

# APPLICATION OF FRUIT BAGGING, SANITATION, AND YELLOW STICKY TRAP TO CONTROL THRIPS ON MANGOSTEEN

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## ABSTRACT

Scars on mangosteen fruits caused by thrips are the most prominent constraint in Indonesian export of mangosteen. Most of the exported mangosteen are rejected due to scar appearance. This research aimed to study the effects of fruit bagging, sanitation, and sticky trap application on the scar intensity on mangosteen. The research was conducted at a farmer's polycultured mangosteen orchard in Lima Puluh Kota, West Sumatra, Indonesia from September 2006 to February 2007. The mangosteen trees were cultured with cacao and coconut. To study the effects of bagging on the number of scars, the fruits were individually bagged at different time points starting from the time of calyx falling down (0) followed at 2, 4, 6, 8, 10, 12, and 14 weeks later. Each treatment was replicated six times. The experiment of sanitation (SNT) and yellow fluorescent sticky trap (YST) application was designed in a completely randomized design with six replications, except for the control which was replicated only three times. Four treatments studied were SNT, YST, combination of SNT+YST, and control. The sanitation was applied by removing all weeds under the canopy of mangosteen trees followed with soil tillage and fogging. The sticky trap was nailed on woody sticks and placed on 3 m above the ground at four different positions around the tree canopy. Parameters observed were the percentage and intensity of scars and number of thrips caught on the sticky traps. The results showed that application of early bagging, SNT, YST, and SNT+YST were effective to reduce intensity and percentage of scars. However, combination of SNT+YST demonstrated the best results in reducing the intensity and percentage of scars by 32.14% and 42.82%, respectively. Combination of SNT+YST also drastically decreased thrips population as indicated by the low number of thrips caught after five biweekly observations. Since the fifth observation, the thrips population was low (less than 5 thrips caught per sticky trap) and far below the economic threshold. The present study implies the importance of early fruit bagging, sanitation, and sticky trap application in protecting mangosteen fruits from scars.

[Keywords: Mangosteen, thrips, pest control]

## INTRODUCTION

Mangosteen is one of the important fruit commodities of Indonesia both for domestic and international markets. Mangosteen is expected to become a major Indonesian fruit export commodity because the plant

is widely grown throughout the country. Indonesia is one of the main producing mangosteen countries in the world besides Thailand and Malaysia (Poerwanto 2000). Export of mangosteen in 2000 reached 7182 tons equal to US\$5,885,035 and contributed up to 45% to the total fruit export value (Winarno 2002).

One of the constraints in export of mangosteen is the high percentage of scars, causing only 25% of the exported fruits fulfilled the international standard quality (Susan, mangosteen exporter, pers. comm.). Preliminary study showed that thrips (Tysanoptera: Thripidae) infestation caused scars on the mangosteen fruit. The pest is also known to cause scars on other fruits such as apples (Childs 1927; Jacob 1995), grapes (McNally *et al.* 1985), and avocado (Dennil and Erasmus 1992; Hoddle and Morse 1997). Typical symptoms of the mangosteen fruit affected by thrips are silvering of the skin, pale yellow to brown discoloration, elongated and patchy scars or hardened, and "alligator skin" like scars that may cover the entire fruit surface. Heavily scarred skin can sometimes prevent the fruit development to achieve the normal size.

Methods to control thrips on mangosteen are still limited. However, several control methods can be adopted to control the thrips, such as application of botanical pesticides derived from the seeds of *Schoenocaulon officinale*, as well as synthetic insecticides such as abamectin and spinosad (Hoddle *et al.* 1998; Wee *et al.* 1999; Faber *et al.* 2000; Astridge and Fay 2006). Other cultural techniques to control thrips population are application of composted organic yard waste or composted mulch under the plant canopy, and augmentation of predatory thrips *Frankliniopsis orizabensis*, *F. vespiformis*, and *Leptothrips mcconnelli* (Hoddle *et al.* 1998; Hoddle *et al.* 1999; Hoddle *et al.* 2002). University of California Statewide Integrated Pest Management Program (2006) suggested an integrated pest management (IPM) for controlling thrips population, including optimal use of natural enemies, sanitation

by removing all weeds under the canopy to eradicate its alternative hosts, regular pruning of infected trees, application of fluorescent yellow sticky trap, and using reflective mulch to disturb host plant orientation of the thrips. Synthetic insecticide is used as the last alternative when other control methods are not satisfied. Application of fluorescent sticky trap is limited for monitoring thrips population due to expensive price of adhesive glues such tanglefoot (Chu *et al.* 2006). Therefore, it is necessary to modify the application of sticky traps not only for monitoring the thrips but also for controlling its population.

Any control methods of thrips on mangosteen need to be socialized to farmers because they did not realize the importance of thrips infestation to the quality of mangosteen fruits they produced. Recently, price of mangosteen fruits is determined based on a collateral price system, therefore farmers were not affected very much, although the price they received was lower. On the other hand, at the level of collectors and exporters, the quality of mangosteen fruits especially those free of scars significantly determines the price. The study aimed to evaluate the effect of fruit bagging, sanitation, and sticky trap application on the percentage and intensity of scars on mangosteen fruits.

## MATERIALS AND METHODS

The research was conducted at a farmer's mangosteen orchard at Lima Puluh Kota, West Sumatra, from September 2006 to February 2007. The mangosteen tree was planted in a polyculture system with cacao and coconut. The planting distance amongst mangosteen trees was 8-9 m x 9 m. The cacao and coconut were planted sporadically in the orchard. The mangosteen trees are 10-15 year-old with approximately 4-7 m height. Scar intensity at the orchard was high (may reach 100%) and endemic.

### Effects of Fruit Bagging

Twenty-four trees were sampled and used for the experiment. Fruits were randomly chosen from branches lie 3 m above the ground. Selected fruits were individually bagged using a double layer food paper (one side was paper; the other side was plastic layer). The size of the paper was 38.7 cm x 29.5 cm. Bagging of the fruits was started just after the calyx falling down followed 2, 4, 6, 8, 10, 12, and 14 weeks later. Each treatment was replicated six times. Scar intensity was observed when the fruits were harvested.

### Effects of Sanitation and Sticky Trap

The experiment was designed in completely randomized design with four treatments and six replications, except for the control which was replicated only three times. The treatments were sanitation (SNT), yellow fluorescent sticky trap (YST), combination of SNT+YST, and control. Sanitation was applied by removing all weeds under the canopy of mangosteen tree followed with soil tillage and fogging through burning the coconut husk. Burning of coconut husk was done when there was no wind blowing around the experimental field. Among each unit of sample trees there was a barrier of non-sampling mangosteen trees to avoid a drift effect due to fogging. The sanitation practices were repeated monthly until reaching the harvesting period.

YST tubes made of aluminum zinc having a tube shape of 10 cm in diameter were nailed on a woody stick as high as 3 m above the ground. A transparent rat glue was smeared on one side of the surface of a transparency overhead projector (OHP) plastic (21 cm x 33 cm). The plastic with the glue part outside was then put on the YST tube. Four wooden sticks with YST tubes were put at four different opposite points of the mangosteen canopy about 30 cm from the outer side of the canopy. Any insects trapped were stuck on the YST glue. The sticky trap plastics were removed and the thrips were counted and then replaced with the new one in every 2-week period. The treatment of SNT+YST was performed by combining both procedures as previously described.

### Data Collection and Analysis

Parameters observed include the percentage and intensity of fruit scars, percentage and intensity of scars collected once in 2 weeks of a single mangosteen fruit bagging done during the harvesting time, and the number of thrips caught on the sticky trap done once in 2 weeks during the fruit growth stage. Percentage of scars was defined as number of scarred fruits divided by total number of observed fruits, then multiplied by a hundred percent. Modification of Mahfud *et al.* (1994) method was used to count the intensity of scarring that was defined as value of scars (1-100) divided by the highest value of scars, then multiplied by a hundred percent. Scar intensity was calculated by dividing the mangosteen fruits being eight parts in the same portion. Each part contains 12.5% toward all portions of a mangosteen fruit. Observations were done once in 2 weeks. The collected data were analyzed using a Duncan Multiple Range Test (DMRT).

## RESULTS AND DISCUSSION

### Effect of Fruit Bagging Period

Scar intensity on the mangosteen fruits bagged at different times after the calyx drops off increased with the delaying of bagging time (Table 1). Scar intensity increased sharply from 2.79% at the first observation (week 0) to 12.13% after 4 weeks, and finally it became 44.26% after 14 weeks. It indicates that any control means to protect the fruits from scars must be applied as early as possible. Scar intensity on the fruits determines its selling price at both collectors and exporters. Although the mangosteen fruits with scar intensity less than 30% are still accepted by the traders, the price would be lower than those contain no scars. However, no trader will accept mangosteen fruits with more than 30% scars.

Generally fruit bagging was effective to reduce scar intensity without affecting the fruit diameter (average diameter was 5.78 cm), because the normal fruit size ranged 5.0-6.5 cm. Further study is necessary to find other type of bagging which is not only effective to protect fruits from thrips infection but could also maintain fruit appearances.

Early bagging, just after the calyx falling down resulted in low scar intensity (2.79%), possibly because the fruits were protected from the thrips while collecting pollens, a prominent source of protein for thrips to produce an egg (Tsai *et al.* 1996). Delayed bagging of the fruits, in contrary, allowed the thrips to search more pollen and colonize fruits, resulting in higher scar intensity (44.26%). On citrus, as comparison, thrips infestation last for 3-5 weeks after flowering increased the severity of fruit damage (Hasyim *et al.* 2003).

### Effect of Sanitation and Yellow Sticky Trap

The results showed that sanitation by removing all weeds significantly reduced thrips infestation by

97.5%. This sanitation practice was associated with the elimination of weeds used as alternative hosts for breeding habitat, food and refugee of the thrips (Rethwisch *et al.* 1998; Kuepper 2004). Application of YST reduced thrips population by 1.92 thrips per trap at the end of observation. Similar results were reported by after workers that YST was effective to control thrips on avocado (Hoddle dan Morse 2003) and citrus (Hasyim *et al.* 2003).

Observation on scar intensity showed that sanitation was effective to reduce scar intensity by 25.24%. However, combination of SNT+YST gave the most significant reduction on scar intensity by 32.24% (Table 2). Sanitation will cut off life cycle of the thrips and the survive thrips will be trapped by yellow sticky trap.

All of the treatments applied also successfully reduced the percentage of scarring and was significantly different from control (Table 2). Single treatments of SNT or YST reduced the percentage of scarring by 16.44% and 21.63%, respectively, compared to control. Combination of SNT+YST on the other hand was able to reduce the percentage of scarring as much as 41.82%. High reducing percentage of scarring by the treatment was possibly due to the effective barrier of that treatment to cut off a life cycle of the thrips.

Observation on thrips caught by the YST as an estimate of thrips population showed a high population number in the early observations (the first and second times of the biweekly observations) (Fig. 1). Funderburk (2002) stated that population dynamics of flower thrips would be a function of flower density.

Treatments of SNT and SNT+YST (Fig. 2) drastically decreased thrips population (Fig. 1). Starting at the fifth observation, the thrips population was evidently low and far below the economic threshold. Hoddle and Morse (2003) stated that when 3-5 thrips was consistently found per leaf for 97 days, 75-36 days before fruit set, and during fruit set, feeding will cause 26-38%, 18-28%, and 6-15% economic scarring

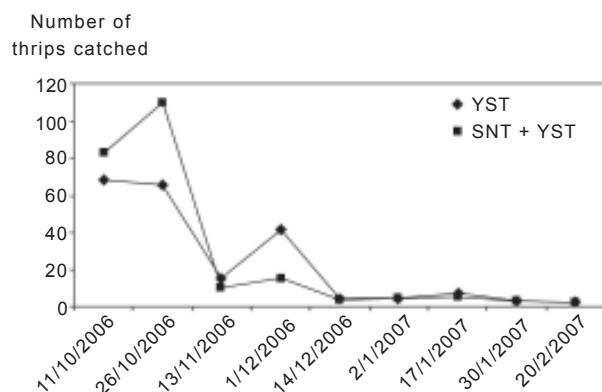
**Table 1. Scar intensity on mangosteen fruits bagged at different time points after the calyx falling down.**

Bagging time (week)	Scar intensity (%)	
	Average	Standard deviation
0	2.79	3.24
2	6.28	6.12
4	12.13	14.98
6	11.61	13.75
8	11.06	10.48
10	19.23	18.90
12	41.82	22.06
14	44.26	22.88

**Table 2. The intensity and percentage of scars on mangosteen fruits of four treatments at the end of observation.**

Treatment	Scar intensity	Scar percentage
Control	41.93a	100.00a
Sanitation (SNT)	16.69b	83.56b
Yellow fluorescent sticky trap (YST)	15.65b	78.37b
SNT + YST	9.79b	58.19c

Mean values in each column with the same letters are not significantly different at  $p = 0.05$  based on Duncan Multiple Range Test (DMRT).



**Fig. 1.** Average number of thrips caught in a biweekly observation of fluorescent yellow sticky trap (YST) and its combination with sanitation (SNT+YST).



**Fig. 2.** Combination treatment of sanitation and yellow fluorescent sticky trap (left), and symptom of scars on mangosteen fruit (right).

damage on avocado fruit, respectively. Hasyim *et al.* (2003) reported that the economic injury level of thrips on citrus occurred if there was enough thrips population available in the field (e.g., 5 thrips were caught per YST). A controlling action, therefore, should be done when the population number observed in the field has reached four thrips caught per YST.

## CONCLUSION

Bagging, sanitation, yellow fluorescent sticky trap, and combination of sanitation and yellow fluorescent sticky trap were effective to reduce the intensity and percentage of scars on mangosteen fruits. Combination of sanitation and yellow fluorescent sticky trap was the best in reducing the intensity and percentage of scars by 32.14% and 42.82%, respectively.

Application of sanitation and yellow fluorescent sticky trap also drastically decreased thrips population in the orchard to be less than 5 thrips caught per sticky trap. The thrips population was far below the economic threshold for thrips management.

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