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Guava wilt

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INTRODUCTION

Guava (*Psidium guajava* L.) is an important and hardy fruit widely grown in tropical and subtropical regions of the world. In India, it is grown in almost all the states. Bihar has the largest area (26.59 thousand ha) followed by Uttar Pradesh (18.49 thousand ha) and Karnataka (11.95 thousand ha). The productivity is the highest in Gujarat 22 t / ha) and the lowest in Himachal Pradesh (0.28 t / ha) (Chauhan and Dabas, 8). Wilt disease is a major limiting factor for the productivity and production of guava. Since, the disease is soil borne in nature, there are limitations in its control. Although, guava wilt was first reported in 1935 from Babakkarpur, Allahabad, limited progress has been made in understanding the disease (Jhooty *et al.*, 23). The present paper reviews the available information on the advances made in guava wilt.

GEOGRAPHICAL DISTRIBUTION

Several workers (Das Gupta and Rai, 9; Prasad *et al.*, 38; Mathur, 27; Edward and Srivastava, 18 and Misra, 33) have reported guava wilt from different parts of the Uttar Pradesh. Occurrence of the wilt has also been reported from West Bengal (Chattopadhyaya and Sengupta, 7 and Chattopadhyaya and Bhattacharjee, 6), Haryana (Suhag, 42 and Mehta, 31), Punjab (Chandra Mohan *et al.*, 5), Bihar (Sridhar, 41), Rajasthan (Katyal, 24), Delhi (Anonymous, 1), Orissa (Saxena and Rawal, 39), Andhra Pradesh (Jhooty *et al.*, 23) Karnataka (Sohi, 46), Gujarat and Maharastra (Mehta *et al.*, 30) and Madhya Pradesh (Saxena and Rawal, 40). Guava wilt has also been reported from other countries, namely, Taiwan (Hsieh *et al.*, 21 and Leu and Kao, 26), South Africa (Grech, 19 and Joubert and Frean, 20), Brazil (Tokeshi *et al.*, 50 and Rodrigues *et al.*, 43), Pakistan (Ansar *et al.*, 3) and Reunion island (Normand, 36).

LOSSES

Precise and recent estimates of the losses caused by wilt disease are lacking. However, in previous estimations, Singh and Lal (44) estimated that 5 to 15 per cent of the trees died due to wilt every year in 12 districts of U.P., resulting into a loss of worth Rs. one million approximately. It has been observed that in several important guava growing areas in U.P., like Allahabad, Sasni (Aligarh) and Bithoor (Kanpur) farmers have abandoned their guava cultivation and they have preferred growing annuals. It is also seen that the contractors fear to purchase guava orchards, which are located in wilt infested areas. In West Bengal, the wilt caused reduction of the yield up to 80 per cent (Chattopadhyaya and Sengupta, 7). In Andhra Pradesh, land value reduced to half due to wilt disease (Jhooty *et al.*, 23). About 150 acres of the wilt-affected guava orchards in Punjab and 300 acres in Haryana were uprooted during 1978-81 (Jhooty *et al.*, 23).

SYMPTOMATOLOGY

First external symptom of the guava wilt is the appearance of yellow colouration with slight curling of the leaves on terminal branches.

Subsequently, browning, drooping and pre-mature shedding of the leaves occur. Some of the twigs become bare and fail to bring forth new leaves and/or flowers and eventually dry up. Generally, the symptoms appears after the rains, i.e. during October-November, when the fruits are small. As the wilt progresses, the fruits of affected branches remain under developed, hard and stony. Later on, the entire plant becomes defoliated and eventually dies, but hard, stony and dark brown and/or black fruits hang on the branches for some time. Usually, fifteen days are required for the complete wilting, but some trees take even up to one year. The finer roots show black streaks, which become prominent on removing the bark (Das Gupta and Rai, 9). The roots also show rotting at the basal region and the bark is easily detachable from the cortex. The cortical regions of the stem and root show distinct discolouration and damage. Light brown discolouration is also noticed in the vascular tissues (Chattopadhyaya and Bhattacharjee, 6). In general, above 10-year-old plants are more prone to the wilt incidence. Partial wilting is also common, when one side of the few branches wilt during the first year and in the next year full plant dies.

ETIOLOGY

Large number of the pathogens have been isolated from the wilted plants by various workers in different parts of the world. The exact cause of the disease is still not fully understood, but the pathogens, viz. *Fusarium oxysporum* f. sp. *psidii*, *F. solani*, *Macrophomina phaeseoli*, *Rhizoctonia bataticola*, *Cephalosporium* sp., *Acremonium diospyri* and *Gliocladium roseum* are reported to be responsible for the guava wilt.

Before 1941, wilt was considered to be caused by *Cephalosporium* sp. in North India (Vestal, 51). Dey (10) invariably isolated *Cephalosporium* from the roots of wilted plants. Das Gupta and Rai (9) reported the association of *Fusarium* sp. with the wilt disease in U.P. Later, Prasad *et al.* (38) attributed the wilt to *Fusarium oxysporum* (Fr.) Schl. and proposed the name *Fusarium oxysporum* (Fr.) Schl. f. sp. *psidii*. This view was supporte by Edward and Srivastava (18) and Pandey an Dwivedi (37). Edward (15) also observed that th *F. oxysporum* f. sp. *psidii* exists in a variety of th forms, which differ in their cultural an morphological characters. He reported that the *oxysporum* f. sp. *psidii* penetrates either direct through the root piliferous layer of the guav seedlings or through the openings caused b secondary roots. Hyphae are found in xylem vesse of the roots of inoculated plants.

Besides, the involvement of above pathogen association of other pathogens with guava wilt ha been reported by different workers from differe places. In West Bengal, both *Macrophomin phaseoli* (Maubl.) Ashby and *Fusarium sola* (Mart.) Sacc. were found to incite the wilt eithe individually or in combination (Chattopadhyay and Sengupta, 7). *M. phaseoli* was found to b more predominant in the Gangetic alluvial trac and confined exclusively to the root regio Whereas, *F. solani* was present in aerial parts a well as upper region of the root system and it wa predominant in the dry lateritic areas of the We Bengal (Chattopadhyaya and Bhattacharjee, 6 Both *M. phaseoli* and *F. solani* were found to inci the wilt disease either individually or i combination. In either case, the fungus firs colonizes the surface of the roots and then ente into its epidermal cells. Thereafter, intercellula mycelium establishes first in the epidermal cell and then spreads into the cortical cells, whic get considerably damaged and filled up wit the mycelium. *F. solani* enters the xylem vessels grows inside and blocks them. *M. phaseo* first invades the phloem and destroys it. Th xylem vessels are also attacked in few case (Chattopadhyaya and Bhattacharjee, 6 an Chattopadhyaya and Sengupta, 7).

Gliochadium vermoesenii Corda., a know saprophytic fungus, was found to be associate with the wilted plants in Punjab (Chandra Mohan 4). From Varanasi, *M. phaseolina* was reported t incite the guava wilt (Dwivedi, 12).

In recent studies, at the Central Institute for Subtropical Horticulture, Lucknow, out of several pathogens isolated from the wilt affected guava plants, *Gliocladium roseum* was found to be the most potent pathogen, which could reproduce the symptoms of wilt in field on a large scale in 4- to 8- year old trees after artificial inoculation (Fig. 1). The stem hole inoculation technique was standardized, which could reproduce the disease after two months of the inoculation (Misra and Pandey, 35).

Varying reports from other parts of the world show similar symptoms of the wilt, but with different pathogens. In Taiwan, the disease is reported to be caused by *Myxosporium psidii* Corda (Hsieh *et al.*, 21 and Leu and Kao, 26). In South Africa, *Septofusidium* sp. was found to be associated with rapid wilt of the guava plants (Grech, 19). In another report, *Acremonium diospyri* was given as the causal organism of the wilt (Joubert and Frean, 20). From Brazil, *Pseudomonas* sp. (Tokeshi *et al.*, 50) and *Erwinia psidii* (Rodrigues *et al.*, 43) have been isolated from the wilt affected plants. In Pakistan, *F. oxysporum* and *Colletotrichum gloeosporiodes* (*Glomerella cingulata*) are found to be associated with the disease and they are supposed to act synergistically, when they are present together (Ansar *et al.*, 3).

From the above information, it is apparent that there may be more than one cause for the guava wilt. But the recent information about the *Gliocladium roseum* reported from CISH, Lucknow by Misra and Pandey (35) opens a new line of the work, which might be useful in solving the problem of guava wilt.

EPIDEMIOLOGY

The wilting is observed during rainy season. It starts in August with the largest number of plants dying in September and October. The incidence decreases markedly in November and it becomes negligible with the advancement of winter (Das Gupta and Rai, 9). In June-July, only old twigs are affected, in August young shoots begin to die and the disease increases in its severity upto the beginning of October. Later on, the cool season from January to March and less humid season from January to June prevent the spread of infection (Tandon and Agarwala, 49). Edward (15) observed

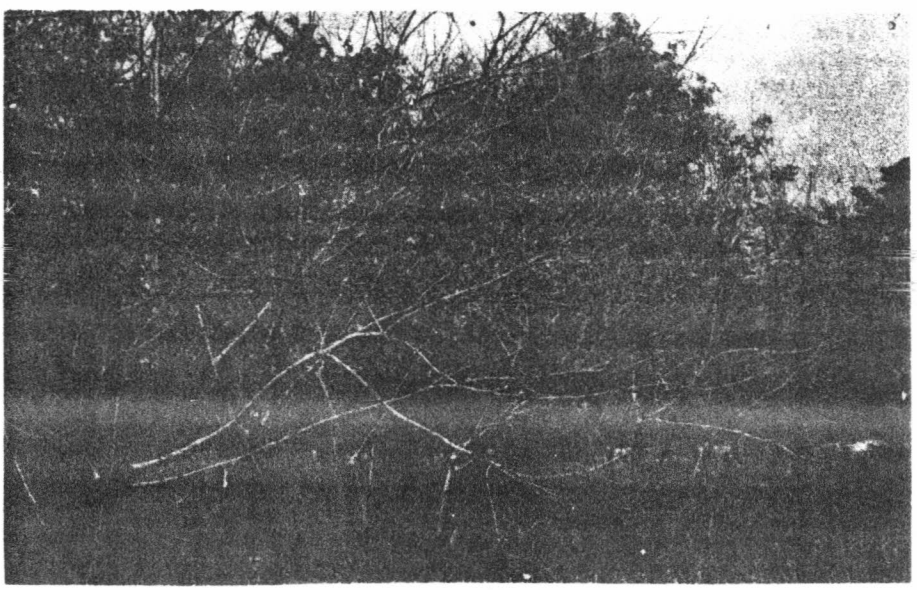

Fig. 1. Wilting of the guava plants after artificial inoculation with *Gliocladium roseum*

that the disease starts in the beginning of June, but the intensity of infection and the spread increase with the onset of monsoon. The highest wilting of guava trees is, however, restricted to September and October, beyond which the incidence reduces gradually. Suhag (47) also reported that soon after the rainy season, in September and October, the entire tree dries up within a period of 3 to 4 weeks. However, sometimes due to unknown reasons, the death of tree is slow and it takes 6 to 8 months for its complete collapse. Dwivedi *et al.* (14) found more pathogenic fungi during rainy and winter seasons surviving better in association with the root bits. Pattern of the spread was studied by Kumar and Sharma (25) and they concluded that the spread pattern was at random.

Mehta (32) reported that the severe incidence of wilt was due to *F. oxysporum* in alkaline soils at pH ranging from 7.5 to 9.0. However, Mehta (31) reported that the disease was more even in clay loam and sandy loam as compared to other soil types. Soil pH 6 was found to be optimum for the development of disease caused by *F. solani* and *M. phaseoli* (Chattopadhyaya and Bhattacharjee, 6).

VARIETAL REACTION

Varieties, White Guava No. 6,229, Clone 32-12, Webber, Popeno, Hart, Rolf Riverside, Safeda from Sri Lanka, Banarasi (Andhra strain), Dholka, Sindh and Nasik (Bombay strain) have been found to be tolerant to the wilt disease (Mathur and Jain, 28). Edward (16) reported that the cultivars like Chittidar, Hafsi, Safeda, Riverside, Rolf and Stone Acid were susceptible. Whereas, *Psidium cattleianum* var. *lucidium* and *Syzigium cuminii* were resistant to the wilt. *S. cuminii, P. molle, P. guineense,* Chinese guava (*P. friedrichsthalianum*) and Philippine guavas were found to be resistant to the wilt (Edward and Gaurishanker, 17). Allahabad Safeda was found fairly resistant to the combined infection of *F. solani* and *M. phaseoli* (Chattopadhyaya and Bhattacharjee, 6). Singh *et al.* (45) reported that under natural conditions Lucknow-49 was free from the wilt and Allahabad Safeda had the incidence of only four per cent Whereas, Karela and Behat Coconut were susceptible. None of the species, *P.araca, P. cattleianum, P. cattleianum* var. *lucidium, P. corecium, P. cujavillus, P. guineense* and *P. friedrichsthalianum,* developed the wilt infection. A local variety of the Taiwan, Pei-Pa has been reported to be resistant and *P. friedrichsthalianum* has been recommended as a possible rootstock (Leu and Kao, 26). The strawberry guava (*P. cattleianum*) was found relatively hardy and was recommended for the use as a rootstock in Reunion island (Normand, 36). Fan Relief, the most extensively cultivated guava variety of South Africa was observed highly susceptible to the wilt (Du Preez, 11). Relative field tolerance of 20 guava cultivars was recorded at the CISH, Lucknow. Of these, Chittidar, Portugal, Seedless, Spear Acid and Smooth Green were found to be tolerant, while Apple Colour and Red Flesh were moderately tolerant (Anonymous, 2).

CONTROL

Injection of 0.1 per cent water soluble 8-quinolinol sulphate was found to have chemotherapeutic action against the wilt pathogen (*F. oxysporum* f. sp. *psidii*). Injection of the apparently healthy guava plants in a diseased area with 0.1% of this chemical provided protection against the wilt for about one year. When injected into slightly wilted plants, it was beneficial for their partial recovery (Jain, 22). Mathur (27) advocated for the proper sanitation in the orchard to check the disease. Wilted trees should be uprooted, burnt and trench should be dug around the tree trunk. Edward (15) recommended that the pits may be treated with formalin and kept covered for about three days and then the transplanting should be done after two weeks. While transplanting, roots of the plants should not be damaged. Tree vigour should be maintained by

timely and adequately manuring, interculture and irrigation. Since, *P. cattleianum* var. *lucidium* and *Syzigium cuminii* seldom get attacked by the disease and there is interspecific and intergeneric graft compatibility, their use as the rootstocks could be an effective method for the control of wilt (Edward, 16). Both at Allahabad and Lucknow, the wilt was reported to be controlled by soil treatment with 1.82 kg lime or gypsum / tree (Mathur *et al.*, 29). Chattopadhyaya and Bhattacharjee (6) found that the disease symptoms did not appear under green manuring and the disease development was less, when organic sources of the nitrogen were used. Suhag (47) observed that it is possible to regenerate even the worst affected trees by severe pruning followed by drenching with 0.2 per cent either benlate or bavistin 4 times in a year and spraying twice with metasystox and zinc sulphate. Spread of the wilt could be checked by judicious amendments of N and Zn (Suhag and Khera, 48). Biocontrol agents *Trichoderma* sp. and *Streptomyces chibaensis* have been suggested for the control of wilt pathogens (Dwivedi, 13). Ansar *et al.* (3) found the control of guava wilt by combined use of the Topsin-M sprays and the antagonists *Trichoderma harzianum* and *Arachniotus* sp. added in the soil amended with wheat straw. At CISH, Lucknow wilt disease could be checked by application of 6 kg *neem* cake + 2 kg gypsum per plant (Misra and Pandey, 34).

SUMMARY

Several causal organisms and various factors mainly edaphic in nature, which are responsible for the wilt, have been reported from different parts of the world. This indicates that the disease is complex in nature and a single factor can not be solely attributed as its cause. At present, it is not feasible and economical to control the disease with the use of chemicals and soil amendments, as these are costly and easily degradable in the soil. Nevertheless, the cultural practices may be identified, which could control the disease upto certain extent. However, the practical and long lasting solution lies with the use of resistant rootstock / cultivar.

FUTURE THRUST AREAS OF RESEARCH

Different pathogens have been claimed by various workers in India and abroad for the cause of guava wilt. It is essential to establish, whether, one pathogen is solely responsible, or more than one pathogen or different pathogens in different areas are responsible for causing the disease.

Inoculation technique developed at the Central Institute for Subtropical Horticulture, Lucknow may be used immediately to screen all the available guava cultivars and *Psidium* sp. to identify the source(s) of resistance.

There is an urgent need for the introduction of *Psidium* species and allied genera from the exotic sources for their testing against the wilt and graft compatibility with commercial cultivars.

Breeding for wilt resistant rootstocks, by using the source of resistance from *Psidium* and / or allied genera, should be taken up.

Development of the wilt resistant scion varieties, of which self-rooted plants could be used for commercial cultivation.

Suitable economical and effective chemicals and soil amendment materials need to be identified to control the disease.

Suitable cultural practices, e.g. irrigation time, its method, tillage and intercultural practices should be identified, with which the disease could be kept below the threshold level.

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