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The efficacy of insecticidal control in pomelo fruit fly IPM program in Nakhon Si Thammarat Province, Thailand

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The major problem of pomelo production is fruit fly (Tephritidae; Diptera), that damaging causes fruits to fall from the trees so that it is necessary for farmers to use chemicals for controlling continuously. The IPM program for controlling fruit flies were used in Taptim Siam pomelo orchards in Pakpanang district, Nakhon Si Thammarat province, Thailand, from May 2012 to August 2013, with 4-time spraying, 10 days apart during the period of 3-month-old pomelo fruits. The experimental design using RCBD with 3 replications and 6 methods (M) was: 1.(M1)imidacloprid10 %SL+imidacloprid10 %SL+fipronil 5%SC+ imidacloprid 10%SL, 2.(M2) abamectin 1.8% EC+ imidacloprid10 %SL+ fipronil 5%SC+ abamectin 1.8% EC, 3. (M3) petroleum oil 83.9% EC + imidacloprid10 %SL+ fipronil 5%SC+ petroleum oil 83.9% EC, 4.(M4) Thai neem extract (aza. 0.05%)+ imidacloprid%10 SL+ fipronil 5%SC+ Thai neem extract (aza. 0.05%), 5.(M5: farmer method) abamectin 1.8% EC+ abamectin 1.8% EC + abamectin 1.8% EC +abamectin 1.8% EC and 6.(M6) control (non treated). The results revealed that, the average numbers of fruit damage (sting mark per fruit) before sprayed were 0.49-0.72 sting mark per fruit, not significantly different ($p>0.05$) from the control. The average numbers of fruit damage after application IPM program at the time of 3,4,5 and 6 month-old pomelo fruits, found that all methods were significantly difference ($p<0.01$) from control (non treated), were 0.50-1.05, 0.60-1.39,0 .65-1. 39and 0.75-1.39 sting mark per fruit, respectively. The highest effectiveness method at harvesting stage)6-month-old pomelo fruits) was M5 (81.35%), followed by M1, M2 and M3 at 81.29 81.29 and 78.22 %, respectively. The lowest effectiveness method was M4 (76.98%) compared with control (non treated).

Keywords : Taptim Siam Pomelo, IPM, imidacloprid, fipronil, petroleum oil, Thai neem, abamectin

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Introduction

The economically importance pomelo in Nakhon Si Thammarat Province, Thailand, is Taptim Siam pomelo. Recently the demand for this fruit has gradually increase in both domestic and international markets, especially in China, Taiwan, Malaysia, Singapore and Brunei. For commercial purpose, these pomelo should have dark green leaves cover with soft hair, big round fruit with knot and smooth green-yellow skin with compacted tiny oil glands, thin light pink peel with tight row of small dark pink to red shrimp-like flesh, juicy and sour-sweet taste (Sukkaard, 2010). The major problem of Taptim Siam pomelo production is fruit fly, that female adult lay eggs in the fresh of ripening and ripe fruits (Jirasurat, 1987). Once the eggs hatch, the larvae begin to feed within the fruit, causing into ripen prematurely, rot and drop to the ground (Drew, R.A.I. and D.L. Hancock., 1994; Metcalf, R.L., 1990).

According to high price of Taptim Siam pomelo, 200-300 bath/ fruit (DOAE, 2013), the farmer's orchard expand plantation increasing continuously and the side effects that occurred were a large quantities and frequently spraying of pesticide during growing season to protect the pomelo from pest infestation. Such phenomenon, integrated pest management (IPM) was used in the experiment. IPM was the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations, reduce the use of pesticides, decrease risks to human health and the environment (FAO, 2014). IPM is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people and the environment. (US.EPA., 2014). The efficacy of insecticidal control in pomelo fruit fly IPM program in Nakhon Si Thammarat Province, Thailand, aimed to find appropriated methods that are available carefully, reduce pests, avoid the potential harm to humans, natural enemies, environment and less interfere with the agricultural ecosystem.

Materials and methods

The study was conducted on 5 years old Taptim Siam pomelo plantations from May 2012 to August 2013 in Pakpanang district, Nakhon Si Thammarat Province, Thailand. The experimental design was using RCBD with 4 replications (1 tree per replicate) and 6 methods (M) with the following steps.

1. Randomly sampled from 24 trees in the stage of young fruit (3-month-old), if the outbreak of fruit flies occurred over 1 fly per trap (DOAE, 2010), the insecticidal IPM program had been treated with 4-time spraying, 10 days apart by the following methods (M);

1. (M1): imidacloprid10 %SL.+imidacloprid10 %SL.+fipronil 5%SC.+imidacloprid10 % SL.

2. (M2): abamectin 1.8% EC.+ imidacloprid10 %SL.+ fipronil 5%SC.+ abamectin 1.8% EC.

3. (M3): petroleum oil 83.9% EC.+imidacloprid10 %SL.+ fipronil 5%SC.+ petroleum oil 83.9% EC.

4. (M4): Thai neem extract (aza. 0.05%)+ imidacloprid10 %SL.+ fipronil 5%SC.+ Thai neem extract (aza. 0.05%)

5. (M5): abamectin 1.8%EC.+abamectin 1.8% EC.+abamectin 1.8% EC. +abamectin 1.8% EC. (farmer method)

6. (M6): control (non treated)

For the used of imidacloprid10 %SL. and fipronil 5%SC. at the 2 and 3-time spraying in the experiment were adapted from the Instructions of DOA (2010).

2. Recorded the numbers of fruit fly damage on pomelo fruit surface (number of sting mark per fruit) at 3 to 6 month-old fruits before and after spraying (during the period of 3-month-old pomelo fruits to harvesting stage)

3. Analysis of variance (ANOVA) and means were compared by using the Duncan's Multiple Range Test (DMRT). Calculated the effectiveness methods(%) at the 3 to 6 month-old fruits after spraying compared with the control (non treated).

Effectiveness method (%)= $[(C_2\ T_1 - C_1\ T_2)/C_2\ T_1] \times 100$ (adapted from Handerson and Tilton, 1995).

C_1 and C_2 : Number of sting mark per fruit before and after spraying in control)non treated (

T_1 and T_2 : Number of sting mark per fruit before and after spraying in each methods

Results

The efficacy of insecticidal control in pomelo fruit fly IPM in Nakhon Si Thammarat province, Thailand, the result showed that the number of fruit damage (sting mark per fruit) before insecticides application were not significantly different ($p>0.05$) from the control (non treated), the average numbers of fruit damage were 0.49-0.72 sting mark per fruit. After spraying

insecticides, the average numbers of fruit damage at 3, 4, 5,and 6 month-old pomelo fruits were 0.50-1.05, 0.60-1.39,0 .65-1. 39and 0.75-1.39 sting mark per fruit, respectively, which significantly difference ($p<0.01$) from control (non treated), except M3 method at 3 month-old pomelo fruit was not significantly difference from control (Table1).

Table 1. Number of fruit fly damage on pomelo fruit surface (number of sting mark per fruit) at 3-6 month-old fruits before and after spraying during the period of 3-month-old pomelo fruits to harvesting stage on farmer's orchard from May 2012 to August 2013

Methods	Number of damage on fruit surface (sting mark per fruit) [5/]				
	before spraying	after spraying at 3 to 6 month-old pomelo fruits [6/]			
		3	4	5	6
M1: Imi [1/] +Imi[2/]+Fip[3/]+Imi[4/]	0.49	0.50c	0.60d	0.65c	0.75c
M2: Aba [1/] +Imi[2/]+Fip[3/] +Aba [4/]	0.61	0.63b	0.78d	0.80c	0.90bc
M3: Pe[1/] + Imi[2/]+Fip[3/]+ Pe[4/]	0.78	1.05a	1.39b	1.39b	1.39b
M4: Ne[1/] + Imi[2/]+Fip[3/]+ Ne[4/]	0.60	0.70b	1.09c	1.13b	1.13bc
M5: farmer's method (Aba[1/] +Aba[2/] + Aba[3/]+ Aba[4/])	0.59	0.60bc	0.70d	0.75c	0.90bc
M6: control) non treated (	0.72	1.10a	2.23a	3.40a	5.89a
F-test	ns	**	**	**	**
C.V.(%)	24.20	9.07	16.08	15.94	20.34

[1/] 1st spraying [2/] 2nd spraying [3/] 3rd spraying [4/] 4th spraying
[5/] average from4 replications (1 tree per replicate, 5 fruits per tree)
[6/] number in the column with same letters not significantly different ($p>0.05$)
ns non significantly different ($P>0.05$) ** significantly different ($P<0.01$)

The meaning of insecticides had been treated in each method :
Imi = imidacloprid10 %SL, 10 ml/ 20 L. of water
Fip = fipronil 5%SC, 10 ml/ 20 L. of water
Aba = abamectin 1.8% EC , 15-20 ml/ 20 L. of water
Pe = petroleum oil 83.9% EC,4 0 ml/ 20 L. of water
Ne = Thai neem extract (aza. 0.05%) 100 ml/ 20 L. of water

The highest effectiveness methods at the period of 3 to 5 month-old pomelo fruits was M5 (farmer method), followed by M1 and M2. The low effectiveness methods were M3 and M4, respectively. The highest effectiveness methods at harvesting stage)6-month-old pomelo fruits) compared with control)non treated (was M5(farmer method), 81.35% and followed by M1, M2 and M3 were 81.29, 81.29 and 78.22 %, respectively. The lowest effectiveness method was M4 (76.98%) compared with control (Table 2).

Table 2. The effectiveness methods (%) from fruit fly damage (number of sting mark on pomelo fruit surface per fruit) at 3-6 month-old fruits after the IPM program had been treated with 4-time spraying, 10 days apart during the period of 3-month-old pomelo fruits compared with control)non treated (on farmer's orchard from May 2012 to August 2013

Methods	Effectiveness methods after spraying at 3-6 month-old fruits compared with control)non treated(%) ([1/]			
	3	4	5	6
M1: Imi [1/] +Imi[2/]+Fip[3/]+Imi[4/]	31.21	60.46	71.91	81.29
M2: Aba [1/] +Imi[2/]+Fip[3/] +Aba [4/]	32.40	58.71	72.23	81.29
M3: Pe[1/] + Imi[2/]+Fip[3/]+ Pe[4/]	11.89	42.35	62.26	78.22
M4: Ne[1/] + Imi[2/]+Fip[3/]+ Ne[4/]	23.64	41.35	60.12	76.98
M5: farmer's method (Aba[1/] +Aba[2/] + Aba[3/]+ Aba[4/])	33.44	61.69	73.08	81.35
M6: control)non treated (	-	-	-	-

[1/]Effectiveness methods(%) = $(C_2 T_1 – C_1 T_2)/ C_2 T_1) \times 100$ (adapted from Handerson and Tilton, 1995)

C_1 and C_2 : Number of sting mark per fruit before and after spraying in control)non treated (

T_1 and T_2 : Number of sting mark per fruit before and after spraying in each method

The meaning of insecticides had been treated in each method :

Imi = imidacloprid10 %SL, 10 ml/ 20 L. of water

Fip = fipronil 5%SC, 10 ml/ 20 L. of water

Aba = abamectin 1.8% EC , 15-20 ml/ 20 L. of water

Pe = petroleum oil 83.9% EC,4 0 ml/ 20 L. of water
Ne = Thai neem extract (aza. 0.05%) 100 ml/ 20 L. of water.

Conclusion

The insecticidal IPM program had been treated with 4-time spraying, 10 days apart from the 3 month-old pomelo fruits,at the age of 3,4,5 and 6 month pomelo fruits found that all methods using were 0.50-1.05, 0.60-1.39, 0.65-1. 39and 0.75-1.39, sting mark per fruit ($p<0.01$) respectively,which were significantly different from control (non treated), The highest effectiveness method at harvesting stage)6-month-old pomelo fruits) was M5-farmer method : (abamectin 1.8% EC[1/] + abamectin 1.8% EC[2/] + abamectin 1.8% EC[3/] +abamectin 1.8% EC[4/]) at 81.35%, followed by the group of synthetics insecticides method : M1 and M2 were 81.29 and 81.29 %, respectively. The lowest effectiveness methods were the group of oil and plant extracts integrated with synthetics insecticides : M3 and M4 were 78.22 and 76.98%, respectively.

The farmer method, that used abamectin 1.8% EC. with 4-time spraying was the highest effectiveness, but for a long time, the groups of synthetics insecticides such as M5 M1 and M2, usually have been found the happening of insect resistance, the insecticidal contaminated in fruit production and ecosystem. The used of synthetics insecticides also side effect to the predatory and parasitoid insects in farmers'orchard.

The group of oil and plant extracts that integrated with synthetics insecticides are decreased chemical using, effectively controlled, safe for farmer, natural enemies, environment and agricultural ecosystem. For the recommend to performed plant extracts and bio-insecticides, should use in the morning or evening because there were not stable and decomposes easily when exposed to sunlight or circumstances change(DOA, 2014). The activity often deteriorates of high leaching conditions. Therefore, considering an appropriate timing of spraying in order to achieve maximum efficiency, as an alternative way, the farmers could decreased synthetics insecticides with the used of oil and plant extracts, which are safer for users and environment.

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