

Global Status of powdery mildew (*Oidium tingitanium* Carter) disease on *Citrus* spp.

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Citrus fruit plants are important crop like other commercial crops cultivated throughout the world including India for their fruits. Powdery mildew of *Citrus* caused by *Oidium tingitanium* Carter (often referred to as *Acrosporium tingitaninum* Carter, Subr.) is one of the important fungal diseases occurring every year throughout the world in severe epidemic form. This pathogen attacks on leaves and twigs of almost all species of *Citrus*. The works on this in India and other countries are very limited particularly the assessment of fruit loss due to the severity of the powdery mildew.

The severity of this disease has aroused much concern and prompted its detailed investigation. In this present paper an attempt has been made to consolidate the scattered information on various aspects of *Citrus* powdery mildew.

Key words : Powdery mildew, *Oidium tingitanium*, *Citrus* spp.

INTRODUCTION

The *Citrus* plant (*Citrus reticulata* Blanco) belonging to the family Rutaceae is well known for its fruits-orange. The genus *Citrus* is a native of sub-himalayan region and well distributed throughout the tropical and temperate region of the world. The genus has about 16 species. All species are evergreen, aromatic, shrub and tree, mostly with thorny branches. The *Citrus* fruits are now being grown in commercial scale in about 30 countries of the world, particularly oranges are the two third of the total citrus area. In India about 244000.0 hectare is reported to cover by various species of *Citrus* with about 2580000.0 tonnes of production. *Citrus* occupies about 9 percent of the total land area under various fruits of the country (Anonymous, 1986). The *Citrus* fruits have different types of medicinal and economical values. *Citrus* fruits are a rich source of vitamin C and also vitamin P.

The crop is vulnerable to different type of diseases. Among the fungal diseases, powdery mildew caused by *Oidium tingitanium* Carter is one of the most destructive. Although powdery mildew is known to occur in India for many years, worked done on this disease is very limited. A review of the work done on this disease both within and outside the country is made with a primary objective of indentifying the gaps and to suggest and residual research priorities on this important disease of *Citrus*.

Distribution

Barkley first noticed the powdery mildew disease on leaves orange in 1874 from Ceylone but Carter (1915) first reported this disease caused by *Oidium tingitanium* from California. Subsequently its occurrence was reported from several other *Citrus* growing countries like India (Butler, 1904; Devarajan, 1946; Subramanian, 1971); Java (Fawcett and Klotz, 1948; Subramanian, 1971); Philippines (Tamayo and Pordesino, 1959); California (Carter, 1915; Fawcett, 1934; Fawcett and Klotz, 1948; and Bosewinkel, 1982); Indonesia (Subramanian, 1971); Celone (Park, 1930, 1933; Lester-Smith, 1932) and N. America (Subramanian, 1971).

Extent of damage

Literature regarding the loss of yield (fruit) due to powdery mildew is lacking. In 1966 Banerjee reported the fruit drop due to this disease but he failed to show the actual loss of yield. Dutta Roy (1990) recorded 10 to 25 percent fruit drop due to powdey mildew. However, the extent of damage caused by powdery mildew remain to be done.

Symptoms

The symptoms of the disease are easily noticeable on young leaves and twigs as greenish white powdery growth. The upper and lower surfaces of the leaves show major symptoms. The most commonly affected part being the young and actively growing leaves and twigs. The old leaves are not usually attacked (Devarajan, 1946 and Dutta Roy, 1990). Usually the young shoots near the centre of the tree and nearest the ground show their symptoms (Fawcett, 1936) and he also noticed that suckers produced immediately after the rains and left to develop from the base through the center of the tree were also affected. Recently Dutta Roy (1990) reported that the margins of the leaves were attacked more severely. Under favourable condition entire lamina of the affected leaves are covered by greenish white patches, and then the leaves became shrivel, dried up and finally

dropped off. The older leaves if attacked do not shrivel but get malformation (Fawcett, 1936 ; Anonymous, 1961 ; Banerjee, 1966). Same symptoms were also noticed in all the *Citrus* species (Dutta Roy, 1990).

Predisposing factors

Carter (1915) found that damp morning when the sun does not come out until the midday was deciding factor to initiate the disease. In general the disease is apparently favoured by warm, summer temperature and humid atmosphere.

The pathogen

The fungus *Oidium tingitanium* causal agent of powdery mildew of *Citrus* was first described by Carter (1915). Later the name of the pathogen was changed by Subramanian (1971) as *Ascosporium tingitaninum* (Carter). The pathogen belongs to the family Erysiphaceae, Ascomycetes. The hyphae of the fungus is hyaline septate and branched. The diameter of the hyphae ranges from 4.5 to 6.7 μ (Petch, 1915, 1919 ; Naik, 1949 ; Ramkrishnan, 1954 ; Tamayo and Pordesino, 1959 ; Banerjee, 1966 and Subramanian, 1971. The fungus is ectoparasite forming haustoria. The conidiophores are 60 to 120 μ m in length and 12 μ m in wide. Conidia are produced in chain of 4 to 8 are colour less, hyaline, finely granular, and barrel shaped with slightly rounded ends. Various workers obtained various sizes of conidia from different parts of the world. A list of various size conidia with references and places of collection was given below :

Author	Place of collection	Diameter in μ m	
		Length	Breadth
Sir Eswin Butler (1918)	Nilgiri hills, India	27.0 to 35.0	12.0 to 15.0
Carter (1915)	California	20.0 to 28.0	10.0 to 15.0
Petch (1915)	Ceylon	36.0 to 42.0	15.0 to 18.0
Fawcett (1936)	Java	35.0 to 38.0	11.0 to 13.0
Devarajan (1946)	Coorg, India	25.0 to 42.0	15.0 to 18.0
Tamayo and Pordesino (1959)	Philippines	21.65 to 43.29	11.65 to 19.98
Subramanian (1971)	India	20.0 to 28.0	10.0 to 15.0

Perenation

Perenation of this fungus takes place through the mycelium present in the old infected shoots (Ram *et al.*, 1977 and Dutta Roy, 1990). Dutta Roy (1990)

also noticed that the fungus persists throughout the years on the host in the field condition with different degree of intensities.

Control measures

Tolerant/Resistant varieties

Different species of *Citrus* give different degree of tolerance against the powdery mildew disease (Ullasa and Naidu, 1975; Ram *et al.*, 1977; Raghavendra *et al.*, 1977; Reddy *et al.*, 1984; and Narayanappa and Ravishankar 1985, 1986). One of the *Citrus* species showed absolute resistant against this disease. Reddy *et al.*, (1984) found that out of mandarin, sweet orange and acid lime, the latter showed resistant. Out of 178 *Citrus* varieties, none was fully immuned against this disease but they showed different degrees of resistance (Roughovendra *et al.* 1977). Similarly Reddy *et al.* (1984) observed that 16 varieties out of 137 varieties against this disease at Tirupati were resistant to some extent. The scion varieties of *C. limon* namely Brazillian, Assam, Eureka, Seveille Malta, Napoor, Nepali Oblong and Cong were reported to resistant, but Kuser and Carpeny were moderate susceptible (Narayanappa and Ravishankar, 1985, 1986).

Different fungicides were used by many workers to control this disease. Park (1930) mentioned that powdery mildew of *Citrus* was satisfactorily controlled by weekly application of 2 percent solution of sulfinate. Lester-Smith (1932) recommended good control of the powdery mildew by weekly application of certain lime-sulphur mixture during warm damp weather. Again Park (1933) recommended two or three application of sulphur spray during the growing period. Dusting of finely powdered sulphur was also recommended by many workers (Devaranjan, 1943; Fawcet and Klotz, 1948; Ramkrishnan, 1954; Govindu, 1963; and Banerjee, 1966). Sudaraman (1927-28) found that Bordeaux mixture also controlled the disease. Narasimhan (1936) suggested that powdery mildew of orange caused by *Oidium tingitaninum* was controlled by gingelly oil bordeaux. Bertus (1931) claimed that powdery mildew could be controlled by weekly application of concentrated lime-sulphur or by fortnightly application of a 2 percent solution of lime-sulphur supplemented by the removal and destruction by fire of all affected twigs and leaves. Tamayo and Pordesino (1959) suggested that where infection was likely to cause tremendous damage, spraying with Bordeaux mixture or dusting with sulphur would help to minimize losses due to the disease. A solution having wettable sulphur (2 lb), zinc sulphate (5 lb), manganese sulphate (2 lb), copper sulphate (3 lb), ferrous sulphate (2 lb), boric acid or borax (1 lb), lime (1 lb), urea (10 lb), water (100 galon) gave good result for control of the disease (Anonymous, 1961). Govindu (1963 vide Reddy, 1968) and Reddy (1968) described the controlling of this disease by spraying with Thiovit (0.5 kg in 100 lt water) or ultra sulphur (0.15

percent) at an interval of 20-30 days. Ram and Naidu (1978) recommended 0.1 percent carbendazim or benomyl as well as 0.15 percent tridemorph for effective control of the disease.

Narasimhan *et al.* (1984) reported that spray with wettable sulphur (0.05%), bayco W. P. (0.05%), tridemifon [Bayleton] (0.05% or olino carp [Karathane] (0.05%) at intervals of ten day starting from initial disease appearance effectively controlled the powdery mildew of mandarin.

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