

EFFICACY OF FIVE FUNGICIDES, THREE PLANT EXTRACTS AND A BIOAGENT IN CONTROLLING DIE BACK OF CITRUS CAUSED BY *COLLETOTRICHUM GLOESPORIOIDES*

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ABSTRACT

An investigation was undertaken to find out the effect of five fungicides, three plant extracts and a bioagent on the incidence and severity of dieback of citrus caused by *Colletotrichum gloeosporioides*. Five fungicides namely Dithane M-45 (0.3%), Ridomil MZ-72 (0.2%), Bavistin 50 WP (0.1%), Champion 77 WP (0.25%) and Bordeaux mixture (1%), three plant extracts viz. Bishkatali (*Polygonum hydropiper*) leaf extract, Garlic (*Allium sativum*) clove extract and Neem (*Azadirachta indica*) leaf extract and one bioagent (*Trichoderma harzianum* T₂₂) were tested as foliar spray for six times to control the disease. The highest reduction of dieback severity (PDI) was obtained with Dithane M-45 (73.46%), which was followed by Neem extract (67.34%), Bordeaux mixture (59.19%) and *Trichoderma harzianum* T₂₂ (57.67%).

Key words: dieback, *Colletotrichum gloeosporioides*, citrus, fungicide, plant extract, bioagent, control.

INTRODUCTION

Citrus (*Citrus limon* L.) is an important fruit crops in Bangladesh. Its fruits play an important role in human health. In the country, citrus is cultivated in about 15,008 ha of land with a total production of 31750 metric tons per annum (Anon., 2005).

Various factors are responsible for lowering the yield of citrus. Among the factors, disease plays an important role. In Bangladesh, twelve diseases are known to occur in different species of citrus. Among the diseases, dieback, scab, lichen, sooty mould and canker are considered as major diseases (Alam, 2003). Dieback caused by *Colletotrichum gloeosporioides* is the most serious disease of citrus which formerly known as decline, wither tip, twig blight, anthracnose etc. Prevalence of dieback on Elachi lemon and Kagzi lime was 89.9% and 100%, respectively in Bangladesh (Miah and Fakir, 1987). The use of chemicals is common in the existing practices for controlling the disease. Indiscriminate use of chemicals may disrupt the natural ecological balance. Use of plant extracts in controlling plant pathogens is now-a-days an eco-friendly approach and is successfully employed against many fungal pathogens (Ahmed and Islam, 2000; Meah, 2003; Islam, 2004). The bio-control agents are reported to have antifungal, plant growth promoting and plant defense-inducing activities. Considering the above facts, the present study has been under taken to find out the efficacy of selected fungicides, plant extracts and bio-agent against die back of citrus.

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MATERIALS AND METHODS

The experiment was conducted in the citrus orchard of Sher-e-Bangla Agricultural University, Dhaka in the kharif season of 2005. There were 10 different treatments namely T₁ = Dithane M-45 (0.3%), T₂ = Ridomil MZ-72 (0.25%), T₃ = Bavistin 50 WP (0.1%), T₄ = Champion 77 WP (0.2%), T₅ = Bordeaux mixture (1%), T₆ = Bishkatali leaf extract (1:4 w/v), T₇ = garlic (*Allium sativum*) clove extract (1:4 w/v solution), T₈ = Neem leaf extract (1:4 w/v), T₉ = *Trichoderma harzianum* spore suspension (10⁷ conidia/ml water) and T₁₀ = Control. The experiment was laid out in a randomized complete block design with three replications (citrus plants). Standard intercultural operations were followed. Recommended dosages of fertilizer were applied (Anon., 1997). Insecticide, Diazinon 60EC was applied three times at 1ml/liter of water at 10 days interval against leaf minor. The spore suspension of *Trichoderma harzianum* isolate T₂₂ (10⁷ conidia/ml of water) was prepared. Carboxymethyl cellulose (CMC) at 1.2% (w/v) was added just before the use to increase the efficacy of antagonist. The plants were sprayed with each material starting from 15 June 2005 for six times with an interval of 15 days.

Data on incidence and severity of dieback were recorded just before first spray and after 15 days of sixth or last spray. At the time of data collection, five twigs of each citrus tree under all treatments were selected randomly and tagged. To compute incidence of dieback, numbers of infected and healthy leaves in a twig were counted. Percentage of diseased leaves was computed based on total number of leaves checked. Selected twigs were checked carefully and severity of dieback was recorded based on a subjective scale of 0 - 5, where 0 = no infection, 1 = up to 10% twigs infected, 2 = 11 - 20% twigs infected, 3 = 21 - 30 leaves infected, 4 = 31 - 50% leaves infected and 5 = above 50% leaves were infected. The severity was expressed as percent disease index (PDI). The PDI was computed following a standard formula (Mian, 1995) with some modification as described below:

$$\text{PDI} = \frac{\sum (\text{Disease grade} \times \text{twig number in that grade})}{\text{Total numbers of twigs} \times \text{the highest value of the grading scale}} \times 100$$

The data were analyzed for analysis of variance and differences among the means were compared for significance following standard statistical procedures (Gomez and Gomez, 1983) and MSTATC computer programme.

RESULTS AND DISCUSSION

Just before starting the first spray, the incidence and severity of dieback of citrus plants were recorded and presented in Table 1. The disease incidence in terms of infected leaves ranged from 40.56 to 43.91% with a mean of 41.78. The severity in term of PDI ranged from 21.33 to 26.00 with a mean of 24.57. Variations in both the parameters on different plants were not significant. The results clearly showed that both incidence and severity of dieback of the citrus plants selected for all 10 treatments of the experiment were more or less uniform.

The effect of fungicides, plant extracts and bioagent on incidence and severity of dieback recorded from citrus plants under different treatment at 15 days after sixth and last spray are also presented in Table 1. The incidence of dieback ranged 10.40-53.91% under different treatments including control. The highest incidence was recorded under control and the lowest under the treatment with Dithane M-45. All treatments gave significant reduction in disease incidence. However, the maximum reduction was achieved with Dithane M-45, which was followed by Bordeaux mixture and neem extract. The

efficacy of the later two treatments was statistically similar. Plants sprayed with Champion 77 wp, Bishkatali leaf extract, garlic clove extract and *Trichoderma harzianum* reduced disease incidence to 21.48, 21.02, 20.42 and 20.74%, respectively. Efficacy of the four treatments was not significantly different. The second highest incidence of 26.51% was recorded from plants sprayed with Ridomil MZ-78 and Bavistin 50wp. In case of disease severity, expressed in percent disease index (PDI), varied from 8.67 to 32.67. Significantly the highest PDI was recorded under control. The lowest PDI was found under Dithane M-45, which was statistically similar to Neem extract. Efficacy of other seven treatments was statistically similar and reduced PDI values by 48.97 to 57.67%.

Results of the present investigation showed that foliar spray with appropriate fungicides or plant extracts is effective to control dieback of citrus. Among the fungicides tested in the present study Dithane M-45 was the most effective, which gave 80.70% reduction in incidence and 73.46% reduction in severity of dieback. Neem extract was recorded as the second most effective biofungicide giving 75.71% reduction in incidence and 67.34% reduction in PDI. Other fungicides and plant extracts gave more than 50% reduction in incidence and severity of citrus dieback. Other investigators also reported the effectiveness of foliar sprays with fungicides to control citrus dieback (Ebenezar and Shubramanian, 1996; Thakore *et al.*, 1994; Das *et al.*, 1998). Ebenezar and Shubramanian (1996) reported that dieback of citrus was successfully controlled by spraying of 1% Bordeaux mixture. Thakore *et al.* (1994) reported that the best control of dieback of citrus was achieved by spraying Dithane M-45 at 2000 ppm. However, Das *et al.* (1998) reported that Dithane M-45 and Ridomil MZ-72 were not found effective against dieback of citrus. Among botanicals tested Neem leaf extract was effective against dieback of citrus. The bioagent *Trichoderma harzianum* also found promising in reducing the disease, next to Bordeaux mixture. Yesmin (2004) reported that Neem leaf extract was most effective in controlling dieback of twig and branch of citrus. Khan *et al.* (1998) reported that four Neem based products, namely Bemokil, Nemokil-S, SDS and SDC has antifungal activity against *Colletotrichum gloeosporioides*. Their findings are in agreement with of the present findings.

Table 1. Effect of fungicides, plant extracts and bio-agent on the incidence and severity of dieback of citrus after three months of starting of spray

Treatments	Before spraying		After three month of starting of spray			
	Disease incidence	Percent Disease index (PDI)	Disease incidence	Percent Disease index (PDI)	% Decreased over control	
					PDI	Incidence
T ₁ = Dithane M 45	43.33 a	26.00 a-c	10.40 d	8.67 d	73.46	80.70
T ₂ = Ridomil MZ 72	40.56 a	21.33 c	26.51 b	14.00 bc	55.56	50.83
T ₃ = Bavistin 50 WP	40.56 a	23.33 bc	26.51 b	16.67 b	48.97	50.83
T ₄ = Champion 77 WP	41.48 a	26.00 a-c	21.48 c	15.33 b	53.07	60.16
T ₅ = Bordeaux mixture	43.91 a	24.66 bc	12.01 d	13.33 bc	59.19	77.72
T ₆ = Bishkatali extract	41.82 a	26.00 a-c	21.02 c	15.83 b	51.57	61.01
T ₇ = Garlic extract	41.11 a	26.00 a-c	20.42 c	15.93 b	51.23	62.12
T ₈ = Neem extract	40.56 a	26.00 a-c	13.10 d	10.67 cd	67.34	75.71
T ₉ = <i>Trichoderma harzianum</i>	43.91 a	24.67 bc	20.74 c	13.83 bc	57.67	61.53
T ₁₀ = Control	40.56 a	21.67 c	53.91 a	32.67 a	-	-

Means within the same column having same letter do not differ significantly (P = 0.05)

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