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REVIEW PAPER

Management of Bacterial Canker in Acid Lime (*Citrus aurantifolia* Swingle) in Telangana – Review

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ABSTRACT

Acid lime (*Citrus aurantifolia* Swingle) is considered as one of the major revenue generating fruit crop for farmers in India. It is nutritionally rich and acts as good supplement of Vitamin C. Acid lime is facing many production constraints because of diseases especially bacterial canker. Severe infection with canker leads to effects like defoliation, reduced fruit quality and premature fruit drop. It results in considerable yield loss, loss in nutritional value leading to decline in market value. The causative agent of bacterial canker is *Xanthomonas citri*. The current review discusses on present status of the disease and its management by biological, chemical and integrated management methods.

Key words *Bacterial canker, Acid lime, Biological control, Chemical control, Integrated disease management*

Acid lime (*Citrus aurantifolia* Swingle) commonly known as sour lime, mexican lime is one of the important tropical fruit crop of India. It is more popular for its use in making of juice and pickles preparation. Pickles are popular not only in India but also other parts of the world. Economic importance of lime can be attributed to exportation of pickles to other countries like America, England. Nutritionally it is very important as it is good source of vitamin C and acts as good antioxidant (Kumar, *et al.,* 2011). The vitamin C in lime juice increases resistance to many diseases, eye health and play a major role in wound healing (Subha, 2014). The areas with moderate humidity and normal winds are more suitable for cultivation of acid lime. In terms of performance it shows good yield in frost free areas of Central and South India with rainfall not exceeding 750 mm per annum. In India acid lime is predominantly grown in Telangana, Andhra Pradesh, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh and Maharashtra. Among them Telangana in south India is the one of the leading producer of acid lime with an area of about 0.06 lakh ha, production of 0.77 lakh tons with productivity of 15120 Kg/ha in 2013 – 14 followed by Gujarat. Area under acid lime cultivation is increasing but simultaneously the incidence of various diseases is also proportionally increasing. Among all the diseases that pose challenge to production, bacterial canker is one of the most devastating. Knowledge on canker and its management has become mandatory by virtue of its severity. This review deals with the effect of bacterial canker on production of acid lime and control measures that should be adopted to increase the crop yield and maintain fruit quality in Telangana State.

Morphology

Acid lime grows up to 16 ft height with thorns all over resembling shrubs. Leaves are ovate ranging from 2 to 9 cm long resembling orange leaves. The flowers are 2 to 3 cm in diameter yellowish white with purple margins. Size and quality of harvest depends on the method of cultivation. It takes 3 to 4 years for the initial harvest and maximum yield is attained at 10 years of age (Lal, and Dayal, 2014).

Citrus canker (*Xanthomonas citri*)

Canker is caused by bacterium *Xanthomonas citri* and it occurs in large areas of the world. In India citrus canker is endemic and occurs in all the citrus growing areas (Dinesh *et al*., 2009). First record of citrus canker in India was from Punjab and subsequently from different citrus growing states (Kalita, *et al.*, 1995). It is also reported from Telangana, Andhra Pradesh, Gujarat, Tamil Nadu, Karnataka, Rajasthan, Madhya Pradesh and Assam. Damage by citrus leaf miner (CLM), *Phyllocnistis citrella* has been reported to increase citrus canker throughout the world (Hall, *et al.,* 2010). Das, *et al.,* (2012) studied the intensity parameters and concluded that along with citrus leaf miner other weather variables are responsible for disease severity.

Symptomology

Canker infections are usually seen on leaves, fruits, stem and twigs. Canker lesions initially start as small spots and attain a diameter of 2-8 mm. The size of the spot depends on type of cultivar and infection stage. On leaves they resemble blisters and develop a yellow halo around the edges. On fruits, infection causes premature fruit drop but sometimes mild infection is seen on top layer of fruit hence may be edible. Stems and twigs are usually not prone to infections and if infected for long duration it is seen as brown lesions.

Disease Management

The general effective method of controlling canker is eradication of the pathogen inoculums. All infected and suspected trees should be burnt and tools used for this purpose should be disinfected. Along with the above, use of disease-free nursery stock for planting in new orchards and pruning of the affected twigs in old orchards, eradication of diseased trees, prevention of importation and distribution of infected plants should be followed (Cubero, and Graham, 2002). Care is to be taken in selecting stock as no true resistant variety is being developed in acid lime.

Biological control of Bacterial canker

Literature on studies on the effect of biological agents on bacterial canker pathogen is less available. The use of

bacterial and fungal antagonists has recently been applied to control citrus canker (Heydari, *et al.*, 2004; Bora, and Bhagabati, 1996; Shahriari, *et al*., 2005). Khodakaramian, *et al.,* (2008) reported that *Pseudomonas* sp., were capable of reducing the incidence of bacterial canker disease significantly in vitro and in green house conditions. Das *et al*., (2014) observed that *Bacillus subtilis* effectively inhibited canker with single application.

Chemical control of Bacterial canker

The common way to control bacterial canker is by pruning of infected twigs followed by spraying of 1% Bordeaux mixture at regular intervals (Paracer, 1961). Another method to prevent canker infection is by giving preventive sprays of copper-based bactericides (Stall, and Seymour, 1983). Effectiveness of copper sprays depends on cultivar and weather conditions and in general 3 to 5 copper sprays are mandatory (Leite, and Mohan, 1990; Leite, 1990). Rangaswami, *et al.,* (1959) reported that spraying with 1000 ppm streptomycin sulphate was observed to be effective when sprayed with 1% glycerine. Balaraman and Purushotman (1981) observed that six sprays of 1000 ppm streptomycin sulphate reduced the canker to maximum extent. Khan, *et al*., (1992) studied the effect of application of streptomycine sulphate and Agrimycin-100 and the results showed the decrease in canker. Application of streptocycline and copper oxychloride (0.1%) at an interval of 15 days shows remarkable effect on canker pathogen (Kale *et al.,* 1994). Ghosh and Roy (2013) reported that spraying of streptocycline at concentration of 0.5 g/l followed by spraying of copper oxychloride at 0.25% concentration with 7 days interval showed maximum effect on canker disease. Other bactericides like cupravit, bavistin, dithane M-45 and vitavax were also proved to be more effective (Sahi, *et al.,* 2007) along with streptocycline and Agrimycin-100. Zhang, *et al*., (2013) studied the effectiveness of new bactericide copper gluconate with copper hydroxide and DT (combination of copper succinate, copper glutarate and copper adipate) as standards in vitro and in vivo conditions. Results showed that copper gluconate showed its toxicity on pathogen on par with the standards used. Spraying of insecticides also lead to the lessening of canker incidence since damage due to insects promotes canker infection (Das, 2003).

Integrated Disease Management of Bacterial canker

Integration of management practices like use of disease free plants sprays with antibiotics and insecticides for leaf miner control should be followed for basic control of canker (Sharma, and Sharma, 2009). Combination of pruning of infected twigs, application of fungicide (copper oxychloride (0.3%)), bactericide (streptocycline (100 ppm)) and neem cake was found very effective in controlling the disease (Das and Singh, 2000). Mustafa, *et al.,* (2015) studied the efficacy of plant extracts together with the pesticide and bactericide under field conditions. Plant extracts used were *Withania somnifera* (Aksin), *Achyranthus aspera* (Akk) and antibiotic (Agrimycin-100). They concluded that plant extracts individually showed less effect while the combination of plant extracts and pesticide showed high impact in controlling the disease compared to control. Khan, *et al.,* (2003) showed that the combined application of streptomycin sulphate and garlic extract (1%) reduced the disease to 51.3% when compared to control. Mosses and Chandramohan (1993) also found that crude plant extracts like neem oil, neem leaf and garlic extracts showed effect on canker pathogen. Mohammed, *et al*., (2016) showed that integration of *P.fluorescens* and salicylic acid play a major role in the management of canker disease.

LITERATURE CITED

Balaraman, K. and Purushotman, R. 1981. Control of citrus canker on acid lime. *South Indian Horticulture,* **29**: 175-177.

Bora, P.K.L. and Bhagabati, K.N. 1996. Phylloplane micriflora of citrus and their role in management of citrus canker. *Indian Phytopathology*, **49**: 234-237.

Cubero, J. and Graham, J.H. 2002. Genetic relationship among worldwide strains of *Xanthomonas* causing canker in citrus species and design of new primers for their identification by PCR. *Applied Environmental Microbiology*, **68**: 1257-1264.

Das, A.K. 2003. Citrus canker – A review. *Journal of Applied Horticulture,* **5**(1):52-60.

Das, R, Mondal, B, Mondal, P, Khatua, D. C. and Mukherjee, N. 2014. Biological management of citrus canker on acid lime through *Bacillus subtilis* (S-12) in West Bengal. *Indian Journal of Biopesticides,* **7**(supp):38-41.

Das, A.K. and Singh, S. 2000. Management of Acid lime canker by using chemicals with compatible cultural practices. Hi-tech Citrus Management – Proc. Intn. Symp. Citric., Nov. 23-27, 1999, Nagpur, Maharashtra (S.P. Ghosh and Shyam Singh, Eds.) pp. 1054-1056.

Das, R, Mondal, B, Mondal, P, Khatua, D.C. and Mukherjee, N. 2012. Disease intensity of citrus canker on acid lime in relation to abiotic and biotic factors. *Journal of Agrometeorology*, **14** (Spl.): 107-112.

Dinesh, D, Chiranjivi, R. and Basnyat, S.R. 2009. Etiology and Control of Citrus Canker Disease in Kavre. *Nepal Journal of Science and Technology*, **10:** 57-61.

Ghosh, S. N. and Roy, S. 2013 Management of canker and scab in acid lime for better yield and plant health. *Environment and Ecology*, **31**: 772-774.

Hall, D.G, Gottwald, T.R. and Bock, C.H. 2010. Exacerbation of Citrus Canker by Citrus leafminer *Phyllocnistis citrella* in Florida**.** *Florida Entomologist*, **93**(4): 558 – 566.

Heydari, A, Fattahi, H, Zamanizadeh, H.R, Zadeh, N.H. and Naraghi, L. 2004. Investigation on the possibility of using bacterial antagonists for biological control of cotton seedling damping-off in greenhouse. *Applied Entomology and Phytopathology*, **72**: 51-68.

Kale, K.B, Kolte, S.O. and Peshney, N.L.1994. Economics of chemical control of citrus canker caused by *Xanthomonas campestris* pv *citri* under field conditions. *Indian Phytopathology,* **47**: 253-255.

Kalita, P, Bora, L.C. and Bhagabati, K.N. 1995. Influence of environmental parameters on citrus canker incidence in Assam. *Journal of Agricultural Science,* **8**(1): 33-35.

Khan, M.A, Iqram, F. and Rashid, A. 2003. Comparative efficacy of streptomycin sulphate and garlic extract *Xanthomonas campestris pv. Citri* (Hasse) dye *in vitro* and on the control of citrus canker in green house. *Pakistan Journal of botany,* **35:** 987 – 991.

Khan, I.A, Jaskani, M.J. and Ali, S.N.H. 1992. Breeding for seedless Kinnow, a Progress Report. In: Proceed. 1st Inter. Sem.

Citriculture in Pakistan. Dec. 2-5. University of Agriculture Faisalabad. pp: 103-55.

Khodakaramian, Gh, Heydari, A. and Balestra, G.M. 2008. Evaluation of *Pseudomonads* Bacterial Isolates in Biological Control of Citrus Bacterial Canker Disease. *International Journal of Agricultural Research,* **3**: 268-272.

Kumar, M, Parthiban, S, Saraladevi, D. and Aruna, P. 2011. Evaluation of acid lime (*Citrus aurantifolia* Swingle) cultivars for yield attributes. *The Asian Journal of Horticulture* **6** (2): 442 – 444.

Lal, G. and Dayal, H. 2014. Effect of integrated nutrient management on yield and quality of Acid Lime (*Citrus aurantifolia* Swingle). *African Journal of Agricultural Research,* **9**(40): 2985 – 2991.

Leite, Jr, R. P. and Mohan, S. K. 1990. Integrated management of the citrus bacterial canker disease caused by *Xanthomonas campestris* pv. *citri* in the State of Paraná, Brazil. *Crop Protection,* **9**:3-7.

Leite, Jr., R. P. 1990. Citrus canker: Prevention and control in the state of Parana. Fundacao IAPAR, Circular Instituto Agronomico do Paraná. No. 61.

Mohammed, A, Al-Saleh, Amgad, A, Saleh. And Ibrahim, Y.M. 2016. Integration of *Pseudomonas fluorescens* and salicylic acid improves citrus canker disease management caused by *Xanthomonas citri sp citri-A. Archives of Phytopathology and Plant Protection,* **88**: 745 – 750.

Moses, G.J. and Chandramohan, B. 1993. Potential of neem and other plant extract for management of crop diseases: Neem for the management of crop diseases (V. Mariappan Ed.). Associative Pub. Co., New Delhi. 91- 97 p.

Mustafa, M, Imran, M, Azeem, M, Riaz. and Afzal, A.M. 2015. Commercial citrus cultivars resistance evaluation and management to canker disease. *International Journal of Agronomy and Agricultural Research,* **6**: 1-9.

Paracer, C.S. 1961. Some important diseases of fruit trees. *Punjab Horticulture Journal,* **1**(1): 45-47.

Rangaswami, G, Rao, R.R. and Lakshaman, A.R. 1959. Studies on control of citrus canker with streptomycin. *Phytopathology,* **49**: 224-226.

Sahi, S. T, Ghazanfar, M. U, Afzal, M, Rashed, A. and Habib, A. 2007. Incidence of citrus canker disease caused by *Xanthomonas campestris* pv. *citri* (hasse) dows on kinnow (*Citrus reticulata*) and its chemotherapy. *Pakistan Journal of Botany*, **39**(4): 1319-1327.

Shahriari, F, Khodakaramian, Gh. and Heydari, A. 2005. Assessment of antagonistic activity of *Pseudomonas fluorescens* biovars toward *Pectobacterium carotovorum* sp. *atrosepticum*. *Journal of Science Technology Agriculture Natural Resource*, **8**: 201-211.

Sharma, S.K. and Sharma, R.R. 2008. Citrus canker approaching century – a review. *Tree and forestry science biotechnology*. Global science books, 54 – 65.

Stall, R. E. and Seymour, C. P. 1983. Canker: A threat to citrus in the Gulf Coast states. *Plant Disease*, **67**: 581-585.

Subha, G 2014. Health Benefits of Lime: A Review. *Asian Journal of Chemical and Pharmaceutical Research,* **2**(1): 94-95.

Zhang, Y, Mao, R, Zheng, J, Xiao, Y, Tang, M. and Quan, J. 2013. Laboratory bioassay and field evaluation of copper gluconate as a new potential bactericide against *Xanthomonas campestris pv citri* (Hasse) Dye. *Journal of Agricultural Science,* **5**(12): 23-29.

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