

## Original Research Article

### *In Vitro* Management of Kagzi Lime Bacterial Canker Caused by *Xanthomonas axonopodis* pv. *citri*

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#### ABSTRACT

##### Keywords

Kagzi lime,  
Bacterial  
canker, PDI,  
*Xanthomonas*  
*citri* pv. *citri*,  
Integrated  
management

Three antibiotics, three antibacterial fungicides and three botanicals were used for the management of bacterial canker disease of kagzi lime caused by *Xanthomonas axonopodis* pv. *citri*. (Pot culture). In these antibiotics, streptomycin was found most effective with lowest PDI mean 33.77 per cent. The second and third best control recorded was mancozeb and plantomycin 60 which recorded comparatively minimum disease incidence 34.88 and 38.33 per cent respectively.

## Introduction

Citrus bacterial canker (CBC), caused by *Xanthomonas citri* sub sp. *citri* is one of the most devastating diseases throughout the world that affects many kind of commercial citrus varieties. The origin of CBC is known but thought to have originated from south-east Asia or India and then widely distributed around the world (Civerolo 1984; Verniere *et al.*, 1998). All young, above ground tissues of citrus are susceptible to *Xanthomonas axonopodis*. In fact, bacterial pathogens infects into the plant tissues through natural openings (stomata) and mechanical injuries (wounds). Kagzi lime (*Citrus aurantiifolia*) is grown in many regions of India covering an area of 286.4 mha with annual production of 2835 metric tons and productivity of 9.9 tons/ha (NHB, 2013-14). In Maharashtra, area under Kagzi

lime were 45 million ha., Production and Productivity of Kagzi lime were, 306 metric tons and 6.8 tons / ha, respectively during 2013-14 (Anonymous, 2014).

## Materials and Methods

A total of 10 treatments comprising most effective (based on plate culture studies) antibiotics (@ 500ppm), fungicides (@ 300 ppm), and botanicals (@ 20%) were attempted (alone) for the integrate management of bacterial canker of kagzi lime caused by *Xanthomonas axonopodis* pv. *citri*. The earthen pots (60 cm dia.) filled with potting mixture of soil: sand: FYM (2:1:1) planted with kagzi lime seedlings were used. One year old seedlings with uniform vigour and stem diameter

(approximately 1 cm) was cut back to allow one dominant shoot to develop. Four leaves per plant as well as four areas per leaf were selected for puncturing (pin prick method). In each area, 20 wounds were made and the upper leaf surfaces immediately sprayed with mixture of *Xac* strains. Inoculated seedlings immediately covered with plastic bags for 48 hrs and were maintained. Per cent incidence and severity was recorded before spraying. After that each of five plants were sprayed with ca.  $20 \pm 5$  ml of one of the treatments. After 14 days, per cent disease incidence and severity was recorded (Graham and Leite, 2004).

Second spraying was done at 15th day and observations were recorded after 14 days. The experiment was carried out in completely randomized design with 10 treatments and 3 replicates with two spraying. One of the treatments including five seedlings inoculated with bacterial suspension as positive control. Five seedlings will be sprayed only with sterile distilled water as negative control (Samavi *et al.*, 2009).

## Results and Discussion

The result recorded on per cent incidence and percent severity is presented in (Table 1 and 2).

### Disease incidence

Results (Table 1) indicated that the all antibiotics, fungicides and botanicals tested (pot culture) against *X. axonopodis* pv. *citri* significantly reduces the disease incidence after first and second spraying over control (untreated).

However, antibiotics streptomycin was found most effective with lowest PDI mean 33.77 per cent. The second and third best control recorded was mancozeb and

plantomycin which receded comparatively minimum disease incidence 34.88 and 38.33 per cent respectively. Another treatments in order of merit found effective were Bordeaux mixture (PDI 41.33), Cyamoxanil + Mancozeb (PDI 40.88), 2-Bromo-2 Nitro propane-1,3-diol (PDI 44.00), *Z. officinal* (PDI 44.00), *A. sativum* (PDI 46.66), *A. indica* (PDI 51.22) recorded significantly minimum per cent disease incidence over unsprayed i.e. control (PDI 58.44).

Per cent disease control (PDC) achieved after two spraying in all treatments over respective unsprayed i.e. control is presented in table 1. Similar trend as that of percent disease incidence was observed (Table 1). After first and second spraying significantly maximum disease control achieved from 10.13 to 36.28 per cent and 24.78 to 68.77 per cent, respectively.

However maximum disease control was achieved with antibiotic streptomycin 36.28 and 67.88 per cent after first and second spraying, respectively these was followed by mancozeb (35.62 and 61.19), plantomycin (32.68 and 50.65), Bordeaux mixture (20.206 and 54.77), Cyamoxanil + Mancozeb (28.46 and 45.05), 2-Bromo-2 Nitro propane-1, 3-diol (21.89 and 45.05), *Z. officinal* (21.65 and 44.08), *A. sativum* (21.86 and 35.47)

Mean per cent disease control (PDC) achieved with all the treatment (Table 1) ranged from 17.45 to 52.59 per cent. However highest mean disease control of 52.69 was recorded with streptomycin followed by Mancozeb (48.40), Plantomycin (41.059), Bordeaux mixture (38.25), Cyamoxanil + Mancozeb (36.75), 2-Bromo-2 Nitro propane-1,3-diol (33.49), *Z. officinale* (32.86), *A. sativum* (28.66). The lowest per cent disease control was achieved with *A. indica* i.e. 17.45.

**Table.1** Effect of various treatments on bacterial canker disease incidence on kagzi lime

Treatments	PDI* before spraying	PDI* after spraying		Mean PDI	PDC* after spraying		Mean PDC
		First	Second		First	Second	
Sreptocycline @ 500 ppm	45.33 <b>(42.32)</b>	36.67 <b>(37.25)</b>	19.33 <b>(26.07)</b>	33.77	36.28 <b>(37.02)</b>	68.77 <b>(56.04)</b>	52.69
Mancozeb 75WP @ 3000 ppm	43.33 <b>(41.16)</b>	37.33 <b>(37.26)</b>	24.00 <b>(29.32)</b>	34.88	35.62 <b>(36.63)</b>	61.19 <b>(51.48)</b>	48.40
Plantomycin @ 500 ppm	45.33 <b>(42.31)</b>	39.00 <b>(38.64)</b>	30.67 <b>(33.61)</b>	38.33	32.68 <b>(24.84)</b>	50.50 <b>(45.28)</b>	41.59
Bordeaux mixture @ 3000 ppm	50.67 <b>(45.34)</b>	45.33 <b>(42.31)</b>	28.00 <b>(31.93)</b>	41.33	20.06 <b>(26.48)</b>	54.77 <b>(47.74)</b>	38.25
Cyamoxanil 8% WP +Mancozeb 64% WP @ 3000 ppm	47.33 <b>(43.46)</b>	41.33 <b>(40.04)</b>	34.00 <b>(35.66)</b>	40.88	28.46 <b>(32.32)</b>	45.05 <b>(42.15)</b>	36.75
2-Bromo-2 Nitro propane- 1,3-diol @ 500 ppm	52.67 <b>(46.53)</b>	45.33 <b>(42.31)</b>	34.00 <b>(35.66)</b>	44.00	21.89 <b>(27.81)</b>	45.09 <b>(42.17)</b>	33.49
Ginger ( <i>Z. officinale</i> ) (20%)	52.00 <b>(46.14)</b>	45.33 <b>(42.31)</b>	34.67 <b>(36.06)</b>	44.00	21.65 <b>(27.72)</b>	44.08 <b>(41.59)</b>	32.86
Neem leaf ( <i>A. indica</i> ) (20%)	54.67 <b>(47.67)</b>	52.33 <b>(46.33)</b>	46.67 <b>(43.08)</b>	51.22	10.13 <b>(18.43)</b>	24.78 <b>(29.84)</b>	17.45
Garlic ( <i>A. sativum</i> ) (20%)	48.67 <b>(44.23)</b>	45.33 <b>(42.31)</b>	40.00 <b>(39.22)</b>	46.66	21.86 <b>(27.80)</b>	35.47 <b>(36.54)</b>	28.66
Control(untreated)	55.33 <b>(48.06)</b>	58.00 <b>(49.60)</b>	62.00 <b>(51.94)</b>	58.44	0.00	0.00	-
<b>S.E. ±</b>	<b>1.78</b>	<b>1.55</b>	<b>1.39</b>		<b>1.71</b>	<b>1.98</b>	-
<b>C.D. (P=0.01)</b>	<b>4.13</b>	<b>3.73</b>	<b>3.38</b>		<b>4.92</b>	<b>4.66</b>	-

\*Mean of three replications,

\*Figures in Parenthesis are arcsine transformed values

PDI: - Percent Disease incidence

PDC: - Percent Disease Control

**Table.2** Effect of various treatments on bacterial canker disease intensity on kagzi lime

Treatment	PDI* before spraying	PDI* after spraying		Mean PDI	PDC* after spraying		Mean PDC
		First	Second		First	Second	
Sreptocycline @ 500 ppm	21.55 (27.64)	18.29 (25.27)	10.66 (19.02)	16.83	37.35 (37.65)	67.49 (55.27)	52.42
Mancozeb @ 3000 ppm	23.89 (29.24)	19.22 (25.96)	13.08 (21.13)	18.53	33.92 (35.58)	60.19 (50.90)	47.05
Plantomycin @ 500 ppm	26.22 (30.79)	20.11 (26.85)	12.33 (20.52)	19.55	30.22 (33.33)	61.07 (51.00)	45.64
Bordeaux mixture	22.22 (28.10)	19.22 (25.96)	14.55 (22.35)	18.66	34.08 (36.11)	55.01 (47.87)	44.54
Cyamoxanil 8% WP + Mancozeb 64% WP @ 3000 ppm	22.22 (28.10)	19.33 (26.06)	16.33 (23.82)	19.29	33.44 (35.31)	49.98 (44.98)	41.71
2-Bromo-2 Nitro propane-1,3-diol @ 500 ppm	24.11 (29.40)	20.19 (26.59)	17.22 (24.51)	20.50	29.66 (32.92)	46.90 (43.19)	38.28
Ginger ( <i>Z. officinale</i> ) (20%)	23.77 (29.14)	21.51 (27.59)	18.44 (25.38)	21.24	25.88 (30.50)	43.65 (41.34)	34.76
Neem leaf ( <i>A. indica</i> ) (20%)	23.88 (29.23)	23.22 (28.78)	20.88 (27.17)	22.66	19.98 (26.50)	34.87 (36.17)	27.42
Garlic ( <i>A. sativum</i> ) (20%)	27.78 (31.80)	22.63 (28.36)	20.44 (26.84)	23.61	22.15 (28.05)	37.88 (37.97)	30.05
Control(Untreated)	26.11 (30.72)	29.00 (32.57)	32.66 (34.84)	29.25	0.00	0.00	
<b>S.E. ±</b>	1.17	1.38	1.32		1.86	1.80	
<b>C.D. (P=0.01)</b>	3.45	4.03	4.09		4.75	4.32	

\*Mean of three replications,

\*Figures in Parenthesis are arcsine transformed values

PDI: - Percent Disease intensity

PDC: - Percent Disease Control

### Disease intensity

Results (Table 2) indicated that the all antibiotics, fungicides and botanicals tested (pot culture) against *X. axonopodis* pv. *Citri* significantly reduces the disease intensity after first and second spraying over control (untreated). However, antibiotics streptocycline was found most effective with lowest PDI mean 16.83 per cent. The second and third best controls recorded were mancozeb and Bordeaux mixture which receded comparatively minimum disease incidence 18.53 and 18.66 per cent

respectively. Another treatments in order of merit found effective were Cyamoxanil + Mancozeb (PDI 19.29), Plantomycin (PDI 19.55), 2-Bromo-2 Nitro propane-1, 3-diol (PDI 20.50), *Z. officinal* (PDI 21.24), *A. sativum* (PDI 20.66), *A. indica* (PDI 23.61) recorded significantly minimum per cent disease incidence over unsprayed i.e. control (PDI 29.25).

Per cent disease control (PDC) achieved after two spraying in all treatments over respective unsprayed i.e. control is presented in table 2. Similar trend as that of percent disease

intensity was observed (Table 2). After first and second spraying significantly maximum disease control achieved from 19.98 to 37.35 per cent and 34.47 to 67.49 per cent, respectively. However maximum disease control was achieved with streptomycin 37.35 and 67.49 per cent after first and second spraying, respectively these was followed by Mancozeb (33.92 and 60.19), Plantomycin (30.22 and 61.09), Bordeaux mixture (34.0 and 55.01), Cyamoxanil + Mancozeb (33.34 and 49.98), 2-Bromo-2 Nitro propane-1, 3-diol (29.66 and 46.90), *Z. officinal* (25.88 and 43.65), *A. Sativum* (22.15 and 37.88).

Mean per cent disease control (PDC) achieved with all the treatment (Table 2) ranged from 27.42 to 52.42 per cent. However highest mean disease control of 52.42 was recorded with streptomycin followed by Mancozeb (47.05), Plantomycin (45.64), Bordeaux mixture (44.64), Cyamoxanil + Mancozeb (41.71), 2-Bromo-2 Nitro propane-1,3-diol (38.28), *Z. officinale* (34.76), *A. Sativum* (30.05). The lowest per cent disease control was achieved with *A. Indica i.e.* (27.42). These results obtained in present study are in accordance with the reports of many earlier workers. Sahi *et al.*, (2007) reported that the toxicants Streptomycin sulphate, Dithane M-45 at 0.2% was proved to be effective in reducing the disease intensity as compared to inoculated control. Similar results were also reported earlier by many workers (Shahid *et al.*, 2005; Giri *et al.*, 2008; Dhakal *et al.*, 2009).

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