

RUST

Symptoms

The first symptoms of tropical rust appear on older leaves. They are mostly visible in the form of minute, bright yellow to orange lesions on the upper leaf surface. On the underside, spots of similar color but slightly bigger and rougher in appearance appear. As the disease progresses, they turn into target, raised, pale brown fungal pustules surrounded by a yellow halo. As they burst open and release their spores, they often coalesce and form irregular dark brown spots. On stems and petioles these pustules are usually elongated and are not much raised. Plants become prematurely defoliated as the disease develops, resulting in reduced boll size.

Trigger

Rust of cotton is an aggressive disease caused by the fungus *Phakopsora gossypii*. It is not seed- or soil-borne and thus needs green living tissue to survive. During the season, the spores produced in the pustules of cotton infect gramma grasses (*Bouteloua* spp) around the fields and produce elongate brownish or black spots on their leaves. At the beginning of the next season it is the spores produced on these grasses that will infect cotton plants to complete the cycle. The spores penetrate the plant cells directly rather than through pores or wounds in the leaf tissue. High humidity leaf wetness and moderate to warm temperatures are conducive for the disease.

Biological Control

Products containing essential oils of *Corymbia citriodora* at 1% *Cymbopogon nardus* at 0.5% and *Thymus vulgaris* at 0.3% have been used with other rusts to reduce their severity and occurrence.

Chemical Control

Always consider an integrated approach with preventive measures together with biological treatment if available. Selecting the right fungicide and applying it at the right time is crucial. Apply fungicides based on hexaconazole and propiconazole (1-2 ml/l of water) about 75 days after sowing at 15 days interval and up to 120 days to limit the yield losses. Spray mancozeb 0.25% prior to the formation of spores from gramma grass.

Preventive Measures

- > Plant early and if possible choose an early maturing cultivar.
- > Alternatively plant late to take advantage of drier periods.
- > Use wider row spacing to hasten canopy drying.
- > Monitor your plants regularly and weed out alternative hosts, particularly gramma grasses.

WOOLLY APHIDS

Symptoms

White hairy insects can be feeding on buds, twigs, branches, and even on the roots. Distorted leaves, yellowing foliage, poor growth and branch dieback are the consequence of this activity. A white fluffy covering and honeydew appear near the feeding sites. On bark and shoots, the development of cankers and swellings is also characteristic. Underground forms of the aphid also attack roots and lead to the formation of swollen enlargements or large knots. The impaired transport of water and nutrients explains the yellowish appearance of the trees. These galls increase in size from year to year as a result of aphid feeding. The wounds caused by the insects and the presence of the honeydew also attract opportunistic fungi that may cover the infected tissues with sooty mold. Young trees are easily uprooted when infested.

Trigger

The symptoms are caused by the feeding activity of the woolly aphid *Eriosoma lanigerum*. Unlike most aphids, it sucks sap from the woody stems, rather than from foliage. This insect is characterized by its white, thick, fluffy wax covering. It overwinters on its host in cracks on the bark or on suppressed wounds around old feeding sites. As temperature increases in the spring the aphids become active again and climb on the suckers, younger shoots and branches in search of a vulnerable site (areas with thinner bark). There, it feeds gregariously, sucking sap from beneath the bark, and starts secreting the fluffy hairs that eventually wrapped the colony. Opportunistic pathogens can colonize the open wounds. During the cure, the adults grow wings and fly off in search of new host plants. Elm trees in the vicinity of orchards increase the migration of the aphid to the apple orchards.

Biological Control

Spray solutions must be able to penetrate the woolly coat secreted by the aphids to kill them. Diluted alcohol solutions or insecticidal soaps can be splashed over the woolly spots to disturb them. Ecological oils or neem extracts (2-3 ml/l water) can also be sprayed over the trees. Good coverage and a follow-up spray 7 days after first application are essential. Parasites and predators such as lacewing, ladybugs (*Exochomus quadripustulatus*), hoverfly larvae, and parasitic wasps (*Aphelinus mali*) can help to control populations. Artificial refuges foster populations of predator earwigs, for example *Forficula auricularia*.

Chemical Control

Always consider an integrated approach with preventive measures together with biological treatment if available. Chemical controls can be applied either preventively or after detection. Systemic treatments can be useful to deter the aphids from feeding on treated trees. Unfortunately they can also be harmful to beneficial insects. Reactive sprays include formulations based on deltamethrin, lambda-cyhalothrin, and acetamiprid. Carbamates and pyrethroids should be avoided as they encourage outbreaks of aphids by killing parasites and predators. Trees in flower should not be sprayed due to the danger to pollinating insects.

Preventive Measures

- > Choose resistant varieties if available.
- > In mild infestations, the insect can be monitored and scrubbed with a brush.
- > Apply fortifiers or balanced fertilization to strengthen the trees.
- > Avoid the excessive usage of pesticides as they can decrease population of beneficial insects.
- > Summer prune in late summer to remove developing colonies.
- > Remove affected young shoots and branches.
- > Remove suckers at the base of the tree to create less favorable conditions for the aphids.
- > Paint large pruning cuts with commercial pruning paint to discourage aphid colonies.
- > Do not plant elm trees close to apple tree orchard.

MOSAIC VIRUS

Symptoms

Initially, trifoliate leaves become slightly lighter in color. Gradually, light and dark green mosaic pattern appears on the leaf blade (o green mosaic). Some veins or parts of them show sign of chlorosis (yellowing). As the disease progresses, parts of the leaves might become puckered, blistered or distorted Curled down or rolled leaves are other late symptoms. Plants which were infected during the early growth stages may be severely stunted and unproductive, with fewer pods and fewer seeds per pod in some susceptible varieties, the virus can cause the blackening of roots, a symptom that is only observed at temperatures above 30 C

Trigger

The primary source of inoculum are infected seeds. The secondary transmission from plant to plant occurs via infected pollen, vectors pests (mostly aphids) or through mechanical injury to the plants during field work Symptoms and effects on yield depends on plant variety, environmental conditions (temperature and humidity) and time of infection. Runner beans seem to be immune to the virus, while pole beans and bush beans are more vulnerable Losses of up to 100% can be found in susceptible plants grown from seeds carrying the virus (seed-borne infection). Later infections by aphids are usually less severe.

Biological Control

Direct treatment of the virus is not possible Diluted mineral oils can reduce the transmission of the virus by aphids, but in high concentrations these oils might be toxic to the plants.

Chemical Control

Always consider an integrated approach with preventive measures together with possible biological treatment. Chemical treatment of viral infections is not possible Chemical control of the aphid vector is often ineffective.

Preventive Measures

- > Use healthy seeding material from certified sources.
- > Plant resilient varieties whenever possible
- > Plant densely to prevent aphids from entering the canopy.
- > Plant early to avoid aphid peak population.
- > Remove infected plants when first symptoms are observed
- > Cultivate beans far from other bean production sites.
- > Rotate crops with non-host plants
- > Plant companion crops to block the aphids