet, compact, crusted, or is low in nutrients or organic matter from the time of planting through emergence.

In certain soil types, when emergence is slow, growth of the emerging seedlings may be further retarded by some of the herbicides applied at planting time. Such retardation may predispose the plants to seedling infection at or near the soil level.

Low availability of nutrients or an imbalance of nutrients inhibits optimal growth of the plants. Thus the plants may be subjected to nutritional stress throughout the growing season and root rot may be severe.

Too little or too much moisture anytime during the growing season imposes moisture stress on the plants. Excess moisture reduces root aeration. Root rot is common at sites or in fields where there is water puddling or poor drainage. The heavier soils likewise affect root aeration, and root rot is most common in these soils.

The amount of organic matter in the soil affects the incidence and severity of root rot. Soils low in organic matter have more root rot, particularly if heavily textured. Soils with ample organic matter retain moisture better, enabling the grower to maintain a more constant supply of water for the beets, thus preventing moisture stress.

The type of organic matter also is important. Crops that are excellent hosts of the disease-causing fungi enable the fungi to build up to a high level of propagules, therefore increasing the likelihood that seedling diseases and root rots will occur in the beet crop. The crops selected in the rotation, particularly those immediately preceding beets, are important. i.e. while peas and beans are hosts of *Pythium* and sugar beet is a host of *Pythium* and *Rhizoctonia*, cereals and corn are considered non-hosts of the species and strains of fungi that attack beets.

Research in many areas of the world has demonstrated that the optimal soil temperature for the development of the root rot phase is above 70°F. Therefore, during the hot part of the summer, every effort should be made to maintain a cool soil. One of the best cooling means is with water, but as mentioned, excessive water reduces aeration, particularly in heavy soils low in organic matter.

A good stand of vigorous growing plants will aid in weed control and will provide an early shade, which assists in maintaining cool soil.

Control of the Diseases

Foremost in the disease control program is the selection of a cropping sequence that (1) provides ample organic matter, (2) maintains nutrition, (3) provides for weed control, and (4) assists in keeping in check the sugar beet cyst nematode. The crop immediately preceding beets should be a non-host for the *Pythium* and *Rhizoctonia* fungi. Cereals or corn are best, followed by clover, then alfalfa. An onion crop is not a good host for either of the fungi, but neither does it provide for ample organic matter. A potato crop is a host for the *Rhizoctonia* fungus but returns little organic matter to the soil. On occasion, severe cases of root rot have been observed in beets that followed potatoes.

Growers should avoid consecutive beet crops in a field.

When the rotation is being selected, the grower should consider a crop that will enable him to fall bed the field. Fall bedding is an opportunity to apply nutrients for decomposition of organic matter, also enabling the grower to plant early in the spring in moist soil when most pathogenic fungi and the cyst nematode are inactive. Fall bedding also permits the soil to warm up faster in the spring because more soil surface is exposed to the sun than would be in a nonbedded or flat field.

With nutrition readily available, ample soil moisture, and optimal soil temperature, the beet seedlings will emerge rapidly and, in so doing, escape infection. Also they will escape a possible retardation due to any herbicide applied at planting time.

Sometimes drying winds force irrigation of beets. The grower should avoid excessive irrigation because this reduces soil aeration and may cause soil compaction, especially under sprinklers.

Provide moisture as needed, but avoid overirrigation throughout the growing season. If nutrients are applied to a growing crop with a shank applicator, place the shanks a sufficient distance from the plants to avoid root pruning or injury to the rootlets. Wounds provide ports of entry for fungi to penetrate with greater ease.

The same can be said of cultivation. One can safely cultivate deep when the beet plants are small without serious injury to the plants. With increased size of the plant, cultivation should be progressively shallower. Yet a good furrow should be maintained to prevent puddling of water.

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