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CITRUS DISEASES AND THEIR MANAGEMENT

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Abstract

Citrus plants attacked by citrus root nematode, *Tylenchulus semipetrans*, which is the main cause of citrus slow decline. Heavily infected root systems appear encrusted, which result in reduced yield and quality of fruit. The foliage lacks vigour, and oozing of gum from the gummosis infected parts of trees is commonly observed. Infected bark remains firm with small cracks through which gum exudation occurs. Citrus wither-tip disease causes twigs and branches to appear as if have been scorched by fire. Citrus canker infected trees had raised, watery spots on leaves, which become thickened, brown and corky with the passage of time. Infection to petioles and midrib causes premature defoliation. Citrus greening causes yellowing of the veins and adjacent tissues, followed by yellowing or mottling of the entire leaf. The damage caused by citrus nematode can be reduced by the use of nematode free seedlings, resistant rootstocks and by the application of Furadan. Citrus canker, a bacterial disease can be effectively managed by spraying with Streptomycin Sulphate @ 100 to 1000 ppm. Application of Bordeaux paste and Bordeaux mixture (copper sulphate lime and water: 4:4:50) at the infected plant parts by gummosis found very effective in reducing the disease incidence. Citrus die-back infected braches must be pruned. The spray with copper fungicides like Carbendazine (Bavistin) at 0.1% has been found effective in managing the disease. The incidence and severity of nematode, fungal, bacterial, and viral disease and their management will be reviewed.

INTRODUCTION

Pakistan is the sixth largest producer of Kinnow mandarin and sweet oranges in the world, with 2.1 million tonnes. Pakistan world mandarin and oranges market share during the year 1997 was 0.9% and 3.6% in terms of value and volume, respectively. Pakistan is also the largest producer of '*Citrus Reticulata*' variety (Kinnow), this unique variety of citrus is indigenous to this part of the world. According to an estimate approx. 95% of the total Kinnow produced all over the world is grown in Pakistan. Area (000 hectares) under citrus cultivation in Pakistan is given in Figure 1 while the area (000 hectares) under different citrus cultivars in Punjab is given below in Figure 2. Actually, Kinnow is a cross of King mandarin (*Citrus nobilis*) and Willow leaf mandarin (*Citrus reticulata*). It is not indigenous to this area, but introduced in the best environment.

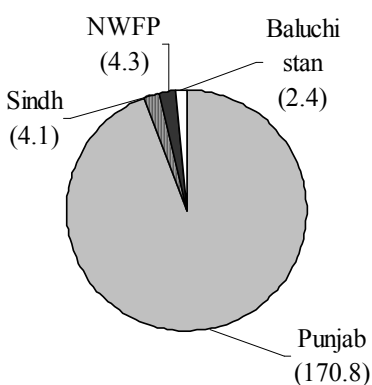


Figure 1: Area under citrus cultivation in Pakistan (thousand hectares)

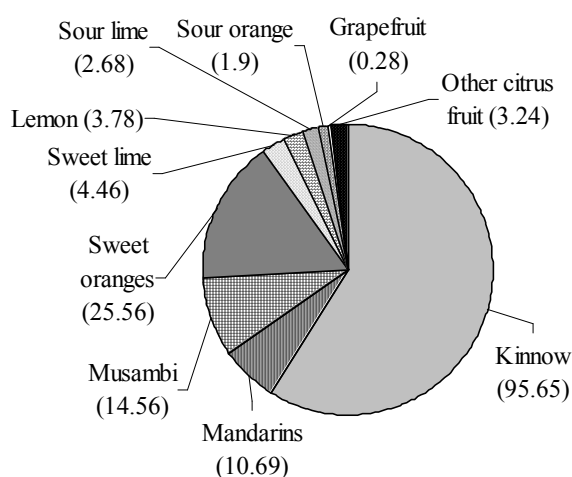


Figure 2: Area under different citrus cultivars in Punjab (000 hectares)

CAUSES OF LOW YIELD

Citrus problems such as physiological disorders, pest and disease damage and nutritional deficiencies are main causes of low yield of citrus fruits but diseases have negative impact on fruit production as well as fruit quality of citrus trees. Citrus is susceptible to a large number of diseases caused by different pathogens. Economic losses due to plant diseases can be severe, but fortunately, not all pathogens attacking citrus worldwide are present in Pakistan. Citrus diseases of economic importance that are currently present in Pakistan include citrus canker, citrus greening, citrus wither tip, citrus tristeza virus, citrus gummosis, slow decline (citrus nematode) spreading decline (burrowing nematode), blight, greasy spot, *Alternaria* brown spot, *Phytophthora*-induced diseases and post harvest decay of citrus fruit.

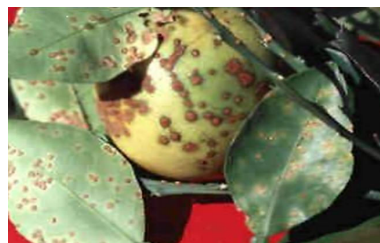
1. Citrus Canker

Citrus canker is a disease affecting citrus orchards in all over the world and is caused by the bacterium *Xanthomonas campestris* pv. *citri*. Infection causes lesions on the leaves, stems, and fruit of citrus trees, including lime, oranges, and grapefruit. While not harmful to humans, canker significantly affects the vitality of citrus trees, causing leaves and fruit to drop prematurely; a fruit infected with canker is safe to eat but too unsightly to be sold.

The disease, which is believed to have originated in South East Asia, is extremely persistent when it becomes established in an area, making it necessary for all citrus orchards to be destroyed for successful eradication of the disease.

Causal Organism

The bacterium causing citrus canker was known as *Xanthomonas campestris* pv. *citri*. The bacterium of citrus canker has a short life in soil or in fallen leaves. The short longevity in natural soil is attributed to microbial interactions, especially the predatory effect of protozoa. This is generally true when the temperature is warm enough to allow the soil microorganisms to compete with the bacterium. When the source of inoculum is removed (removal of affected leaves and twigs) the survival in soil is considerably reduced. In presence of active host tissue for support such as roots it can survive deep in soil. In tissues of fallen diseased leaves and twigs also the bacterium dies quickly. The survival is not for more than 3 weeks if the lesion-bearing leaves and twigs are wetted on the soil surface or are buried at a depth of 3-6 cm. If the plant debris is maintained under dry conditions the survival is increased to 2-3 months.



Symptoms

- First raised, watery spots appear on leaves, twigs, thorns, branches and thorns.
- Later spots become thickened, brown and corky.
- Infection to petioles, midrib causes premature defoliation.
- In severe attack symptoms produced on all plant parts.

Management

- Crude streptomycin at 100-1000 ppm at 15day intervals.
- Phytomycin 2500 ppm or streptomycin-100 at 500 ppm
- Copper Ammonium in China reduced 86-90% disease incidence.

2. Citrus Greening

Citrus greening is a highly destructive disease of citrus caused by the bacterium like organism. It is also called Huanglongbing or yellow dragon disease. The disease is primarily spread by two species of psyllid insects *Diaphorina citri* in Asia and *Trioza erytreae* in Africa. It invades conducting tissues causing a decline of citrus trees rendering them unproductive. It does not occur in Australia, but is the most serious disease of citrus in Asia and could impact heavily on our citrus industry. Citrus greening probably originated in China. Now a day it is serious problem in all citrus producing areas of Pakistan (Sargodha, Faisalabad, T. T. Singh and Sahiwal).



Symptoms

Common zinc deficiency and several other conditions can cause symptoms similar to citrus greening Symptoms are yellowing of the veins and adjacent tissues, followed by yellowing or mottling of the entire leaf, occasionally with corking of the veins, followed by premature

defoliation, dieback of twigs, decay of feeder rootlets and lateral roots, decline in vigor, and ultimately, the death of the entire plant

Diseased leaves become hardened, erect and curl outward, while young leaves developed after premature defoliation are small and slender, with symptoms of zinc deficiency.

Management

- Eradication of citrus psylla with 0.02% diazinon or endrin.
- Spray with Bavistin and ledermycin (500 ppm) six times at 10 day intervals.

3. Citrus Wither Tip

This disease is caused by fungus *Colletotrichum gloeosporioides*. The branches and fruits of the affected trees start drying and the tree becomes uneconomical to maintain. Apply a balanced dose of Bordeaux Mixture 4:5:0 after cutting affected branches from the trees.

Symptoms

- The dieback often progressed slowly and caused leaves to wilt, turn yellow and drop off.
- Twigs and branches appeared to have been scorched by fire.
- Drying of twigs from top to down ward.
- When twigs were dry, minute brown-to-black, slightly raised, clumped pustules are observed which are acervuli of the fungus.
- Dry twigs are ash-coloured
- Affected fruit showed tar stain symptoms.



Management

Spray with benomyle and captafol 1-4 applications. Bordeaux mix (1%) or copper fungicides (copper oxychloride) starting from July at 21day intervals. Bavistin at 0.1% also checks the disease development.

4. Citrus Tristeza Virus

Citrus Tristeza Virus (CTV) is one of the most destructive of the many viruses that affect citrus. The virus pathogen has been responsible for the death and debilitation of millions of citrus trees. These strains varied in severity, vector specificity, and host range. It was proven that several distinct diseases (Tristeza, Stem-pitting, Seeding-yellows, and Lime dieback) were caused by strains of CTV. In Pakistan, later surveys discovered the virus in mature trees of Clementine mandarin, Dancy tangerine, and Marsh white grapefruit at both the Yuma and Tempe University of Arizona Citrus Experiment Stations.

Symptoms

- Vein clearing and flecking of veins.
- Leaves bronze, golden, yellow.
- Leaf wilt, drop, reduced fruit size, while hanging on dead tree.
- Stem pitting- honey combing, pegs
- Sudden death, necrosis of cambium.
- Trees show bushy appearance.
- Twigs tend to be brittle and break.

Management

The management of Tristeza involves cultural management and biological control measures including mild strain cross protection. Genetic engineering and breeding is being done for virus resistance in commercially acceptable scions and rootstock. There is no direct chemical treatment against the virus. It has been suggested that vector control by chemicals over a large area may reduce spread of CTG by reducing aphid populations. The main aphid vector *Toxoptera*

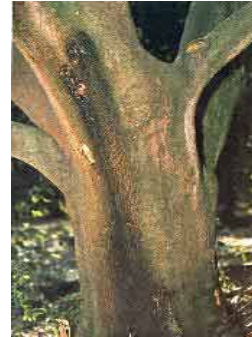
citricidus is not present in Pakistan, but other aphids as *Aphis gossypii* and *T. aurantium* may be involved in transmission of CTV.

5. Citrus Gummosis

This is one of several well-known gumming diseases of citrus. Gum formation on the trunk or branches is a characteristic symptom. Gum exudes from blisters containing gum pockets, usually located on the trunk. Several factors such as freeze damage, high water table and salt accumulation contribute to the disease. Gummosis is believed to be a condition of weak and injured trees and is reported to be infectious. This is also known as brown rot gummosis.

Casual Organism

The disease is caused by one or more species of the fungus *Phytophthora spp.* This disease can affect the root system, the trunk below and above ground, branches, leaves, blossoms and fruit. It is especially troublesome during prolonged rainy periods. Trees with the bud union beneath or close to the soil and trees in poorly-drained locations are highly susceptible. *Phytophthora* fungi are present in almost all citrus orchards. Under moist conditions, the fungi produce large numbers of motile zoospores, which are splashed onto the tree trunks. The *Phytophthora* species causing gummosis develop rapidly under moist, cool conditions. Hot summer weather slows disease spread and helps drying and healing of the lesions. Secondary infections often occur through lesions created by *Phytophthora*. These infections kill and discolor the wood deeper than gummosis itself.



Symptoms

- Lesions are formed on bark at base of trunk and crown roots.
- Infection spreads upward and down ward, causing rotting of fibrous root.
- Oozing of gum from the affected trunk and cracks in the bark.
- During summer gum remain sticking on stem.
- Leaves show symptoms of nutritional deficiency and fall premature.

Management

- Bud union 30-45 cm above the base and soil level at the time of planting.
- Paint with Bordeaux paste up to 70 cm.
- Spray with Bordeaux Mixture (4:4:50), Aliette or Ridomil.

6. Citrus Slow Decline

Citrus decline is widespread throughout Pakistan and is variously attributed to orchard neglect, poor plant nutrition, water logging, fungal diseases or nematodes. While these causes of decline can be expected to affect citrus orchards in Pakistan, it is more likely that the main cause of decline is due to nematode.

More than 40 nematode species have been described worldwide on citrus. But only one species, the citrus nematode, *Tylenchulus semipenetrans*, is important and damaging. The citrus nematode was first found infecting citrus in California in 1912. In Pakistan, the citrus nematode has been reported in all citrus producing regions. Surveys made in the United States indicate that infestations of citrus areas range from approximately 50 to 60% in California and Florida to 90% in Texas and Arizona.



Symptoms

- Similar to poor nutritional symptoms.
- Reduced terminal growth, chlorosis, shedding of leaves, die-back of branches.

- Reduction in number and size of fruits.
- Roots are of brown colour and dirty due to adherence of soil particles.
- Destruction of roots is due to secondary invasion of *Fusarium* spp.

Management

- Various nematicides: Rugby Mocap, Thimet @ 100-200 g per tree by broad cast.
- Organic amendments with castor cake, neem cake @ 10 kg per tree.
- Cultivation of marigold in citrus orchards.

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