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Bio-efficacy of Aliette 80 WP against Citrus Phytophthora in Kinnow Mandarin

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ABSTRACT

The bio-efficacy of Aliette 80 WP was evaluated against citrus foot rot/gummosis disease in the Department of Plant Pathology, Punjab Agricultural University, Ludhiana during 2014-15 and 2015-16. Aliette as sprays and soil drench @ 2.5 g and 4.0g/l of water were tested using 10 l water per tree and compared with Aliette spray + Ridomil Gold soil drench (2.5 g/l water). Aliette spray + Ridomil Gold soil drench, Aliette sprays and soil drench and Aliette each @ 2.5 g/l water gave significantly highest reduction in trunk lesion size and increase in feeder root density and fruit yield in the infected Kinnow plants. Aliette sprays were found significantly better than Aliette soil drench application. Aliette @ 2.5 g and 4.0 g per l of water did not show any phytotoxic effect on leaves, fruit surface and yield and safe to use. *In vitro*, 100 per cent growth inhibition of the pathogen was recorded in Ridomil Gold and Ridomil MZ at 25 ppm where as in Aliette it was more than 200 ppm. Ridomil Gold / Ridomil MZ were found to be highly effective with ED_{50} value < 10 ppm and ED_{90} value < 25 ppm against the pathogen. The ED_{50} and ED_{90} value of Aliette was < 50 µg/ml and <200 µg/ml, respectively indicting its less direct effect on the pathogen. For the effective and safe management of the disease Aliette as sprays @ 2.5 g/ l of water can be used as alternative of Ridomil Gold soil drench and trunk paint application.

Key Words: Aliette 80 WP, Citrus foot rot, Evaluation, Phytotoxicity.

INTRODUCTION

Citrus foot rot/gummosis (*Phytophthora nicotianae* var. *parasitica*) is globbly important disease causing heavy destruction of nursery and orchard and also reduces the life expectancy, quality and yield potential of the citrus plantation (Das, 2009; Thind *et al,* 2004). The malady is fatal to the tree if not properly diagnosed and timely treated especially an early stage of infection. For its effective management, application of Ridomil MZ/ RiromilGold/ Curzate M8 as trunk paint, sprays and soil drench are the commonly followed practices (Kaur *et al*, 2009; Jagtap *et al,* 2013; Dhakad *et al,* 2016). Due to presence of ineffective isomer in Ridomil MZ against Citrus *Phytophthora* and the frequent use of Ridomil Gold/Curzate M8 may causes development of resistance in the pathogen. Aliette is highly effective systemic fungicides against oomycetes especially Plasmopara, Phytophthora, Bremia for citrus, vegetables and strawberry. *Aliette* is a trade name of Fosetyl Aluminium *80% WP of Bayer Crop Science h*aving different mode of action of rapidly absorbed through the plant leaves or roots with acropetally and basipettally translocation. It has no confirmed cases of fungal resistance development under frequent use condition. Therefore, for the safe and effective management of the disease, the experiment was conducted for two years to test the bio-efficacy of Aliettee 80 WP against citrus *Phytophthora* disease.

MATERIALS AND METHODS

Aliette 80 WP efficacy as sprays was evaluated and compared with Ridomil Gold 68 WP (metalaxyl 4% + mancozeb 64% WP) as soil drench for the management of citrus *Phytophthora* disease in

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Table 1. Effect of Aliette on size of trunk lesion in Phytophthora infected Kinnow plants.

Treatment	Method of application	Doses (g/l)	Trunk lesion size (cm^2)*		+/- over initial (%)
			Before treatment	After treatment	
Aliette 80 WP	Soil Drench	2.5	106.83	100.45	-5 .97
Aliette 80 WP	Soil Drench	4.0	109.67	102.30	- 6.72
Aliette 80 WP	Spray	2.5	106.33	54.65	- 48.60
Aiette 80 WP	Spray	4.0	104.33	55.0	- 47.28
Aliette 80 WP	Spray + Soil Drench	2.5	205.0	122.15	- 51.14
Ridomil Gold + Aliette 80 WP (Standard check)	Ridomil Gold (drench) + Aliette (Spray)	2.5 + 2.5	115.5	53.33	- 53.81
Untreated control	-	-	117.5	151.83	+ 29.22
CD at 5%					11.39

*Average of two year observation at three different locations

Kinnow mandarin. The Kinnow tree showing foot rot symptoms with pale yellow canopy were marked in the orchard at different three locations *viz;* FASS, Hoshiarpur, RRS Abohar (Fazilka), KVK, Langroya (SBS Nagar) in Punjab and rated as infected with citrus *Phytophthora* disease. Trunk lesion size, feeder root density (mg/cc soil) and fruit yield (number/tree) were recorded before and after fungicide treatments for two consecutive years of 2014-15 and 2015-16. Trees were soil drenched and sprayed with respective fungicide @ 2.5 g and 4.0 g/l of water twice in a year during April and September using ten litre water/tree (Table 1). For each treatment, three trees were kept with single tree per unit of replication. An equal number of trees were also kept as control. Feeder root density was measured using soil auger (Thind *et al,* 2004). Fruit yield (number) was also recorded in February at time of fruit harvest. The phytotoxic effect of Aliette 80 WP, if any on Kinnow plants, doses of 2.5g and 4.0g as soil drench and spray were also tested to observe any phytotoxic symptoms on the treated plants. An equal number of plants were kept as control.

Three fungicides, Aliette 80 WP (Fosetyl-Al 80 WP, Ridomil Gold 68 WP (metalaxyl 4% + mancozeb 64% WP) and Ridomil 72 WP (metalaxyl 8% + mancozeb 64% WP) were aso evaluated *in vitro* against *Phytophthora nicotianae var. parasitica* in the department of Plant Pathology, PAU, Ludhiana by employing poisoned food technique (Nene and Thapliyal, 1993). A series of concentration of 10, 25,50, 100 and 200 ppm were prepared on active ingredient basis through serial dilution using sterile distilled water to make the final volume of 100 ml. The ED_{50} and ED_{90} value of each fungicide was also calculated by plotting per cent inhibition in colony growth against each concentration of the fungicide.

RESULTS AND DISCUSSION

The data presented in Table 1 reveals a significant reduction in trunk lesion size (5.97 to 53.81%) with all the treatments as compared to untreated control. The highest percentage reduction in trunk lesion size was recorded in Ridomil Gold soil drench + Aliette spray @ 2.5 (53.81%) and 4.0 g (47.28 %) closely followed by Aliette spray + soil drench @ 2.5 g (51.14%) and Aliette spray (48.60%) and these were statistically at par with each other where as in the control lesion size increased to 29.22per cent. Among the different doses of Aliette as soil drench, the doses @ 2.5 g and 4.0 g were at par with each other. Similarly, the spray doses of Aliette @2.5g. and 4.0 g were also found at par with each other in

Table 2. Effect of Aliette on feeder root density in Phytophthora infected Kinnow plants.

Treatment	Method of application	Dose (g/l)	Feeder root density (mg/cc soil)*		+/- over initial (%)
			Before treatment	After treatment	
Aliette 80 WP	Soil Drench	2.5	0.123	0.134	+8.94
Aliette 80 WP	Soil Drench	4.0	0.127	0.140	+10.24
Aliette 80 WP	Spray	2.5	0.130	0.176	+35.38
Aiette 80 WP	Spray	4.0	0.109	0.136	+24.77
Aliette 80 WP	Spray + Soil Drench	2.5	0.116	0.158	+36.21
Ridomil Gold + Aliette 80 WP (Standard check)	Ridomil Gold (drench) + Aliette (Spray)	2.5 + 2.5	0.109	0.160	+46.79
Untreated control	-	-	0.094	0.058	-38.29
CD at 5%					8.54

*Average of two year observation at three different locations

reducing the size of trunk lesion. The Aliette sprays were found significantly better than Aliette soil drench treatments.

All the treatments significantly differ from untreated control in increasing the feeder root density of the infected Kinnow plants (Table 2). A significant increase in the feeder root density was recorded in Ridomil Gold soil drench + Aliette spray (46.79%) which differ significantly from all the treatment where as in control a reduction in feeder root was 38.29%. The second best treatment were Aliette sprays + soil drench @ 2.5 (36.21%) and Aliette sprays @ 2.5g and these were at par with each other. The Aliette spray @ 2.5 g was significantly differ from Aliette spray @ 4.0 g in the recovery of feeder root in the infected plants.The Aliette soil drench @ 2.5 g dose was at par with Alitte 4.0g dose. The Aliette sprays were singnificantly better than Aliette soil drench treatments.

The data (Table 3) indicate a significantly highest increase in fruit yield in Ridomil Gold soil drench + Aliette spray (54.47%) and differ significantly from all the treatments, however, there was reduction in the yield (- 9.38%) of untreated control plants. Aliette sprays + soil drench @ 2.5 increased the 43.90 % fruit yield and was at par with Aliette sprays @ 2.5g (40.20%) and 4.0 g (38.76%) but differ significantly to Aliette soil drench @ 2.5g and 4.0 g. Aliette doses @ 2.5g and 4.0g as soil drench were at par with each other in increasing the feeder root density. Similarly Aliette sprays @ 2.5 g and 4.0 g were at par with each other. Aliette sprays were better than Aliette soil drench treatments.

The observations showed that there was no any phytotoxic symptoms like injuries to leaf tips and surface, leaf tip burning, leaf yellowing, vein clearing, leaf necrosis, epinasty and hyponasty by the application of Aliette and Ridomil Gold @ 2.5g and 4.0 g as soil drench and spray application. Even Aliette and Ridomil Gold at the highest doses of 4.0 did not cause any phytotoxic symptoms. There was not any adverse effect on the fruit rind and yield.

The results *in vitro* efficacy of fungicides against the pathogen were presented in Table 4. The highest growth inhibition of the pathogen was recorded in Ridomil Gold (78.14%) followed by Ridomil MZ (77.98%) at 10 ppm. The cent per cent growth

Table 3. Effect of Aliette on fruit yield in Phytophthora infected Kinnow plants.

Treatment	Method of application	Dose (g/l)	Fruit Yield (No.)	+/- over initial (%)	
			Before treatment	After treatment	
Aliette 80 WP	Soil Drench	2.5	425	480	+12.94
Aliette 80 WP	Soil Drench	4.0	500	551	+10.20
Aliette 80 WP	Spray	2.5	500	701	+40.20
Aiette 80 WP	Spray	4.0	485	673	+38.76
Aliette 80 WP	Spray + Soil Drench	2.5	492	708	+43.90
Ridomil Gold + Aliette 80 WP (Standard check)	Ridomil Gold (drench) + Aliette (Spray)	2.5 + 2.5	492	760	+54.47
Untreated control	-	-	480	435	-9.38
CD at 5%					9.77

*Average of two year observation at three different locations

Table 4. *In vitro* evaluation of fungicides against citrus Phytophthora pathogen.

Fungicide	Mycelia growth inhibition (%)					ED_{50} (ppm)	ED_{90} (ppm)
	Concentration (ppm)						
	10	25	50	100	200		
Aliette 80 WP	11.42	14.90	23.92	52.54	96.82	< 50	< 200
Ridomil Gold 68 WP	78.14	100.00	100.00	100.00	100.00	< 10	< 25
Ridomil MZ 72 WP	77.98	100.00	100.00	100.00	100.00	< 10	< 25

inhibition was recorded at 25 ppm in Ridomil Gold and Ridomil MZ at 25 ppm where as Aliette showed only 14.9 per cent growth inhibition. The Ridomil Gold and Ridomil MZ were found to be highly effective with ED_{50} value < 10 ppm against the pathogen. The ED_{50} value of Aliette was < 100 ppm. Similarly, the ED_{90} value of Ridomil Gold and Ridomil MZ was < 25 ppm . The ED_{90} value of Aliette was very high < 200 µg/ml.

During the present investigation, Aliette sprays and Aliette + soil drench @ 2.5 g / l of water were highly pronounced in controlling foot rot/gummosis and increasing feeder root density and fruit yield of *Phytophthora* infected Kinnow mandarin and was comparable with Aliette spray + Ridomil soil drench. Foliar application of fosetyl Al and soil application of metalaxyl resulted in reduction of trunk lesion size and propagules density of the pathogen and increase in feeder root and fruit yield in *Phytophthora* infected citrus plants. The present findings were in agreement with those of Kaur *et al(* 2009) who have reported reduction in trunk lesion size and increase in feeder root density and fruit yield in the foot rot infected citrus trees after the application of various fungicides as paint, soil drench and sprays. Therefore, loss of feeder rot in kinnow mandarin due to infection by Phytophthora pathogen can be corrected by application of fosetyl Al as spray or metalaxyl as soil drench. The effectiveness of Ridomil Gold 68 WP, Ridomil MZ 72 WP and Curzate M8 *in vivo* and *in vitro* has also been reported by Kaur *et al(* 2011) and Dhakad *et*

al(2016). The ED_{50} value for Aliette was > 50 ppm and Ridomil Gold was < 10 ppm.

CONCLUSION

Spray application of Alette (2.5g/ litre of water) in April and September can be used as alternative of Ridomil MZ/Ridomil Gold trunk paint + soil drenh for the effective and safe management of citrus foot rot/gummosis disease.

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