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Management of Citrus Bacterial Canker Disease (CBCD) through chemicals and plant extracts on Acid lime (*Citrus aurantifolia*)

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Citrus Bacterial Canker Disease (CBCD) caused by *Xanthomonas axonopodis* pv. *citri* (*Xac*) has became a serious concern specially on Acid limes in recent years in different citrus growing areas in West Bengal. The disease caused severe loss in fruit quality and yield under favourable weather condition. The present experiments were thus carried out on 5-6 year old Acid lime (*Citrus aurantifolia)* plants at Horticulture Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia,West Bengal during 2010 and 2011 to find out the efficacy of different antibiotics and plant extracts for the management of Citrus Canker Disease under field condition. Four antibiotics and one fungicide namely Streptomycin (100 ppm), chloramphenicol (100 ppm), streptocycline (100 ppm), tetracycline (100 ppm) and copper oxychloride (3 g/l) and some plant extracts viz. karanj oil (*Pongamia pinata*) @ 3 ml/l, neem oil (*Azadirachta indica)* @ 3 ml/l, turmeric powder(*Curcuma longa)* @ 5 g/l , zinger paste (*Zingiber officinale*) @ 50,000 ppm and garlic paste (*Allium sativum*) @ 50,000 ppm were used as spray. Results obtained from two years data (2010 &2011 & Pooled mean) showed that all the chemicals and plant extracts with their respective doses significantly reduced the disease severity as compared to control (water spray). Two years (2010 & 2011) pooled mean data showed that minimum disease severity (5.34%) was noticed in the orchards through spraying with streptocyline after pruning followed by spraying with streptocycline (100 ppm) + copper oxychloride mixture (7.78%) and spraying with copper oxychloride(3 g/l) after pruning (10.10%). Karanj oil, neem oil, turmeric powder, garlic and ginger paste also showed superiority in reducing the Bacterial Canker Disease severity over control. Though chemicals were found better than plant extracts in reducing disease severity but plant extracts would not harm the environment. The results therefore concluded that application of streptomycin (100 ppm) after pruning of plants gave maximum disease reduction and recommended for farmer's practice.

Key words: Citrus canker, *Xanthomonas axonopodis* pv. *citri* (*Xac*), management, chemical, plant extracts, Acid lime *(Citrus aurantifolia).*

INTRODUCTION

Citrus canker is one of the most feared disease of citrus, affecting all types of important citrus crops but more severe on Acid lime (*Citrus aurantifolia*) and caused by *Xanthomonas axonopodis* pv. *citri* (*Xac*) which is a widespread disease in citrus-producing areas of the tropics and subtropics. Citrus is native to a large area, which extends from Himalayan foot hills of North East India to North Central China, the Philippines in East and Burma, Thailand, Indonesia and New Caledonia in Southeast (Das, 2003). In India, in terms of area under cultivation, citrus is the third largest fruit industry after

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banana and mango. The area and production under citrus cultivation in India are 987.3 thousand hectare and 9638.0 thousand metric tons respectively with an average productivity of 9.8 tons per hectare, (Indian Horticulture Database, 2010). Citrus canker was first reported from Punjab (Luthra and Sattar, 1942; Bedi, 1961). In West Bengal citrus occupies an area of 11.3 thousand hectare with a production of 100.9 thousand metric tons, (Indian Horticulture Database, 2010). Among the commercial cultivars, Acid lime (*C. aurantifolia*) is the most susceptible one and up to 50-60% yield reduction has been reported (Das, 2003). Crater-like lesions with a raised margin and sunken centre surrounded by a yellow halo characterize the disease (Graham *et al.*, 2004). In severe infection disease produces a variety of effects including defoliation, dieback, severely blemished fruit, reduced fruit quality and premature fruit drop. Warm, humid, cloudy weather, along with heavy rainfall and strong wind promote the disease. In countries where canker is present, integrated systems of compatible cultural practices and phytosanitary measures consisting of resistant hosts, removal of inoculums sources, properly designed windbreak systems, timely application of protective copper-containing and antibiotic sprays are generally the most effective means of disease management (Das, 2003). Using copper-based bactericides is a standard method to control Citrus Bacterial Canker Disease worldwide (Leite and Mohan, 1990). Plant essential oils and extracts are of interest as an alternative source of natural pesticide for the control of plant pests and diseases (Omidbeygi *et al.*, 2007). For the management of citrus canker the generally pruning, spraying of chemicals and antibiotics were recommended. Since the disease depends much upon its secondary spread through mechanical contacts in stormy weather as also infestation with some insects acting as vectors, thus the trials have been tried with the aim of finding a suitable method of using chemicals and plant extracts for the management of Citrus Bacterial Canker Disease under field condition.

MATERIALS AND METHODS

Chemical compounds used

Four antibiotics and one fungicide namely streptomycin (100 ppm), chloramphenicol (100 ppm), streptocycline (100 ppm), tetracycline (100 ppm) and copper oxychloride (3 g/l) and some plant extracts viz. karanj oil (*Pongamia pinata*) @ 3 ml/l, neem oil (*Azadirachta indica)* @ 3 ml/l, turmeric powder(*Curcuma longa)* @ 5 g/l, zinger paste (*Zingiber officinale*) @50,000 ppm and garlic paste (*Allium sativum*) @ 50,000 ppm were used as spray.

Preparation of plant extracts

For preparation of garlic and zinger paste each of peeled 50 g of ginger and garlic rhizome were macerated in 100 ml of distilled water and a slurry was prepared and sieved through muslin cloth. This was diluted at 10 times in water and used for spray.

Disease observation and estimation of disease severity in the field

Disease observations were made at weekly interval based on fixed plot survey in the experimental citrus orchard. Four branches of randomly selected ten plants at different direction (N-E-W-S) were selected to record the disease intensity using (0-5 scale) described below.

Grade	% of disease infection
0	0
1	1-10 % leaf area infected
2	11-20% leaf area infected
3	21-40% leaf area infected
4	41-60% leaf area infected
5	61-?80% leaf area infected

PDI **(%)** was calculated by using the following formula :

$$PDI = \frac{\text{Summation of numerical ratings}}{\text{Total number of leaf observed} \times \text{Maximum rating}} \times 100$$

The pruning was imposed in January month. First spraying was done at June-July, 2010 followed by another spray at 15 days interval. The experiment was again repeated during June– July, 2011.

Statistical analysis

Randomized Block Design (RBD) was followed with

four replications for each treatment including control in both years.

RESULTS AND DISCUSSION

Results presented in Table 1 revealed that all the treatments reduced the disease severity of Citrus Bacterial Canker Disease (CBCD) over untreated control. Treatments also showed differences in their efficacy in controlling the citrus canker disease. Lowest disease severity (4.36% & 6.32%) was recorded when spraying with streptocycline (100 ppm) was applied after pruning in both 2010 and 2011. The order of disease severity obtained with combined application with streptocycline @ 100 ppm + copper oxychloride @ 0.3% (6.35% & 9.21%) and pruning + spraying of copper oxychloride (0.3%) (8.25% and 12.07%) during 2010 and 2011 respectively. Steptromycin sulphate, (9.56% & 13.86%), chloramphenicol (9.86% & 14.30%), tetracycline (10.40% & 15.08%) and copper oxychloride (11.26% & 16.32%) at their respective doses also showed good efficacy in reducing disease severity of CBCD over control treatment (39.48% & 57.25%) during 2010-2011. Use of different plant extracts at the selected concentrations and simple pruning practice also showed promising results in reducing disease severity of CBCD over the control treatment. Among them spraying with turmaric powder (14.22% & 18.61%) showed good efficacy followed by garlic paste (15.04% & 19.12%), neem oil (18.05% & 22.17%), removal of canker affected plant parts by pruning (19.27% & 24.04%), ginger paste(19.56% & 25.36%) and karanj oil (20.20% & 26.23%), respectively in both 2010 & 2011. Combined treatments either with antibiotics + fungicide or pruning + antibiotics/fungicide exhibited better results than spraying of antibiotics/fungicide /plant extracts and single pruning practices alone in reducing the CBCD severity. The similar trend was observed during the entire two spray schedule in 2010 & 2011. Results obtained from two years (2010 & 2011) data revealed that treatments are statistically significant .The best results(5.34% pooled) in reducing CBCD was recorded by pruning followed by spraying with streptocyline over control (48.37%) and it statistically differed with other treatments. The effects of tetracycline & streptomycine, and turmeric & garlic in reducing the disease load of CBCD are at par. Koizumi *et al.* (1996) reported that control measures developed in Japan included windbreaks or pruning of diseased summer and autumn shoots, forecasting and chemical sprays. Das and Singh (2001) pointed out that pruning of all the infected twigs before monsoon followed by burning and periodical spraying with suitable copper-based bactericides was effective to reduce inoculums build-up on new flushes and on expanding fruit surfaces. Sahi *et al.* (2007) observed that among the different chemicals tested, Agrimycin –100, cupravit, bavistin, dithane M-45 and vitavax proved more effective against multiplication of *Xanthomonas campestris* pv. *citri*. Kale *et al.* (1994) found that foliar spray with combined chemicals of streptocycline-100 ppm + copper oxychloride (0.1%) against *Xanthomonas campestris* pv. *citri* on 6 years old Kagzi lime at an intervals of 7 or 15 days resulted the most cost effective chemical control for citrus canker disease in Maharastra , India. Reddy and Rao, (1960) reported that application of neem cake solution to the foliage reduced CBC in nurseries. Vudhivanic (2003) observed that different types of Thai herbal extracted by 95% ethyl alcohol at 100,000 ppm concentration were tested by paper disc diffusion method on double layered NGA against *X. axonopodis* pv. *citri*.. Guava leaf, beleric myrobalan fruit, pomegranate fruit peel, nut gall fruit and myrobalan wood fruit had more pronounced effect on the inhibition of bacteria, on culture media. Manonmani *et al.* (2009) used some selected herbal exracts *viz., Acalypha indica, Achyranthes aspera, Aloe vera, Azadirachta indica, Datura metal, Hibiscus rosasinensis, Nerium oleander, Ocimum sanctum,* O. *basilicum, Phyllanthus emblica, Polyalthia longifolia, Piper betle, Punica granatum, Solanum torvum* and *Solanum trilobatum in vitor* against the growth of citrus canker disease causing pathogen, *Xanthomonas axonopodis* pv. *citri (Xac).* The leaf extract of *P. longifolia* followed by *A. aspera* recorded the maximum growth inhibition of 9.77mm and 8.47mm diameter respectively. .

The above mentioned findings confirmed the results as done in the present experiments. Thus, from the present findings it may be concluded that streptocycline after pruning or sprying in combination with copper oxychloride was found to be effective in reducing the citrus bacterial canker pathogen on Acid lime (*Citrus aurantifolia*) under field condition in the Gangetic plains of West Bengal.

Table 1: Effect of chemical and plant extract for the management of citrus canker (*Xanthomonas axonopoidis* pv. *citri*) disease

	Treatments	Pooled Disease Severity (PDI %) of *Xac* on leaves of acid lime		Pooled
		2010	2011	
T_1	Pruning of canker affected plant parts only	19.27 (26.04)**	24.04* (29.33)	21.66 (27.68)
T_2	Pruning +spraying with copper oxychloride(3 g/L)	8.25 (16.68)	12.07 (20.32)	10.16 (18.50)
T_3	Pruning +spraying with streptocycline(100 ppm)	4.36 (12.02)	6.32 (14.55)	5.34 (13.28)
T_4	Streptocycline(100 ppm)+ Cu oxychloride(3 g/L)	6.35 (14.58)	9.21 (17.63)	7.78 (16.10)
T_5	Spraying with Chloramphenical (100 ppm)	9.86 (18.29)	14.3 (22.21)	12.08 (20.25)
T_6	Spraying with Tetracycline (100 ppm)	10.4 (18.80)	15.08 (22.85)	12.74 (20.83)
T_7	Spraying with Streptomycine (100 ppm)	9.56 (18.00)	13.86 (21.85)	11.71 (19.93)
T_8	Spraying with Cu-oxychloride(3 g/L)	11.26 (19.60)	16.32 (23.82)	13.79 (21.71)
T_9	Spraying with Karanj oil(3 ml/L)	20.2 (26.70)	26.23 (30.81)	23.22 (28.76)
T_{10}	Spraying with Neem oil (3 ml/L)	18.05 (25.74)	22.17 (28.09)	20.11 (26.61)
T_{11}	Spraying with Turmaric powder (5,000 ppm)	14.22 (22.15)	18.61 (25.55)	16.42 (23.85)
T_{12}	Spraying with Garlic paste(50,000 ppm)	15.04 (22.81)	19.12 (25.93)	17.08 (24.37)
T_{13}	Spraying with Ginger paste(50,000 ppm)	19.56 (26.23)	25.36 (30.24)	22.46 (28.23)
T_{14}	Control (Water spray)	39.48 (38.93)	57.25 (49.17)	48.37 (44.05)
	CV(%)	6.18	6.50	6.47
	SEm (+)	0.454	0.65	0.397
	CD At 5%	1.299	1.859	1.118

* Average of 4 replications, ** Figure in the parenthesis indicates angular transform value

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