



Summary of clubroot symptoms and preventative measures

Worldwide soil borne fungal disease of cruciferous crops caused by *Plasmodiophora brassicae*.

Conditions favourable to development of Clubroot

1. High soil moisture content
2. Acidic soils (pH < 7)
3. Daily temperatures between 20 – 25 °C. Infection can incur as low as 12°C, but unlikely.
4. Unhealthy plants

Field symptoms

Symptoms often only appear in field when heads begin forming, seedlings are commonly symptomless.

Above ground symptoms:

Young plants wilt during heat of the day, but recover at night.

Leaves turn a pale green colour in infected area, lower and outer leaves may turn yellow and drop prematurely.

Growth of plants is stunted, and plants either die before maturing or fail to produce marketable heads.

Below ground symptoms:

Initial infection is on root hairs and cannot be identified with naked eye.

Roots develop tiny, club-like swellings that enlarge rapidly into large club-shaped masses that later turn black and decay releasing foul odours.

Club-like swellings are easily infected by secondary soft-rot diseases.

Survival of fungus

Clubroot commonly remains viable in the soil for at least 7 years from the last Brassica crop, but under favourable conditions can remain viable for up to 20 years.

In the primary stage of the lifecycle, resting spores germinate and infect tiny root hairs. The fungus multiplies rapidly, producing more swimming spores that re infect the roots. During the second stage of the lifecycle, the fungus multiplies within the roots forming the club-like swellings and produces millions of spores. These infected roots decay, releasing the spores into the soil.

Dispersal

- Dispersed by anything that may carry contaminated soil, ie farm machinery, hawkers boots or vehicles, animals feet and even dung of animals that have eaten diseased plants.
- Contaminated irrigation water, especially dam water where infected fields are nearby.
- Runoff in the field, for example along the tracks of a pivot or along contour ridges.
- On the root hairs of infected seedlings.
- Wind dispersal is possible under dry conditions.

Prevention of Clubroot

Farm sanitation is the most important preventative measure.

1. Do not allow buyers onto your farm. Cut cabbages yourselves and transport to a depot that is on the border of the farm and where no farm machinery passes through. Keep this depot clean of debris and sanitize regularly if possible.
2. Do not borrow farm machinery.
3. Avoid farm labour walking through vegetable fields, especially if Clubroot is present in the area. Disinfect shoes if necessary.
4. Rotate lands with non-cruciferous crops.
5. Use disease-free seedlings.
6. Lime soils to a pH of greater than 7.2. (Hydrated lime is more effective)
7. Practice good weed control; some cruciferous weeds are susceptible hosts.
8. Avoid over watering and water run-off.
9. Increase soil concentrations of beneficial plant nutrients (calcium, boron and magnesium).
10. Improve drainage in poorly drained soils and low lying areas.
11. Plant cabbage in its optimum growing slot for the area.
12. Do not pump from rivers where infected growers are upstream.
13. Regular field monitoring is essential, remove any stunted, unhealthy plants (burn).

Control methods

At present there are no reliable, cost effective control measures for club root. Hence prevention is of utmost importance. Some measures that can be taken to reduce the effects of clubroot are:

1. Containment – restrict the infection when first noted. If it's a small area fumigation may be affordable. Sterilize all machinery with Jeyes fluid when entering the infested lands.
2. Long crop rotations with non-cruciferous crops
3. Liming – choice of lime is very important as some are more effective than others. This is the primary measure that can be taken, but is costly in acidic soils.
4. Increase Boron, calcium and magnesium in the soil.
5. Drench seedlings in a fungicide before planting.
6. Fungicides – very few fungicides are registered for clubroot and are not reliable in combating the disease. The most effective appear to be calcium cyanamide; flusulfamides (eg Scablok) and certain surfactants. Some protect the immediate rooting volume, but are seldom cost effective.
7. Promote overall crop health
8. Soil Fumigation – an option if the disease is contained in a reasonably small area. Fumigants include dazomet, chloropicrin, metham sodium, etc. These are hazardous to use.

9. Remove infected debris – do not dispose of near waterways.

At present there are no commercial cabbage cultivars that are resistant to clubroot.

Please note that the above was compiled from existing literature and Sutherland Seedlings takes no responsibility for the efficacy or lack thereof of the above measures.