

Thrip Damage on Off-Season and In-Season Mangosteen Production in Nakhon Si Thammarat, Thailand

Tipawan THONGJUA^{*}, Jarun THONGJUA and Chaisit PREECHA

Faculty of Agriculture, Rajamangala University of Technology Srivijaya, Nakhon Si Thammarat 80110, Thailand

(* Corresponding author's e-mail: kai_thipawan@hotmail.com)

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Abstract

The damage of thrips (Thripidae: Thysanoptera) on mangosteen production were studied in local orchards in Nakhon Si Thammarat from September 2008 to July 2010. It was found that the damage was related directly to thrip population and the cycles of mangosteen growth such as the young leaves, flowering and young fruit stages. For the first and second year-rounds, off-season production, thrip abundance in October was averaged at 0.57 and 0.26 thrips/shoot in September. For the in-season production in April; the amount of thrips was averaged at 0.12 with 0.15 thrips/shoot, respectively. The lowest amount of thrips was noticed in the harvesting season of the two-year-round production. The damage at the flowering and young fruits stages due to rough scarring on the fruit surfaces and calyxes at the harvesting period were caused by thrips. The average rough scars on the fruit surface in the first- and second year- round, off-season production were 22.03 and 28.87 %; in-season production were 23.12 and 21.60 %, respectively. However, the rough scars on fruit calyxes at the harvesting period were found to be 100 %. The fruit gamboges in the first- and second year- round, off-season production were averaged at 45.40 and 23.92 %; and in-season production at 46.44 and 13.19 %, respectively. Over 20 % of rough scars appearing on fruit surfaces of the total mangosteen production lowered the quality for export. Good management in the local orchards is essential for increasing the marketing quality of mangosteen production.

Keywords: Thrip, off-season, in-season, year-round production, mangosteen

Introduction

Mangosteens are one of the economically important tropical fruits both for domestic consumption and export. Thailand is the world's largest producers; most production of mangosteens comes from the eastern and southern provinces [1]. Recently, the demand for this fruit has gradually increased in both domestic and international markets, especially in Europe and Japan. One of the major problems in qualitative production is mangosteen thrips that destroy young leaves, flowers and young fruits, decrease the quality, and cause economic losses. The damage caused by thrips are fine leaf margins rolled upward on both sides, and brown marks on leaves [2,3]. If the outbreak occurs during the young fruit stage, it

may cause fruit-retarding, rough scarring on the fruit surfaces, and fruit gamboges which are unacceptable for the overseas markets. At present, the main factors affecting the mangosteen prices are fruit surface and fruit size the weight of which must be higher than 75 g/fruit [1]. The scarring-free fruits can also get higher prices.

In Thailand, the production of high quality mangosteens is less than 60 % of the total production [4,5]. In Nakhon Si Thammarat, a southern province of Thailand, off-season mangosteens can be produced in many districts; these off-season yields give more attractive market prices. Therefore, this research aimed to determine the species of thrips which cause scarring on

mangosteen fruits, the population of mangosteen thrip distributed in the orchards and the percentage of thrip damage, and to assess the quality of in-season and off-season fruits in the province. The results of the study may be beneficial for thrip control and the management of mangosteen quality in the future.

Materials and methods

Population of mangosteen thrips and thrip damage

Mangosteen thrips were surveyed every week in the local fields in Ron Phibun, Lansaka and Cha-uat districts, Nakhon Si Thammarat province, Thailand. Thrip counting and species identification were randomly selected from 10 shoots/tree, three trees/field and one orchard/district. The methods of thrip counting and identification were modified from Pankeaw [6], which was adapted from the methods of Poonchaisri [3]. To determine the mangosteen thrip populations and thrip damage, the number of thrips and thrip damage were counted from 30 shoots/tree at the low canopy every week from the first year-round mangosteen production (September 2008 to July 2009) to the second year-round mangosteen production (August 2009 to July 2010) at the stages of young shoots, flowers, young fruits, fruit development and harvesting.

Assessment of thrip damage

The percentage of rough scars on fruit surfaces, calyxes and fruit gamboges were studied and recorded during the first-year round (September 2008 to July 2009) and the second-year round mangosteen production (August 2009 to July 2010). Three hundred fruits were randomly sampled in each orchard in the three studied districts during the harvesting period. After collecting the fruits, they were sorted into 4 groups based on visual determinations as follows [7,8]:

rough scars throughout the fruit surfaces = 100 %

rough scars on $\frac{3}{4}$ of fruit surfaces = 75 %

rough scars on $\frac{1}{2}$ of fruit surfaces = 50 %

rough scars on $\frac{1}{4}$ of fruit surfaces = 25 %

The differences among means of rough scars on fruit surfaces, the percentage of fruit having

scars on calyxes, fruit gamboges, and fruit size (> 70 g/fruit) were estimated by paired t-test.

Results and discussion

Population of mangosteen thrips and thrip damage

Two species of thrips found on the local orchards were *Scirtothrips dorsalis* Hoods and *S. oligochaetus* Karny [3,7,9]. Meanwhile *S. dorsalis* Hoods and *S. rubrocinctus* Giard are known as the pests that cause scars on mangosteen in Indonesia [10]. The highest numbers of thrips were collected from young shoots, followed by from young fruits. The smallest number was collected from the flowers [9,11].

First year-round mangosteen production (September 2008 to July 2009)

The thrip population at the off-season increased steadily from September to November with a peak in October, which fell in the fruit development and young shoot stages. After that, the thrip population appeared to decrease considerably in the harvesting period. During the in-season production, the population peaked in April at 0.12 thrips/shoot. At the harvesting stage in June and July, the population of thrips was reduced (Table 1).

Second year-round mangosteen production (August 2009 to July 2010)

The second year-round off-season mangosteen production was earlier than the first year-round approximately 1 month according to the dry period 3 - 4 weeks from June to July 2009 which induced mangosteen flowering in late July to early August 2009. The population of thrips in the off-season was large in August reaching its highest point in September at the fruit development and young shoots stages. In September, the population of thrips in Ron Phibun, Lansaka and Cha-uat districts averaged 0.26 thrips/shoot. In November, at the harvesting stage, the thrips were not found in the fields in all districts. In December, after the harvesting stage, the trees grew new young leaves, causing an increase in the thrip population. The average population of thrips was 0.08 thrips/shoot. In January, the thrips were not found in all districts. However, in February approximately 0.01 thrips/shoot were found, but only in Cha-uat

district. For the in-season mangosteen production, the thrips population increased in March. In April at the flowering stage and young fruit stage, the highest thrip population was observed at 0.15 thrips/shoot. At the fruit development and harvesting stages in May, June and July, the thrips

were not found in all districts. The study shows that the population of thrips was related directly to the growth cycle of mangosteens such as the young leaves stage, flowering stage and young fruits stage with the lowest populations noticed in the harvesting seasons (**Table 1**).

Table 1 Average mangosteen thrip population (thrips/shoot) in Ron Phibun, Lansaka and Cha-uat district, Nakhon Si Thammarat province, during September 2008 to July 2010, the first and second year-round mangosteen production.

First year-round mangosteen production ^{1/} (September 2008 to July 2009)						Second year-round mangosteen production ^{1/} (August 2009 to July 2010)					
Area/ Date	Ron. ^{2/}	Lan. ^{3/}	Cha. ^{4/}	Mean	Development stage	Area/ Date	Ron. ^{2/}	Lan. ^{3/}	Cha. ^{3/}	Mean	Development stage
Aug.						Aug.	0.26	0.08	0.24	0.19	Flower/young fruits
Sep.	0.28	0.46	0.42	0.39	Flower/young fruits	Sep.	0.32	0.11	0.36	0.26	Fruits *
Oct.	0.31	0.52	0.88	0.57	Fruits *	Oct.	0.03	0.06	0.00	0.03	Fruits *
Nov.	0.18	0.15	0.13	0.15	Fruits	Nov.	0.00	0.00	0.00	0.00	Harvesting
Dec.	0.05	0.04	0.12	0.07	Harvesting	Dec.	0.06	0.08	0.11	0.08	Harvesting*
Jan.	0.01	0.01	0.07	0.03	Harvesting	Jan.	0.00	0.00	0.00	0.00	Old leaves
Feb.	0.04	0.03	0.02	0.03	Harvesting	Feb.	0.00	0.00	0.01	0.00	Old leaves
Mar.	0.02	0.02	0.04	0.03	Flower/ *young fruits	Mar.	0.04	0.03	0.06	0.04	Flower shoot
Apr.	0.11	0.13	0.11	0.12	Fruits	Apr.	0.05	0.03	0.36	0.15	Flower/young fruits
May	0.03	0.04	0.03	0.03	Fruits	May	0.00	0.00	0.00	0.00	Fruits
Jun.	0.04	0.03	0.01	0.03	Harvesting	Jun.	0.00	0.00	0.00	0.00	Fruits
Jul.	0.01	0.01	0.03	0.02	Harvesting	Jul.	0.00	0.00	0.00	0.00	Harvesting
Mean	0.10	0.13	0.17	0.20	-	Mean	0.07	0.03	0.10	0.10	-

^{1/}Means from 30 shoots/tree, ^{2/}Ron Phibun district, ^{3/}Lansaka district, ^{4/}Cha-uat district, *Leaves shooting

Assessment of thrip damage

Percentage of rough scars on fruit surfaces

In the first year-round, off-season mangosteen production (September 2008 to July 2009), the percentage of rough scars on fruit surfaces was not significantly different between the off-season and in-season. The results showed that rough scars on fruit surfaces at the harvesting stage in Ron Phibun, Lansaka and Cha-uat districts were approximately 22.03 %, and in-season was about 23.12 %. The second year-round, off-season mangosteen production (August 2009 to July 2010) showed a higher percentage of rough scars on fruit surfaces than that of the in-season production. The average percentage of rough scars on fruit surfaces at the harvesting stage was 28.87 %, and in-season was 21.60 % (Table 2).

When comparing the first year-round, off-season and in-season mangosteen productions from September to February 2008, the thrip population on the fruit surfaces in Cha-uat district were higher than those of Lansaka and Ron Phibun districts, but the percentage of rough scars on fruit surfaces at the harvesting stage in Cha-uat district was less than those in Lansaka and Ron Phibun districts. This may be because in October mangosteen trees in Cha-uat district had young leaf shoots, attracting an abundance of thrips to the trees causing damage to the young leaves. The thrips tended to damage young leaves rather than young fruits and flowers which is probably because young leaves have softer tissue than young fruits and flowers. This is consistent with the study of Pankeaw *et al.* [6] who found that the highest number of thrips was collected from young leaf shoots, followed by young fruits. The smallest number of thrips was collected from the flowers. Jumroenma *et al.* [12] found that the population abundance of thrips on the trees was correlated to the percentage of new flushing shoots. In addition, farmers in Cha-uat district applied chemicals on the trees three times a year to control thrips at the flowering, leaf shooting and young fruit stages, while the farmers in Lansaka and Ron Phibun did not.

Percentage of fruit with rough scars on calyxes

Regarding the percentage of fruit with rough scars on calyxes, off-season and in-season of both year-round mangosteen productions, the results showed that all fruits were 100 % infected due to thrip infestation at the young flower and young fruit stages, leading to rough scarring on the fruit surfaces and calyxes at the harvesting period (Table 2).

Percentage of fruit with fruit gamboges

The average percentage of fruit with fruit gamboges was not significantly different between the off-season and in-season at the first year-round mangosteen production among the three districts (Table 1). Nevertheless, in the second-year round mangosteen production, the average percentage of fruit with fruit gamboges between the off-season and in-season was significantly different. The possible reason of this incidence was the heavy rains during the harvesting period at the off-season which result in sudden enlargement of fruit leading to rind cracking and latex exudation [13] (Table 2).

Percentage of fruit (> 70 g/fruit)

There was a significant difference in the average percentage of fruit of required size (> 70 g/fruit) between the off-season and in-season in the two year-round mangosteen productions. In the first year-round, the off-season averaged 63.00 and in-season 38.67 %, respectively, while the off-season second year-round averaged 77.10 and 65.11 % for the in-season, respectively (Table 2).

It is obvious that most of the in-season fruits after off-season harvesting were significantly smaller than the standard fruits i.e. smaller than 75 g/fruit. The reason is that the trees giving both off-season production and in-season production successively had suffered from insufficient food for fruit development. As a result, the in-season fruits were smaller. It is necessary to provide special management for the trees giving off-season production, for example, weeding, watering, and increasing fertilization. Another factor affecting the fruit size is probably the lower prices of in-season mangosteens. Consequently, less attention is paid to orchard management during the in-season production led to lower quality mangosteen production.

Table 2 Average percentage of rough scars on fruit surfaces and the fruit number with rough scars on calyxes, fruit gamboges and fruit size (> 70 g/fruit) in Ron Phibun, Lansaka and Cha-uat district, Nakhon Si Thammarat province, during September 2008 to July 2010 at off-season and in-season in the first and second year-round mangosteen production.

Mangosteen production	First year-round ^{1/} (September 2008 - July 2009)			Mean ^{2/7/}	Second year-round ^{1/} (August 2009 - July 2010)			Mean ^{2/7/}
	Ron. ^{3/}	Lan. ^{4/}	Cha. ^{5/}		Ron. ^{3/}	Lan. ^{4/}	Cha. ^{5/}	
	<u>Rough scars on fruit surfaces^{6/}</u>							
Off-season	28.49	24.30	13.30	22.03 ^{7/}	36.27	20.06	30.26	28.87 ^{7/}
In-season	30.36	28.35	10.64	23.12	23.48	25.36	15.94	21.60
T-test	ns	ns	ns	ns	*	ns	**	*
	<u>Fruit number with rough scars on calyxes</u>							
Off-season	100	100	100	100	100	100	100	100
In-season	100	100	100	100	100	100	100	100
T-test	ns	ns	ns	ns	ns	ns	ns	ns
	<u>Fruit number with fruit gamboges</u>							
Off-season	46.99	49.44	39.77	45.40	14.77	27.00	19.99	23.92
In-season	51.22	52.99	35.10	46.44	9.58	16.22	13.77	13.19
T-test	ns	ns	ns	ns	ns	ns	ns	**
	<u>Fruit number with fruit size > 75 g/fruit</u>							
Off-season	61.67	56.67	70.67	63.00	81.67	78.67	72.67	77.10
In-season	29.33	28.33	38.67	32.11	69.67	53.00	70.98	65.11
T-test	*	*	*	**	ns	*	ns	*

^{1/} Means from 900 fruits, ^{2/} means from 2,700 fruits, ^{3/} Ron Phibun district, ^{4/} Lansaka district, ^{5/} Cha-uat district

^{6/} Means from 3 replications, ^{7/} means from 9 replications, ns = not significant, * significant at 95 % level, ** significant at 99 % level

Conclusions

Two predominant species of thrips were found; *Scirtothrips dorsalis* Hoods and *Scirtothrips oligochaetus* Karny. Thrip populations were related directly to the cycle of mangosteen growth such as the young leaf, flowering, and young fruit stages. Thrip damage was found at the flowering and young fruit stages producing rough scars on fruit surfaces and calyxes at the harvesting period which depended on the number of thrips on the flowers and young fruits. According to the research on the quality of mangosteen production in the two-year rounds, at the off-season and in-season in Nakhon Si Thammarat province, the mangosteen showed low quality for export. High quality mangosteens for export are determined by good fruit size (> 75 g/fruit), without flesh translucent disorders, without scars on fruit

surfaces and calyxes, and no fruit gamboges. Therefore, methods of controlling thrips on mangosteens need to be introduced to help farmers produce high quality mangosteens in the future.

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