International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 2090-2092

Received: 10-07-2017
Accepted: 11-08-2017

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Effect of different insecticides against blackfly, *Aleurocanthus woglumi* Ashby infesting kagzi lime

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Abstract
Field experiments on effect of different insecticides against blackfly, *Aleurocanthus woglumi* Ashby infesting Kagzi lime was carried out at Horticulture farm, Junagadh Agricultural University, Junagadh during 2015-16 and 2016-17. All the treatments were significantly superior over untreated check. Results of the experiment indicated that the lowest number of blackfly per leaves was observed in the treatment of spinosad 45 SC 0.0135%, it was statistically at par with difenthiuron 50 WP 0.05% and imidacloprid 17.8 SL 0.0072% after seven and fifteen days of first as well as second spray of the both the season. The treatments of thiamethoxam 25 WG 0.0125%, profenophos 40 + cypermethrin 4 EC 0.044 % and profenophos 50 EC 0.05% as mediocre, whereas buprofezin 25 EC 0.025% and nuvaluron 10 EC 0.01% found the least effective.

Keywords: Kagzi lime, Insecticides, Citrus, Blackfly and *Aleurocanthus woglumi*

Introduction
The citrus, *Citrusa urantifolia* Swingle belongs to family Rutaceae. Citrus fruits possess greater adaptability to different climatic conditions, so are grown with equal success in tropical, subtropical and even in some favorable parts of the temperate regions of the world. The productivity and quality of citrus are severely affected by several factors; insect pests being one of them (Rao and Shivankar, 2011) [6]. Among all insect pest infestation the citrus blackfly *L. woglumi* is an important citrus pest. It is an insect whose feeding activity occurs through mouthparts of the piercing-sucking type that causes damage when feeding on phloem parts from citrus plants either in immature or adult phases (Oliveira *et al.*, 2001) [3]. Direct damages are caused by nymphs and adults by means of continuous leaf nutrient suction which results in plant weakness, wilting, and in some cases, plant death. Indirect damages arise from sooty mold which is a symptom resulting from fungus growth on *A. woglumi* nymph exudates over leaves and fruits which impair leaf respiration and photosynthesis (Raga *et al.*, 2013) [4]. Citrus black fly may cause 20-80% citrus yield losses, thus affecting fruit production and exportations. About 5 to 10 nymphs per square centimeter are enough to reduce the nitrogen level below the 2.2% needed for orange fruit growth. Therefore, it is very important to test different chemical pesticides against citrus black fly. Hence, present investigation was carried out on effect of different insecticides against black fly, *A. woglumi* infesting kagzi lime.

Materials and Methods
With a view to effect of different insecticides against blackfly, *A. woglumi* infesting kagzi lime, a field experiment was conducted in completely randomized block design with three repetitions at Horticulture Farm, Junagadh Agricultural University, Junagadh during 2015-16 and 2016-17. 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. Spraying of insecticides was applied after initiation of the pest population. The observations on number of blackfly per twig recorded from randomly selected five twigs from each tress. For recording observation used the lower surface of leaves and calculate number of blackfly per twig before and after 3, 7 and 15 days of each spray. The first spray of insecticides was done at initiation of pest population while subsequent second spray was done after 15 days of first spray.

Results nd Discussion
Population of leaf miner was found non-significant before spray but after first and second spray, it was found significantly differ in all the treatments over control.

Pooled data of two years (2015-16 and 2016-17) after first spray (Table 1) showed that the lowest number of blackfly per twig was recorded in the treatment of spinosad 45 SC 0.0135% (1.28/twig) and it was statistically at par with difenthiuron 50 WP 0.05% (2.07/twig) and imidacloprid 17.8 SL 0.0072% (2.36/twig). The next better treatments were thiamethoxam 25 WG 0.0125%, profenophos 50 EC 0.05%, acetamiprid 20 SP 0.01% and profenophos 40% + cypermethrin 4 EC 0.044 % and it showed 4.19, 4.42, 5.21 and 5.36 per cent leaf damage after three days of first spray. More or less similar trend was also observed after seven and fifteen days of first spray.

The lowest number of blackfly per twig (Table 2) was observed in treatments of spinosad 45 SC 0.0135%, difenthiuron 50 WP 0.05% and imidacloprid 17.8 SL 0.0072% it showed 1.96, 2.59 and 2.67 number of blackfly per twig, respectively after three days of second spray. The highest blackfly population was observed in treatments of nuvaluron (8.28/twig). The treatment of spinosad 45 SC 0.0135%, difenthiuron 50 WP 0.05% and imidacloprid 17.8 SL 0.0072% also prove effectiveness after seven and fifteen days of second spray it showed 2.52 & 4.29, 2.58 & 5.90, 3.35 & 5.27 blackfly per twig, respectively.

The references on blackfly management not available on specific citrus crop however, the present studies are in more or less conformity with the results obtained by Shivankar and Rao (2008) who noted that foliar application of imidacloprid 0.005 % and dimethoate 0.03 % were more effectivein managing blackfly. According to Raghuraman and Gupta (2005) [5], acetamiprid @ 40 g a. i. / ha and imidacloprid @ 100 g a.i/ha found most effective against *B. tabaci* resulted into 48% and 45% increasing in seed cotton yield over control, respectively.

Chander (2009) [1] found that difenthuiron 50 WP @ 400 g a. i. /ha found highly effective and significantly superior than the conventional insecticide (triazophos @ 1.5 lit/ha) against whitefly. Kalyan *et. al* (2012) [2] evaluated different six molecules *i.e.* acephate 75 SP @ 500 a.i./ha, triazophos 40 EC @ 600 a.i./ha, fipronil 5 SC @ 40 a.i./ha, imidacloprid 70 WG @ 50 a.i./ha, spinosad 45 SC @ 75 a.i./ha and dimethoate 30 EC @ 300 a.i./ha were evaluated. Spinosad, imidacloprid, acephate and fipronil effectively control the population of whiteflies and gave significantly higher seed cotton yield over to untreated check and standard check. Tapmay and Bhattacharya (2015) evaluated seven insecticidal treatments single application of imidacloprid 17.8% SL followed by twice applications of spinosad 45% SC gave maximum reduction in infestation of whitefly in okra.

Table 1: Efficacy of different insecticides against black fly in citrus after first spray

Treat.	Before Spray			3 DAS			7 DAS			15 DAS		
	2014-15	2016-17	Pooled	2014-15	2016-17	Pooled	2014-15	2016-17	Pooled	2014-15	2016-17	Pooled
Profenophos 40% + Cypermethrin 4 % 0.044 %	2.70 (7.30)	2.74 (7.52)	2.72 (7.41)	2.70 (7.30)	1.93 (3.73)	2.32 (5.36)	2.89 (8.33)	1.96 (3.83)	2.42 (5.86)	3.04 (9.23)	2.42 (5.83)	2.73 (7.43)
Nuvaluron 10% EC 0.01%	3.11 (9.66)	3.10 (9.60)	3.10 (9.63)	2.77 (7.66)	2.97 (8.80)	2.87 (8.22)	3.11 (9.70)	2.74 (7.49)	2.93 (8.57)	3.14 (9.83)	3.46 (11.99)	3.30 (10.89)
Spinosad 45% SC 0.0135%	2.88 (8.29)	2.70 (7.28)	2.79 (7.77)	1.11 (1.22)	1.15 (1.33)	1.13 (1.28)	1.60 (2.57)	1.20 (1.43)	1.40 (1.95)	1.92 (3.70)	1.88 (3.55)	1.90 (3.62)
Imidacloprid 17.8% SL 0.0072%	3.00 (8.98)	2.91 (8.46)	2.95 (8.72)	1.35 (1.83)	1.73 (2.99)	1.54 (2.36)	1.75 (3.07)	1.73 (2.99)	1.74 (3.02)	2.03 (4.13)	2.32 (5.40)	2.18 (4.75)
Acetamiprid 20% SP 0.01%	2.80 (7.86)	2.35 (5.55)	2.58 (6.65)	2.29 (5.26)	2.27 (5.14)	2.28 (5.21)	2.48 (6.13)	2.22 (4.93)	2.35 (5.51)	2.77 (7.67)	2.76 (7.59)	2.76 (7.63)
Thiamethoxam 25% WG 0.0125%	2.87 (8.24)	2.94 (8.62)	2.90 (8.43)	2.05 (4.20)	2.05 (4.20)	2.05 (4.19)	2.15 (4.63)	2.04 (4.16)	2.09 (4.38)	2.55 (6.50)	2.53 (6.40)	2.54 (6.45)
Profenophos 50% EC 0.05%	3.12 (9.76)	2.68 (7.19)	2.90 (8.43)	1.69 (2.86)	2.52 (6.33)	2.10 (4.42)	2.16 (4.66)	2.54 (6.47)	2.35 (5.53)	2.48 (6.17)	2.56 (6.56)	2.52 (6.37)
Difenthiuron 50 %WP 0.05%	2.96 (8.75)	2.50 (6.27)	2.73 (7.46)	1.41 (1.98)	1.47 (2.16)	1.44 (2.07)	1.70 (2.90)	1.42 (2.03)	1.56 (2.44)	2.40 (5.77)	3.08 (9.50)	2.74 (7.52)
Buprofezin 25 %EC 0.025%	2.93 (8.57)	2.88 (8.29)	2.90 (8.43)	2.53 (6.40)	2.82 (7.97)	2.68 (7.16)	2.24 (5.03)	2.85 (8.13)	2.55 (6.49)	2.83 (8.00)	3.29 (10.82)	3.06 (9.35)
Control	3.16 (9.98)	3.10 (9.63)	3.13 (9.80)	3.77 (14.21)	4.02 (16.16)	3.89 (15.16)	3.88 (15.06)	3.86 (14.91)	3.87 (14.99)	3.80 (14.44)	3.75 (14.04)	3.77 (14.24)
S.Em.±	0.15	0.17	0.12	0.16	0.18	0.19	0.109	0.119	0.21	0.142	0.134	0.18
C.D. at 5 %	NS	NS	0.33	0.46	0.52	0.61	0.321	0.352	0.68	0.419	0.395	0.57
C.V. %	9.05	10.75	9.89	12.61	13.49	13.09	7.865	9.150	8.50	9.124	8.262	8.69
Y												
S.Em.±			0.05			0.09			0.10			0.08
C.D. at 5 %			0.15			NS			NS			NS
YXT												
S.Em.±			0.16			0.17			0.11			0.14
C.D. at 5 %			NS			NS			NS			NS

Data in parenthesis are retransformed values, while outsides were square root transformed values

Table 2: Efficacy of different insecticides against black fly after second spray

Treat.	3 DAS			7 DAS			15 DAS		
	2014-15	**2016-17**	**Pooled**	**2014-15**	**2016-17**	**Pooled**	**2014-15**	**2016-17**	**Pooled**
Profenophos 40% + cypermethrin 4 % 0.044 %	2.69(7.23)	2.02(4.10)	2.36(5.55)	2.86(8.19)	1.94(3.76)	2.40(5.77)	3.04(9.23)	2.65(7.03)	2.85(8.09)
Nuvaluron 10% EC 0.01%	2.76(7.59)	3.00(9.00)	2.88(8.28)	3.10(9.63)	2.94(8.63)	3.02(9.13)	3.14(9.87)	3.76(14.13)	3.45(11.90)
Spinosad 45% SC 0.0135%	1.22(1.49)	1.58(2.50)	1.40(1.96)	1.74(3.03)	1.44(2.06)	1.59(2.52)	1.93(3.73)	2.21(4.90)	2.07(4.29)
Imidacloprid 17.8% SL 0.0072%	1.40(1.95)	1.88(3.53)	1.64(2.67)	1.84(3.40)	1.82(3.30)	1.83(3.35)	2.04(4.17)	2.55(6.50)	2.30(5.27)
Acetamiprid 20% SP 0.01%	2.35(5.53)	2.33(5.43)	2.34(5.48)	2.48(6.16)	2.25(5.07)	2.37(5.61)	2.76(7.63)	2.87(8.22)	2.81(7.91)
Thiamethoxam 25% WG 0.0125%	2.08(4.32)	2.48(6.17)	2.28(5.20)	2.28(5.20)	2.53(6.40)	2.41(5.78)	2.57(6.63)	2.89(8.36)	2.73(7.47)
Profenophos 50% EC 0.05%	1.79(3.20)	2.65(7.03)	2.22(4.93)	2.24(5.00)	2.69(7.23)	2.46(6.07)	2.52(6.33)	3.10(9.63)	2.81(7.90)
Difenthiuron 50 %WP 0.05%	1.44(2.07)	1.78(3.17)	1.61(2.59)	1.71(2.93)	1.50(2.26)	1.61(2.58)	2.41(5.80)	2.45(6.00)	2.43(5.90)
Buprofezin 25 %EC 0.025%	2.52(6.36)	2.83(8.00)	2.68(7.16)	2.30(5.30)	2.90(8.40)	2.60(6.76)	2.84(8.07)	3.50(12.28)	3.17(10.06)
Control	3.72(13.80)	3.44(11.85)	3.58(12.79)	3.81(14.50)	3.67(13.47)	3.74(13.98)	3.70(13.71)	3.82(14.61)	3.76(14.15)
S.Em.±	0.13	0.13	0.21	0.12	0.105	0.21	0.15	0.144	0.16
C.D. at 5 %	0.39	0.38	0.69	0.36	0.310	0.69	0.45	0.425	0.52
C.V. %	10.50	9.24	9.82	8.58	7.699	8.17	9.84	8.376	9.07
Y									
S.Em.±			0.10			0.10			0.07
C.D. at 5 %			NS			NS			0.23
YXT									
S.Em.±			0.13			0.11			0.15
C.D. at 5 %			NS			NS			NS

Data in parenthesis are retransformed values, while outsides were square root transformed values

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