

Comparative study of chemical fungicides for the management of citrus gummosis *Phytophthora nicotianae* var. *parasitica* in north Gujarat condition

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Abstract— Field experiment was conducted at Krishi Vigyan Kendra, Mehsana, Gujarat to test the efficacy of various chemical treatments for the control of gummosis (*Phytophthora nicotianae* var. *parasitica*) of Citrus during the year 2017-2019. Ten -year-old acid lime (Kagzi lime) trees were treated with Bordeaux paste and fosetyl Al. Bordeaux paste application and fosetyl Al significantly reduced gummosis incidence. It can be concluded that for effective control of gummosis, citrus trees may be treated with Bordeaux paste on the main trunk or foliar spray of fosetyl Al gave average 33.33 % and 30.00 % disease index, respectively during the three-year experiments.

Keywords— gummosis, *Phytophthora nicotianae* var. *parasitica*, disease management, Acid Lime, Citrus *aurantifolia*.

I. INTRODUCTION

Acid Lime (*Citrus aurantifolia* Swingle), belongs to the family Rutaceae. Citrus is the third largest fruit crop grown in India after mango and banana. It is generally grown under both tropical and subtropical climatic conditions. Commercially sweet orange, mandarin and acid lime are grown in different agro climatic regions. Citrus fruits like oranges, limes, lemons, etc. have been under cultivation in India since time immemorial. Citrus trees have been derived from eastern Asia domestic species and are presently planted in many countries including Argentina, Australia, Brazil, China, Cuba, Egypt, India, Israel, Italy, Japan, Mexico, Morocco, South Africa, Spain, USA and Iran (Khodakaramian and Ghasemi, 2002). Citrus is a very important fruit tree and being grown in several Northern and Southern provinces (Khodakaramian and Ghasemi, 2002).

The area under Acid Lime in India is 255.20 thousand hectares with production of 2523.50 thousand MT

and productivity of 9.9 MT (Annon., 2017). In Gujarat, Citrus is cultivated in 46279 hectares with production of 605613 MT and productivity of 13.09 MT/ha (Anon., 2017). In Mehsana district, the area, production and productivity is 12516 ha, 177852 metric tones and 14210 kg/ha, respectively (Anon., 2019).

Phytophthora root rot and gummosis are the most important soil borne diseases of Nagpur mandarin causing mortality, slow decline and yield loss of mature trees (Graham and Menge, 1999). Citrus spp. are prone to attack by more than 150 pathogens and disorders caused by fungal, viral and few bacterial pathogens right from nursery level to bearing stage resulting in severe losses. All citrus orchard in central India and other citrus cultivation belts of India, are infected by Phytophthora diseases. Phytophthora propagules have been recorded up to 250- 350 cfu/cc soil in highly infested orchards. Every year 5-10% plants die due to severe root rot in bearing orchards (Naqvi, 2000). It requires due attention for their effective management that

includes use of tolerant rootstocks and fungicides. Applications of the systemic fungicides like metalaxyl and fosetyl-Al have been shown to increase fibrous root weight of citrus rootstocks and to reduce propagules of *P. nicotianae* (Sandler et al., 1989). Use of fungicides can mitigate the problem up to some level but can not eradicate it. Copper fungicides are used as foliar sprays, drenching of basins and trunk paste to reduce foot rot, root rot and gummosis in citrus. The isolation of native *Pseudomonas fluorescens* from citrus rhizosphere and their application against *Phytophthora spp.* (*P. citrophthora*, *P. parasitica* and *P. palmivora*) helps in reduction of *Phytophthora* populations in citrus rhizosphere. It is clear that single component alone is not effective to manage the disease in orchards and further emphasized the needs for integration of effective components of management practices to protect the orchards. In order to develop eco-friendly management of *Phytophthora* diseases, it is necessary to integrate biological and chemical management practices along with soil amendments and nutrition. Accordingly, a schedule for application of different modules are prepared and compared on the basis of reduction of *Phytophthora* population vis- a - vis root rot and gummosis in Nagpur mandarin. Jadeja *et al.* 2000 concluded that for effective control of canker and gummosis, citrus trees may be treated with Bordeaux paste on the main trunk or soil drenching around the basal trunk with *metalaxyl + mancozeb or fosetyl Al in combination with foliar application of streptomycin sulphate + copper oxychloride* three times a year i.e. before monsoon, in August and December.

II. MATERIALS AND METHODS

The experiments were conducted and carried out by Krishi Vigyan Kendra, Mehsana, Gujarat in citrus gummosis affected orchards of different farmers during year 2017-2019. Evaluation of chemical fungicides against Citrus gummosis in field condition for three years. Ten farmers selected from Udalpur, Sanganpur, Jagudan, Akhaj, Kahoda villages citrus growing area of Mehsana district. The two treatment i.e. T1 : application of bordeaux paste on tree trunk up to 45 cm from ground level and apply bordeaux paste on removed gummosis infested parts during before and after monsoon, and T2 : spraying of fosetyl Al 80 % WDG 25 gm per 10 liter water at appearance of gummosis disease. Each treatment consists of 10 lemon plants (kagzilime variety) and replicated in 10 farmers field. Disease index calculated by using appropriate formula as well as economics of the results also calculated. The same experiments conducted for the year 2017-18, 2018-19 and 2019-20 as well as three-year pooled results were recorded.

III. RESULTS AND DISCUSSION

Effectiveness of chemical fungicides against citrus gummosis in acid lime in field condition are shown in Table 1. Perusal of the data presented in Table 1 indicated that both the treatment gave more or less similar results in case of disease index and yield during the three year results. The three year pooled data showed that disease index 33.33 ± 3.34 per cent observed in T1 and 30.00 ± 3.33 per cent in T2. Results presented in Table 1 revealed that the average yield of is 13959 ± 290.74 kg/ha and 14148 ± 184.14 kg /ha in T1 and T2, respectively.

Table 1: Effectiveness of chemical fungicides against citrus gummosis in acid lime.

Treatment	Disease Index (%)				Yield (Kg/ha)			
	2017-18	2018-19	2019-20	Av. \pm SD	2017-18	2018-19	2019-20	Av. \pm SD
T1	36.67	33.33	30.00	33.33 ± 3.34	14256	13945	13675	13959 ± 290.74
T2	33.33	30.00	26.67	30.00 ± 3.33	14345	14120	13980	14148 ± 184.14

Table 2 shows that T2 found at par result in the sense of all the parameter of economics i.e. gross return, net return and cost benefit ratio as compared to T1 treatment during the three year experimental results. The pooled results of three year (Table 2) revealed that gross return, net return

and BCR recorded as 3.50 ± 0.68 lakh/ha, 2.42 ± 0.68 lakh/ha and 3.23 ± 0.62 , respectively in T1, whereas 3.54 ± 0.66 lakh/ha, 2.43 ± 0.67 lakh/ha and 3.19 ± 0.60 , respectively in T2 treatment.

Table 2 : Economics of chemical fungicides against citrus gummosis in acid lime.

Treatments	Gross return (Rs. lakh/ha)				Net return (Rs. lakh/ha)				BCR			
	2017-18	2018-19	2019-20	Av. \pm SD	2017-18	2018-19	2019-20	Av. \pm SD	2017-18	2018-19	2019-20	Av. \pm SD
T1	4.28	3.21	3.01	3.50 \pm 0.68	3.19	2.13	1.92	2.42 \pm 0.68	3.94	3.00	2.76	3.23 \pm 0.62
T2	4.30	3.25	3.08	3.54 \pm 0.66	3.19	2.14	1.96	2.43 \pm 0.67	3.87	2.94	2.76	3.19 \pm 0.60

IV. CONCLUSION

Results of this study although were obtained in farmers field condition indicated that the chemical insecticides T1 : application of bordeaux paste on tree trunk up to 45 cm from ground level and apply bordeaux paste on removed gummosis infested parts during before and after monsoon, and T2 :spraying of fosetyl Al 80 % WDG 25 gm per 10 liter water at appearance of gummosis disease reducing the incidence of gummosis.

From the data recorded of three years, concluded gummosis management an effective method and may be used as an important component of Integrated Disease Management (IDM) strategies for controlling and managing the gummosis which is most damaging and destructive diseases of citrus around the world. Spraying of fosetyl Al 80 % WDG was less laborious and time-consuming method and farmers preferred this method as compared to application of bordeaux paste.

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