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Cole crops disorder: Clubroot

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Clubroot is an old and serious disease of cole crops. It has been known for several centuries and now occurs worldwide. The fungus (*Plasmodiophora brassicae*) infects the subsoil parts of many species of cole crops, wild plants, and weeds of the mustard family. The losses due to clubroot are sometimes very heavy. And once the soil becomes infested, it commonly remains so for an indefinite period, even in the absence of susceptible host plants.

Nearly all cultivated crops that belong to the cabbage family are susceptible to clubroot. The disease also occurs on plants in other families. Some of the most susceptible plants include Brussels sprouts, cabbage, Chinese cabbage, and some varieties of turnip. Broccoli, cauliflower, collards, kale, kohlrabi, rutabaga, and most varieties of turnip and radish are susceptible to a medium degree. Mildly susceptible plants are black mustard, rape, and some turnip and radish varieties.

Symptoms and effects

The most noticeable symptom of clubroot is the abnormal enlargement of the roots. These enlargements may occur on the very small roots, secondary roots, taproot, or underground stem. The root clubs are often thickest at the center, tapering toward either end. Plants with clubbed roots are stunted and leaves may yellow or wilt. In plants where fleshy roots are normally formed (turnip, radish, rutabaga, etc.), infection usually occurs only on the smallest and

Infected roots develop characteristic club-shaped enlargements.

Above-ground symptoms of clubroot. To confirm a diagnosis of clubroot and rule out cabbage maggot damage, dig an affected plant and examine the roots.

secondary roots and the edible taproots are not normally affected. This disease may progress to a considerable extent before the above-ground symptoms of plant stunting and wilt are noticeable.

Disease cycle

The organism which causes clubroot can remain in infested soil for 10 years or more. Infection occurs through root hairs and wounds caused by cultivation or cabbage maggot feeding. As the root infections enlarge, spores of the fungus are produced and subsequently released into the soil. Infested soil is then disseminated by equipment, human activity, and running water. Wet, cool, acid soils with a pH less than 7.2 favor clubroot.

Control

Monitor fields weekly throughout the growing season to determine the level of infection. Keep accurate records of the location of the disease and do not plant susceptible crops in affected areas.

Eliminate all weeds in the mustard family in and near the field. Plant cole crops on well-drained soils since the fungal spores germinate readily in wet soils. Always use clean transplants and don't transplant even a single seedling from infested beds, as asymptomatic seedlings may already be infected. Avoid infestation of new fields by selecting soil free of the pathogen for seedbeds. Practice long crop rotations of at least 7 years.

If compatible with the well-being of other crops in the rotation, keep the soil pH above 7.2. Liming is often ineffective in sandy or muck soils; however, on heavier mineral soils, it provides effective control. Prior to applying hydrated lime, determine the pH of the soil. The rate of hydrated lime needed to raise the pH to 7.2 is provided in the table below. The use of calcium nitrate fertilizer has been shown to be helpful in disease control.

Amount of hydrated lime needed to raise soil pH to 7.2

Original pH	lime (lb/a)
5.0	5000
5.5	4000
6.0	3000
6.5	2000
7.0	1500

Seed companies continue to look for cole crop varieties that are resistant to clubroot. However, there are several strains of the fungus that causes clubroot, and varieties may be resistant to one strain but susceptible to another. Currently, there are only varieties of turnip and radishes available that are reported to be resistant to the clubroot pathogen.

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