

EFFICACY OF BIOCIDES AGAINST CITRUS LEAF-MINER, *Phyllocnistis citrella* Stainton ON KAGZI LIME

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ABSTRACT

*The experiment on efficacy of biocides on *Phyllocnistis citrella* Stainton infesting kagzi lime were carried out at Anand Agricultural University, Anand during 2011. For reducing the leaf damage caused by *P. citrella*, *Bacillus thuringiensis* (0.2%), azadirachtin 0.15 EC (0.0006%) and neem seed kernel extract (5%) were found more effective. The neem leaf extract (10%), naffatia leaf extract (10%) and ardua leaf extract (10%) were noticed moderately effective, whereas *Verticillium lecanii* (0.4%), *Beauveria bassiana* (0.4%) and neem oil (0.3%) being less effective in reducing the *P. citrella* incidence on kagzi lime. The azadirachtin based formulation was noticed best for reducing the pest incidence of kagzi lime.*

KEY WORDS: *C. aurantifolia*, biocides, *P. citrella*

INTRODUCTION

Kagzi lime is one of the important fruit crop in India with the production of 21.08 lakh tones from 2.19 lakh hectares area with an average productivity of 9600 kg/ha (Anonymous, 2011). In India, Gujarat is second largest producer with 19 per cent production of kagzi lime followed by Andhra Pradesh. In Gujarat, kagzi lime covers the area about 39200 hectares and production about 4.09 lac tonnes with an average productivity of 10400 kg/ha (Anonymous, 2011). The productivity and quality of citrus are severely affected by several factors; insect pests being one of them (Rao and Shivankar, 2011). Among them, citrus leaf-miner, *Phyllocnistis citrella* cause severe damage to tender leaf, which serve as an entry point for a number of plant pathogens which cause citrus canker. Considering the seriousness of the problem,

different biocides were evaluated in the present experiment.

MATERIALS AND METHODS

With a view to evaluate the effect of biocides against *P. citrella*, a field experiment was conducted in completely randomized block design with three repetitions at Horticulture Farm, Anand Agricultural University, Anand during 2011. The kagzi lime trees having uniform size, growth and age with a spacing of 6 m between two trees were selected and used for the study. Each selected biocide was sprayed on 3 randomly selected and tagged plants when *P. citrella* damage crossed 5 per cent. One plant was considered as one repetition. Water spray was made in control plants. The spray suspension of respective treatment was made as per required concentration. The application of suspension @ 5 litres / tree was made with the help of the

knapsack sprayer through triple action nozzle. For recording observations, the *P. citrella* infested leaves and total leaves were recorded from each randomly selected twig before application as well as 3, 7, 10 and 15 days after each application. Data were subjected to ANOVA after following arcsine transformation of *P. citrella* damaged leaves.

RESULTS AND DISCUSSION

Efficacy of nine biocides was evaluated against *P. citrella* on kagzi lime. All the tested biocides were found significantly superior to control in reducing the leaf damage up to 15 days of spray and in pooled over period analysis (Table 1).

The lowest leaf damage (4.24 %) was observed in the plots treated with azadirachtin and it was at par with *Bacillus thuringiensis* (4.50 %), neem seed kernel extract (4.53 %) and neem leaf extract (5.23 %) after 3 days of spray. Naffatia leaf extract (5.82 %) and ardusa leaf extract (5.92 %) treated plots found as effective as latter three biocides. The plots treated with neem oil and *Beauvaria bassiana* were noticed 6.12 and 7.40 per cent leaf damage, respectively. The higher (8.18 %) leaf damage was recorded in plots treated with *Verticilium lecanii* and it was at par with *Beauvaria bassiana* (7.40 %) (Table 1).

After 7 days of spray (Table 1), the lowest (4.67 %) damaged leaves was noted in the plots treated with azadirachtin and it was at par with *Bacillus thuringiensis* (4.68 %), neem seed kernel extract (4.80 %), neem leaf extract (5.31 %) and naffatia leaf extract (5.94 %). The highest leaf infestation was observed in the plots treated with *Verticilium lecanii* (9.07 %) followed by *Beauvaria bassiana* (8.45 %), neem oil (7.41 %) and ardusa leaf extract (7.20 %) in reducing the pest incidence.

The leaf infestation was found lowest (4.95 %) in plots treated with *Bacillus thuringiensis* after 10 days of spray and it was at par with azadirachtin (5.25 %), neem seed

kernel extract (5.62 %) and neem leaf extract (6.42 %). Naffatia leaf extract (6.87 %), ardusa leaf extract (7.72 %) and neem oil (8.14 %) were found equally effective as neem leaf extract in reducing the leaf infestation. Among the evaluated biocides, the highest (10.05 %) leaf infestation was noticed in plots treated with *Verticilium lecanii* followed by *Beauvaria bassiana* (9.07 %) (Table 1).

After 15 days of spray, the lowest (5.19 %) leaf infestation was found in plots treated with *Bacillus thuringiensis* followed by azadirachtin (5.75 %) and neem seed kernel extract (6.17 %) (Table 1). The plots treated with neem leaf extract (7.07 %), naffatia leaf extract (7.71 %) and ardusa leaf extract (8.62 %) found at par with each other in reducing the pest incidence. Of the evaluated biocides, the highest (11.98 %) leaf damage was noticed in plots treated with *Verticilium lecanii* followed by *Beauvaria bassiana* (10.47 %) and neem oil (9.46 %).

Pooled over period results (Table 1) showed that the plots treated with *Bacillus thuringiensis* recorded 4.83 per cent damaged leaves and found significantly superior to all the biocides except azadirachtin (4.96 %). The plots treated with azadirachtin (4.96 %) and neem seed kernel extract (5.26 %) found equally effective in reducing the pest incidence. The neem leaf extract, naffatia leaf extract, ardusa leaf extract, neem oil and *Beauvaria bassiana* recorded 5.98, 6.57, 7.33, 7.74 and 8.81 per cent damaged leaves, respectively. Of the tested biocides, the highest (9.78 %) leaf damage was observed in plots treated with *Verticilium lecanii*.

On the basis of above results, it can be concluded that the *Bacillus thuringiensis* @ 0.2%, azadirachtin @ 0.0006% and neem seed kernel extract @ 5% were found more effective in reducing the leaf damage on kagzi lime, whereas neem leaf extract @ 10%, naffatia leaf extract @ 10% and ardusa leaf

extract @ 10% were noticed moderately effective. Among the evaluated biocides, *Verticilium lecanii* @ 0.4%, *Beauvaria bassiana* @ 0.4% and neem oil @ 0.3% being less effective in reducing the *P. citrella* damaged leaves on kagzi lime.

These findings are closely associated with Jothi *et al.* (1993) reported that neem seed kernel extract (2%) being most effective against *P. citrella* than mahua and pongamia oil on limes. Borad *et al.* (2001) reported that neem leaf extract and naffatia leaf extract @ 10% effectively managed the population of *P. citrella* on kagzi lime. Khyami-Horani and Ateyyat (2002) noted the strain *Bacillus thuringiensis kurstaki* gave the highest toxicity against leaf-miner on kagzi lime after 3 days of application. Jayanthi and Verghese (2004) found that neem seed kernel extract and azadirachtin were superior in causing high mortality of leaf-miner infesting kagzi lime. Saravanan and Savithri (2005) noted that neem seed kernel extract @ 5% showed minimum incidence than azadirachtin and anona formulation of *P. citrella* on acid lime up to 7 days after spray.

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Table 1: Effectiveness of biocides on *P. citrella* infesting kagzi lime

Biocides	Before Spray	Leaf Damage (%) Days After Spray					
		3 DAS	7 DAS	10 DAS	15 DAS	Pooled	
Azadirachtin 0.15 EC (0.0006 %)	14.18 (6.00)	11.89 (4.24)	12.48 (4.67)	13.24 (5.25)	13.87 (5.75)	12.87 (4.96)	
NSKE (5.0 %)	13.97 (5.83)	12.29 (4.53)	12.65 (4.80)	13.71 (5.62)	14.38 (6.17)	13.26 (5.26)	
Neem oil (0.3 %)	13.79 (5.68)	14.32 (6.12)	15.80 (7.41)	16.58 (8.14)	17.91 (9.46)	16.15 (7.74)	
Neem leaf extract (10.0 %)	14.24 (6.05)	13.22 (5.23)	13.32 (5.31)	14.68 (6.42)	15.42 (7.07)	14.16 (5.98)	
Naffatia leaf extract (10.0 %)	13.32 (5.31)	13.96 (5.82)	14.11 (5.94)	15.19 (6.87)	16.12 (7.71)	14.85 (6.57)	
Ardusa leaf extract (10.0 %)	13.80 (5.69)	14.08 (5.92)	15.57 (7.20)	16.13 (7.72)	17.07 (8.62)	15.71 (7.33)	
<i>Bacillus thuringiensis</i> (0.2 %)	13.28 (5.28)	12.25 (4.50)	12.50 (4.68)	12.86 (4.95)	13.17 (5.19)	12.69 (4.83)	
<i>Beauveria bassiana</i> (0.4 %)	13.43 (5.39)	15.78 (7.40)	16.90 (8.45)	17.53 (9.07)	18.88 (10.47)	17.27 (8.81)	
<i>Verticilium lecanii</i> (0.4 %)	14.36 (6.15)	16.62 (8.18)	17.53 (9.07)	18.48 (10.05)	20.25 (11.98)	18.22 (9.78)	
Control	15.69 (7.31)	19.86 (11.54)	21.11 (12.97)	22.21 (14.29)	23.91 (16.43)	21.77 (13.76)	
Mean	14.01 (5.86)	14.43 (6.21)	15.20 (6.87)	16.06 (7.65)	17.10 (8.65)	15.70 (7.32)	
ANOVA							
S. Em. ±	Treatment (T)	0.88	0.66	0.95	0.74	0.73	0.34
	Period (P)	-	0.27	0.28	0.30	0.31	0.29
	T x P	-	0.84	0.90	0.95	0.97	0.92
C.D. at 5%	T	NS	1.90	3.04	2.11	2.08	0.95
	P	-	0.74	0.77	0.83	0.86	0.80
	T x P	-	NS	2.53	NS	NS	NS
C. V. %		10.85	10.12	10.21	10.20	9.85	10.11

Figures in parenthesis are retransformed values, those outside are arcsine transformed values.