

Flowering and Fruiting of Sapindaceous Crops in Hawaii

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Introduction

Rambutan (*Nephelium lappaceum*) is an important Sapindaceous fruit crop in Hawai'i. Other Sapindaceous crops include lychee, longan, and pulasan. According to the Hawai'i Agricultural Statistics service, in 2003, 39% of the tropical fruit market was comprised of rambutan sales which totaled \$834,000. The total sales of this crop have been slowly rising each year as the popularity of rambutan is shared throughout the state and the world (HASS, 2004).

Some problems still exist in the cultivation of this fruit. Farmers do not have standard fertilizer application rates for orchards in Hawai'i and so vary in fertilizer rates and applications from orchard to orchard. Furthermore, substantial losses occur from problems of poor pollination and fruit set. Hermaphroditic cultivars tend to produce male flowers that consist of only 0.5-0.9% of the total flower population (Nakasone and Paull, 1998). Pollen produced by male flowers from these trees is typically insufficient for large orchards. Poor fruit set is attributed to insufficient pollination which causes fruits to be deformed, unappealing, and unsalable. This publication will present new data from rambutan fruit nutrient analyses that will help to improve strategies for more efficient fertilization practices as well as data on male flower induction that can be used to increase salable fruit production.

Nutrient Content of Mature Rambutan Fruits

Estimating fertilizer application rate on rambutan trees during fruit development is very difficult. During fruit development a portion of the nutrients is drawn towards the developing fruits. Therefore, adequate amounts of nutrients must be available to the tree during this stage in order for fruit development to progress properly.

During December 2003 and January 2004, nutrient contents of three rambutan cultivars grown at two locations were analyzed. The cultivars 'Binjai' and 'Jitlee' were selected at Orchard A which is located in east Hawai'i at 245 feet in elevation. These 6 year old rambutan trees are grown on Keaukaha extremely rocky muck soil. The cultivars 'R167' and 'Binjai' were selected at Orchard B which is also located in east Hawai'i at 820 feet

in elevation. These 14 year old rambutan trees are grown on Ola's silty clay loam soil. Both farms are irrigated and bordered with windbreaks.

Approximately one pound of mature rambutan fruits were harvested from five trees of each cultivar at the two locations. Post harvest weights of the fruits were taken and the fruits were rinsed with water before being dried in an oven at 70°C. Dry weights were recorded when the weight of the fruits no longer fluctuated meaning that all water was removed from the fruits. When dry weights were reached, the fruits were sent to the University of Hawai'i's Agricultural Diagnostic Service Center (ADSC) for nutrient analysis.

Tissue analysis data received from the ADSC was given as percentages of dry weight for macronutrients and µg per gram for micronutrients (Table 1). Data were then converted to a percentage based on 100 pounds of fresh fruit (Table 2).

For example, nutrient analyses state that there was 1.10% N in one pound of fruit that had dry weight of 0.20 pounds. For every pound of fresh fruit there would be 0.0022 pounds of N and for 100 pounds of fresh fruit there would be 0.22 pounds of N.

Table 2 provides a summary of the weight in pounds of macro nutrients found in one hundred pounds of fresh fruit. The mean values for the three cultivars is 0.22, 0.025, and 0.22 pounds of N,P, and K respectively. These amounts would need to be replaced due to harvesting of 100 pounds of mature rambutan fruit. If 2.2 pounds of a fertilizer with an analysis of 10-5-20 was used, it would provide the orchard with 0.22 pounds of nitrogen, 0.047 pounds of phosphorus, and 0.37 pounds of potassium. These amounts would be sufficient to replace the N, P, and K lost from the fruits, assuming that all of the fertilizer is absorbed by the rambutan tree.

Nutrient analyses of macro and micronutrients in rambutan fruits help to determine approximate amounts of nutrients lost during the fruit harvest period. Additional amounts of fertilizer must be provided to the orchard to compensate for leaching, binding of elements, runoff, and weed competition losses. Fertilizer must also be supplied to maintain a healthy tree canopy and to replace nutrients lost during branch removal. Larger fruit loads require more nutrients for proper fruit development.

Experiments on Rambutan with NAA in Potassium Salt Form

Naphthaleneacetic acid (NAA) is an auxin (plant growth hormone) typically used as a fruit thinning agent. At the 2002 13th Annual Tropical Fruit Conference, NAA was introduced as having the ability to stimulate the production of male flowers on rambutan panicles comprised mainly of functionally female flowers (Nagao, *et. al.*, 2002). A year later, the potassium salt form of NAA (K⁺NAA) was noted to perform as effectively on three cultivars as NAA at a concentration of 90 ppm (Nagao, *et. al.*, 2003). K⁺NAA is preferred for use because it is easily dissolved in water. The effectiveness of K⁺NAA on the different cultivars of rambutan in Hawai'i is not known. Thus, the purpose of this experiment was to identify rambutan cultivars that respond to treatments of K⁺NAA

Eleven rambutan cultivars were treated with 90 ppm of K⁺NAA during the flowering season which took place between June and September 2004. During 2004, flower development was unusually late and the flowering season was extended due to unusually dry weather on the east side of Hawai'i. These cultivars were located at four different orchards in east Hawai'i. Orchard A contained the cultivars 'Binjai', 'Jitlee', and R162 and Orchard B contained the cultivar 'R167'. Orchard C is located 16 feet higher in elevation than Orchard B, has similar soil composition, and contains the cultivar 'R9'. Orchard D is located at an elevation of 370 feet. This farm has Hilo silty clay loam soil and contains the cultivars 'R134', 'R9', 'R137 Red', 'R156 Red', 'Rongrien', 'R7', and 'R156 Yellow'.

The treatments consisted of 15 replications of treated panicles and controls. Control panicles were sprayed with distilled water and treated panicles were sprayed with 90 ppm of K⁺NAA when approximately 10% of the flowers were at anthesis. All panicles were sprayed to wetness. Since rambutan panicles do not open synchronously within a tree or throughout an orchard, treatments were applied periodically as the flowering season progressed. As a result, treatment dates varied between panicles. Male flowers with extended anthers were counted and recorded for the days noted on Table 3. Figure 1 illustrates the differences between female flowers, naturally occurring male flowers, and male flowers that are produced after panicles are treated with K⁺NAA.

Results of this experiment indicate that the cultivars respond to treatments of 90 ppm of K⁺NAA. Little or no male flowers were produced on the control panicles. Male flowers appearing on the control panicles were likely due to the ability of cultivars such as 'R156 Yellow', 'R134', and 'Silengkeng' to naturally produce male flowers (Table 3 and Fig. 2). Male flower production was apparent on treated panicles four to five days after treatment. Maximum numbers of male flowers were produced at 6-8 days and induction ceased after about twelve days (Table 4 and Fig. 3).

Physical and physiological characteristics of the different cultivars influence the intensity and responsiveness to K⁺NAA treatments. Cultivars such as 'Rongrien' and 'Jitlee' are very responsive and consistently produce male flowers. Anthesis occurs more synchronously in these cultivars. Although 'Binjai', 'R162', and 'R156 Red' have the ability to be very responsive to K⁺NAA, low numbers of male flowers are produced if panicles are not treated during the peak flowering period. Climate also influences the effectiveness of K⁺NAA treatments. Rambutan trees grown in higher elevations did not respond as well as those at lower elevations, probably due to cooler conditions. Promotion properties of K⁺NAA are as effective as NAA in inducing the production of male flowers on rambutan panicles with the advantage of being easier to use.

Timing Application Experiment of K⁺NAA

Timing of application of the K⁺NAA sprays was also studied in July and August 2004. M. Nagao suggests treating rambutan panicles with NAA that are approximately 10% open (Nagao, *et al.*, 2002). Since rambutan panicles do not open synchronously, some panicles have flowers that are just beginning the anthesis process during the same time

that other panicles are finishing the process. When spraying large or numerous trees, spray bottles are not efficient for use. With the use of larger sprayers, precision is lost and many panicles are treated even though only one is targeted. The objective of this experiment was to determine if treatments of K^+NAA were successful in inducing male flowers during advanced stages of anthesis. The effects of multiple applications of K^+NAA were also studied.

'Jitlee' panicles at Orchard A were treated with 90 ppm K^+NAA when approximately 50% of the flowers were open. Twenty replicate panicles were treated. The panicles were sprayed to wetness and flower counts were made every two days starting on the fourth day after treatment.

Panicles treated at 50% open had male flowers that were visible in approximately four days. Data show that the production of male flowers peaked 6-8 days after the treatment and gradually ceased after about twelve days. Table 5 and Fig. 4 provide total averages for the 20 replications. Ten percent of the treated panicles did not respond to the treatment.

Multiple treatments were also conducted and the effects were observed. 'Binjai' and 'Jitlee' rambutan grown at Orchard E were chosen for this experiment. Orchard E is located in east Hawai'i at an elevation of 295 feet. The rambutan trees were about 6 years old growing on Hilo silty clay loam. The panicles were treated at 10% open with 90 ppm K^+NAA and retreated with the same concentration eight days after the first application when approximately 50% of the flowers were open. Data was taken every three days beginning on the sixth day after the first treatment.

Data from Table 6 and Fig. 4 show that the number of male flowers peaked approximately nine days after the first treatment and ceased to be induced seven days after the second treatment (15 days after the first spray). There was a slight increase in the average number of male flowers per panicle on the twelfth day after treatment when the data was compared to that of panicles sprayed once at 10% or at 50% open (Fig. 6). These results suggest that a second application of 90 ppm K^+NAA prolongs the formation of male flowers by approximately 3 days.

Results of these experiments show that panicles at advanced stages of development respond to K^+NAA treatments but the response is less than when panicles are treated earlier. Multiple applications of this auxin are also successful at inducing and prolonging the formation for male flowers by approximately 3 days.

Other Growth Regulators

Auxins come in many different forms and chemical compositions. Six different compounds or forms of auxins were tested for their ability and effectiveness to induce male flowers on rambutan panicles. The compounds used were: Indole-3-butyric acid (IBA), Indole-3-butyric acid potassium salt (K^+IBA), Indole-3-acetic acid (Na^+IAA), Tre-Hold®, Fruitone®, and K-Salt™ Fruit Fix. The active ingredients in these commercial

formulations are similar in structure to that of NAA. The active ingredient in Tre-Hold® is 1.15% ethyl-1-naphthaleneacetic acid, in Fruitone® is 3.5% 1-Naphthaleneacetic acid sodium salt (Na^+NAA), and in K-Salt™ Fruit Fix is 24.20% K^+NAA . These compounds are normally used in fruit thinning and for controlling early fruit drop of apples and pears.

Concentration experiments were conducted with IBA, K^+IBA , and Na^+IAA to find a rate that was successful at inducing the production of male flowers. A range of concentrations was tested and narrowed to those that produced the most male flowers.

‘Jitlee’ and ‘Binjai’ panicles at Orchard A were treated with IBA, K^+IBA , and Na^+IAA at concentrations of 45, 90, 135, 180, and 270 ppm in July 2004 when panicles were 10% open. A 0.27% stock solution of IBA in 70% ethyl alcohol was prepared to make the different concentrations of IBA solutions. The IBA solutions were difficult to make since the stock solution precipitated out of solution when it was added to water too quickly and at low temperatures. Male flowers were counted every two days starting on the fourth day after treatment.

‘Jitlee’ panicles treated with different concentrations of IBA, K^+IBA , and Na^+IAA did not produce male flowers. Two of the three treated ‘Binjai’ panicles responded to K^+IBA treatments at the 135, 180, and 270 ppm concentrations with the two highest concentrations inducing the most male flowers. At 45 and 90 ppm there were no effects on the panicles.

Higher concentrations of 135, 270, and 540 ppm of K^+IBA were tested on ‘Binjai’ panicles at Orchard A in July 2004. Panicles 10% open were sprayed to wetness. Data was taken 4, 6, 8, 10, and 12 days after the treatments were conducted.

Results of this experiment showed that two of the five (40%) replications produced low numbers of male flowers at 540 ppm 6-10 days after being treated. Three out of the five (60%) replications did not respond to the treatments.

The last experiment involved spraying 540 ppm K^+IBA and Na^+IAA at Orchard E in August 2004 on ‘Jitlee’ and ‘Binjai’ panicles that were approximately 10% open. Data were taken at 7, 8, and 9 days after treatments were done.

Seven out of the ten (70%) K^+IBA treatments and six out of the ten (60%) Na^+IAA treatments conducted on ‘Binjai’ did not respond. Nine out of the ten (90%) K^+IBA treatments and five out of the ten (50%) Na^+IAA treatments conducted on ‘Jitlee’ did not respond. One (10%) control panicle from the Na^+IAA treatment performed on ‘Binjai’ as well as four control (40%) panicles on ‘Jitlee’ produced male flowers (Table 7 and Fig. 7).

As a result of these experiments, it may be concluded that IBA, K^+IBA , and Na^+IAA have the ability to induce the production of male flowers at concentrations of 135 ppm and greater with effectiveness increasing with increasing concentration.

Tre-Hold® was tested on the cultivars 'R167' and 'R134' at Orchard D in August 2004. A 90 ppm active ingredient (AI) solution of Tre-Hold® was made and sprayed on the panicles to wetness. The controls were sprayed with distilled water. Panicles at 10% open were randomly selected for each treatment. Male flower counts were taken seven days after the panicles were treated.

Results of this experiment show that the controls did not produce any male flowers. All (100%) 'R134' and 'R167' replications produced at least one male flower seven days after being treated.

At Orchard E, 90 ppm AI of Fruitone® and K-Salt™ Fruit Fix were applied to panicles of 'R134' and 'R167' in September 2004. The controls were sprayed with distilled water and all panicles were sprayed to wetness. Six panicles for each treatment were treated when 10% of the flowers were open. Data were taken seven days later.

Results show that all panicles of both cultivars produced male flowers seven days after treatment while male flowers were not visible on the control panicles. Table 8 and figure 8 provide the average number of male flowers induced seven days after Tre-Hold®, Fruitone®, and K-Salt™ Fruit Fix treatments were conducted.

Table 9 summarizes results of the various auxins tested.

These experiments demonstrate that other forms of auxins and NAA promote male flower production on rambutan panicles. Although data show that IBA, K⁺IBA, and Na⁺IAA have the ability to induce the production of male flowers, these compounds are not as effective as K⁺NAA while Tre-Hold®, Fruitone®, and K-Salt™ Fruit Fix are just as effective as K⁺NAA. All three commercial formulations dissolve in water or create a suspension that is easy to apply with a sprayer. However, these commercial brands are not registered for use on rambutan in Hawai'i and it is unlawful to use these compounds in ways other than what is noted on the label.

Pollen Germination of Male Rambutan Flowers

The ability to induce the formation of male flowers with viable pollen is important in ensuring that proper pollination occurs throughout an orchard. Viability of these pollen grains was determined by a simple pollen germination technique developed by Brewbaker and Kwack (Brewbaker and Kwack, 1963). Pollen initially did not germinate on their full strength media, but successful germination was obtained with solutions at half strength. The solution used in this study contained:

50 ppm H₃BO₃
150 ppm Ca(NO₃)₂ · 4H₂O
100 ppm MgSO₄ · 7H₂O
50 ppm KNO₃
5% Sucrose

Flower panicles were removed during the morning hours and kept in a polybag with a moistened paper towel. Whatman filter paper was first placed on the bottom of a Petri dish and then dampened with distilled water to provide moisture and prevent desiccation of the media and pollen grains. The slide was prepared by placing a drop of media, no larger than 3 mm in diameter, in the center of the slide. Flowers that had dehiscent anthers as well as those that were not dehiscent were removed from the panicle and placed on a slide. Using a dissecting microscope, pollen from two anthers originating from the same flower were removed with a needle and placed into the media. Pollen was also collected from anthers that became dehiscent under the warmth of the microscope (Fig. 9).

Pollen from the eleven cultivars listed in Table 3 was tested for viability. In addition, pollen from naturally produced male flowers of 'Silengkeng', flowers of a male tree, and flowers from 'R167' and 'R134' panicles treated with Tre-Hold® (Ethyl-1-naphthaleneacetate) were also tested.

Pollen from the treated cultivars, 'Silengkeng', and the male tree successfully germinated in 15-42 hours of being placed in the germination medium (Fig. 10). The pollen of 'Rongrien' flowers seemed to respond better than other cultivars; in 24 hours, the average number of germinating pollen grains was greater and the pollen tubes were more elongated than those of other cultivars.

Results of the germination tests confirm that induced and non-induced male flowers are able to supply viable pollen for pollination. Pollen germination and viability percentages are cultivar dependent.

Conclusion

Fruit nutrient analyses help to determine fertilizer rates that would replace nutrients lost during fruit harvests. Many components of orchard management must be considered when applying fertilizers. These components include but are not limited to leaching and run-off of nutrients, tree health and vigor, soil composition, pruning, and fruit load.

Fruit set requires the pollination of flowers. Insufficient pollination causes the production of undersized and deformed fruit. Proper pollination produces fruits that are robust and appealing to consumers. Pollination can be improved by incorporating male trees into the orchard and with applications of NAA to panicles to increase the number of male flowers. NAA in the salt forms as well as commercial brands of NAA like Tre-Hold®, Fruitone®, and K-Salt™ Fruit Fix can induce the production of male flowers on rambutan panicles at concentrations of 90 ppm AI. Flower panicles at different stages of anthesis respond positively to treatments of NAA. Spot treatments are encouraged throughout the orchard since treated panicles often do not produce fruit. Response of auxins IBA, K⁺IBA, and Na⁺IAA were inconsistent as some controls produced more male flowers than treated panicles. Additional experiments with these compounds should be conducted.

Literature Review:

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Nakasone, H.Y. and R.E. Paull. 1998. Tropical Fruits. CABI Publishing. New York. p. 184.

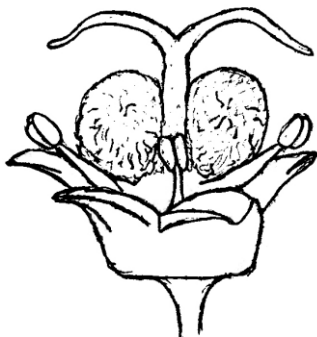
Table 1. Nutrient element composition of 'Jitlee', 'Binjai', and 'R167' rambutan fruits on a dry weight basis.

Location:	Cultivar	Percent of Dry Weight						ppm of Dry Weight	
		N	P	K	Ca	Mg	S	Zn	B
Farm A (12/4/03)	Jitlee'	1.23 ± .12*	.12 ± .01	1.22 ± .10	.22 ± .03	.12 ± .02	.10 ± .01	22 ± 2.83	15 ± 1.14
Farm A (12/4/03)	Binjai'	1.12 ± .28	.11 ± .01	1.22 ± .29	.24 ± .07	.13 ± .02	.09 ± .02	21 ± 3.32	13 ± 1.92
Farm B (1/12/04)	Binjai'	1.04 ± .11	.13 ± .01	.94 ± .15	.22 ± .04	.17 ± .01	.09 ± .01	21 ± 1.87	12 ± 1.67
Farm B (1/12/04)	R167'	.82 ± .10	.11 ± .01	.86 ± .11	.21 ± .05	.14 ± .02	.08 ± .01	15 ± 3.49	11 ± 1.92
*Mean ± STDEV		1.05 ± .17	.12 ± .01	1.06 ± .18	.22 ± .01	.14 ± .02	.09 ± .01	20 ± 3.10	13 ± 1.69

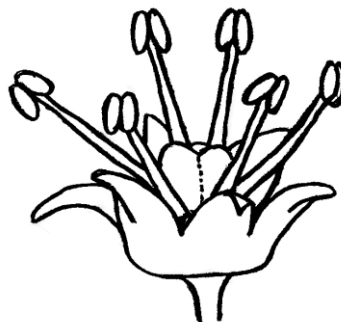
Table 2. Nutrient element composition of 100 pounds of fresh rambutan fruits.

Location:	Cultivar	Percent of Fresh Weight					
		N	P	K	Ca	Mg	S
Farm A (12/4/03)	'Jitlee'	.253	.024	.251	.044	.025	.021
Farm A (12/4/03)	'Binjai'	.228	.024	.249	.049	.027	.019
Farm B (1/12/04)	'Binjai'	.221	.027	.200	.046	.035	.019
Farm B (1/12/04)	'R167'	.180	.025	.189	.047	.031	.017
Mean ± STDEV		.220 ± .030	.025 ± .001	.222 ± .032	.047 ± .002	.030 ± .004	.019 ± .002

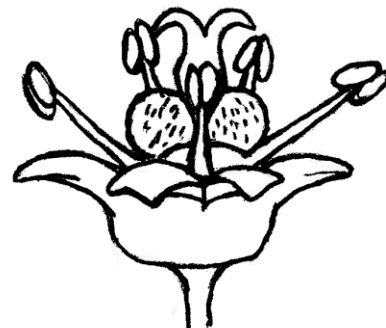
Figure 1. Pictorial drawings of the three types of flowers present on rambutan panicles.



Female Flower



Male Flower



Induced Male Flower

*Courtesy of A. Kawabata

Table 3. Average number of male flowers on control panicles of 90 ppm K⁺NAA treatment produced over a 12 day period.

Cultivar	Farm	Elevation	Days After Treatment					
			0	4	6	8	10	12
'Binjai'	A	75 m	0	0	0	0	0	0
'Jitlee'	A	75 m	0	0	0	0	0	0
'R162'	A	75 m	0	0	0	0	0	0
'R167'	B	245 m	0	0	0	0	0	0
'R9'a	C	250 m	0	0	0	0	0	0
'R134'	D	115 m	.1	.3	.4	.3	.1	0
'R9'b	D	115 m	0	0	0	0	0	0
'R137 Red'*	D	115 m	0	0	0	0	0	0
'R156 Red'	D	115 m	0	0	0	0	0	0
'Rongrien'	D	115 m	0	0	0	0	0	0
'R7'	D	115 m	0	0	0	0	0	0
'R156 Yellow'	D	115 m	.2	.4	.1	0	0	0

* Nine panicles treated on R137 Red.

Figure 2. Trend of male flower development on control panicles of 90 ppm K⁺NAA treatment.

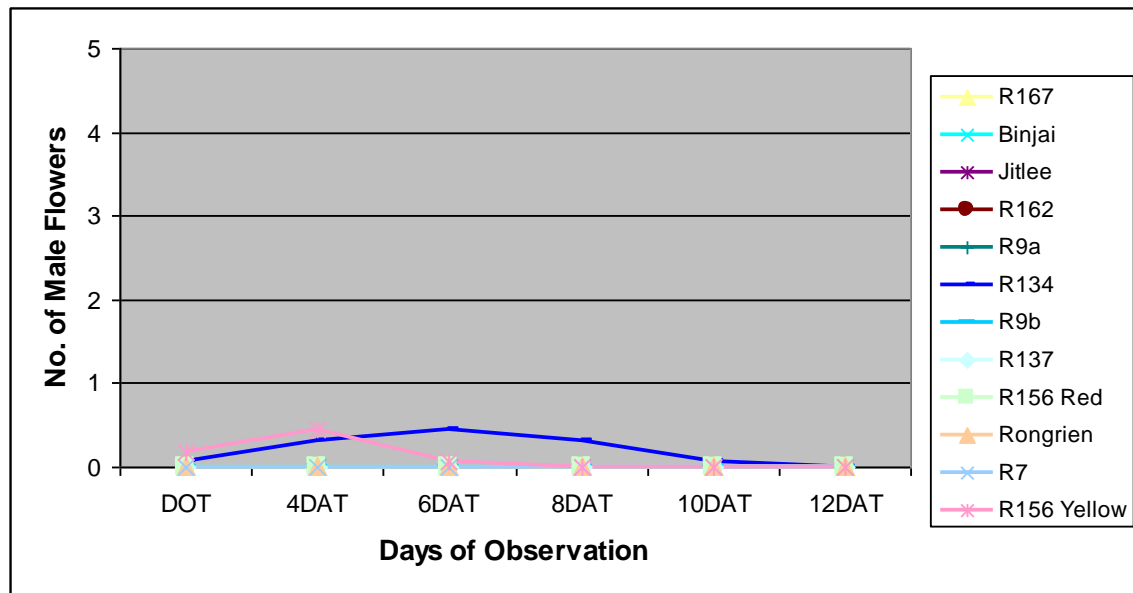


Table 4. Average number of male flowers produced over a 12 day period on panicles treated with 90 ppm K⁺NAA at 10% open.

Cultivar	Farm	Elevation	Days After Treatment					
			0	4	6	8	10	12
'Binjai'	A	75 m	0	23.3	28.5	19.4	6.4	1.3
'Jitlee'	A	75 m	0	10.5	65.8	84.8	65.0	15.2
'R162'	A	75 m	0	0	4.0	6.8	2.7	0
'R167'	B	245 m	0	0	16.5	28.9	17.6	7.4
'R9a'	C	250 m	0	0	1.2	13.7	5.1	.7
'R134'	D	115 m	0	2.7	37.0	36.5	18.3	5.6
'R9b'	D	115 m	0	0	41.4	55.5	26.5	14.0
'R137 Red'*	D	115 m	0	.9	26.2	17.7	11.8	.6
'R156 Red'	D	115 m	0	0	4.5	9.6	6.7	4.4
'Rongrien'	D	115 m	0	18.5	106.2	111.2	88.9	41.6
'R7'	D	115 m	0	.6	27.4	81.7	47.3	17.0
'R156 Yellow'	D	115 m	0.8	13.6	37.3	67.9	52.1	19.8

* Nine panicles treated on R137 Red.

Figure 3. Trend of male flower development on panicles treated with 90 ppm K⁺NAA at 10% open.

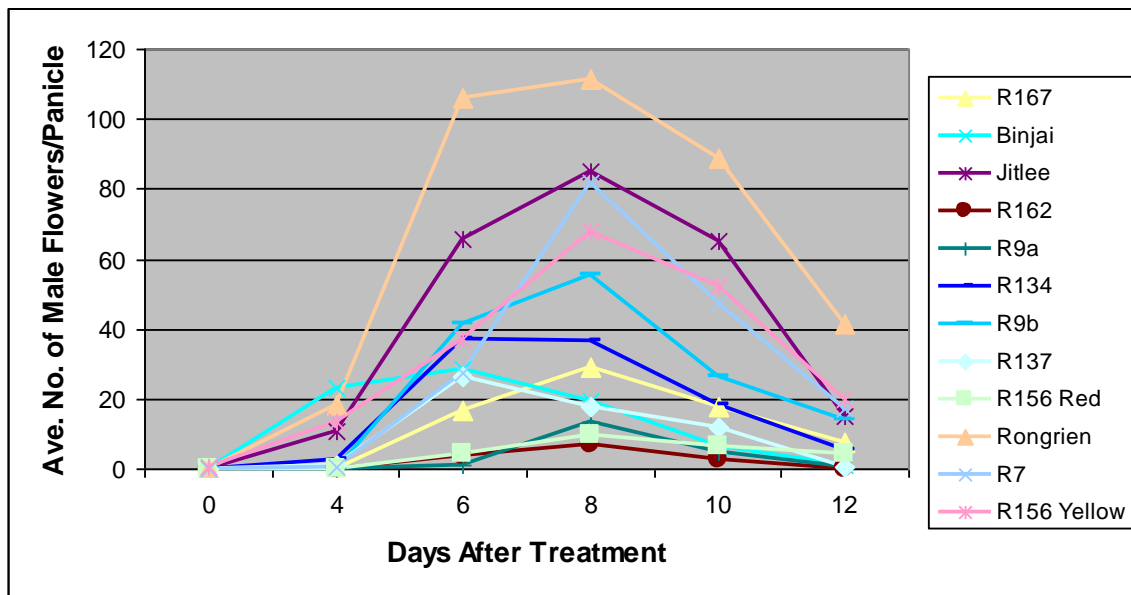


Table 5. Average number of male flowers produced on 'Jitlee' panicles when treated with 90 ppm K⁺NAA at 50% open.

Treatment	Days After Treatment					
	0	4	6	8	10	12
Treated	0	13.2	85.8	47.0	20.5	4.7
Control	0	0	0	0	0	0

Figure 4. Trend of male flower development on panicles treated with 90 ppm K⁺NAA at 50% open.

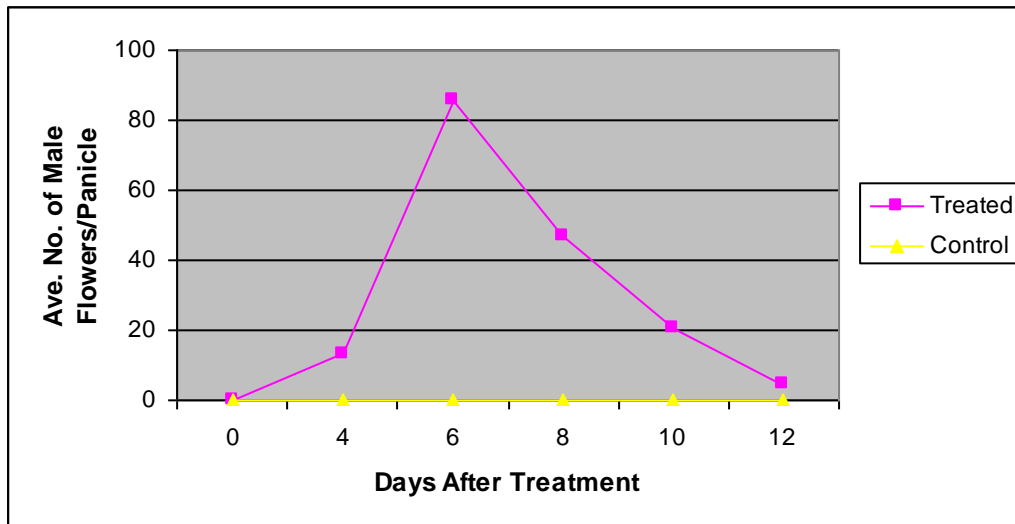


Table 6. Average number of male flowers produced on 'Binjai' and 'Jitlee' panicles treated with 90 ppm K⁺NAA at 10% + 50% open.

Cultivar	Treatment	Days After Treatment				
		0	6	9	12	15
'Binjai'	Treated 10% + 50%	0.1	39	49.9	21.2	3.8
'Binjai'	Control 10% + 50%	0.1	0.2	1.3	1.3	0.2
'Jitlee'	Treated 10% + 50%	0	42.3	67.3	39.3	6.5
'Jitlee'	Control 10% + 50%	0	0	0	0	0

Figure 5. Trend of male flower development on panicles treated with 90 ppm K⁺NAA at 10% and 50% open.

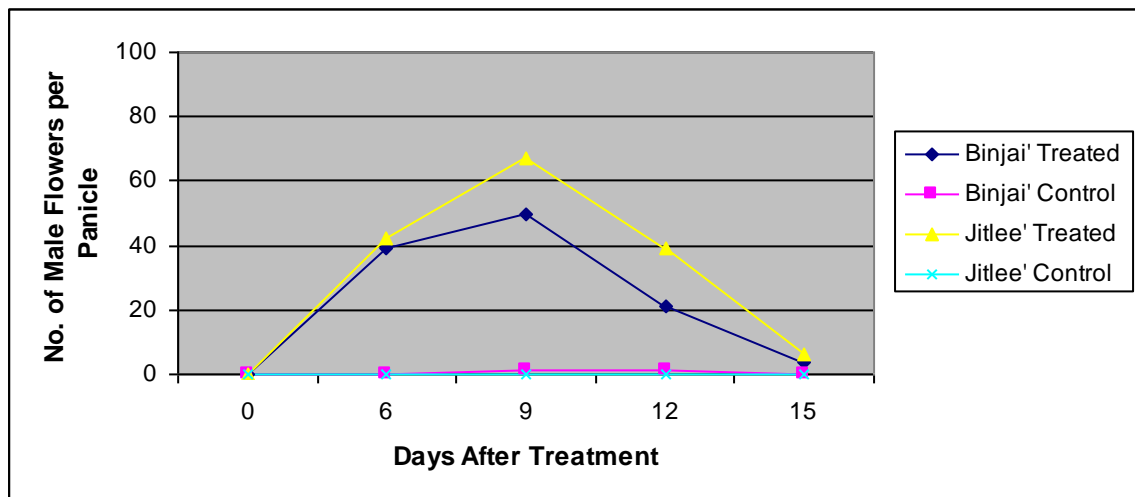


Figure 6. Average number of male flowers produced on 'Binjai' and 'Jitlee' panicles 12 days after treatment with 90 ppm K⁺NAA at 10%, 50%, or 10% + 50% open

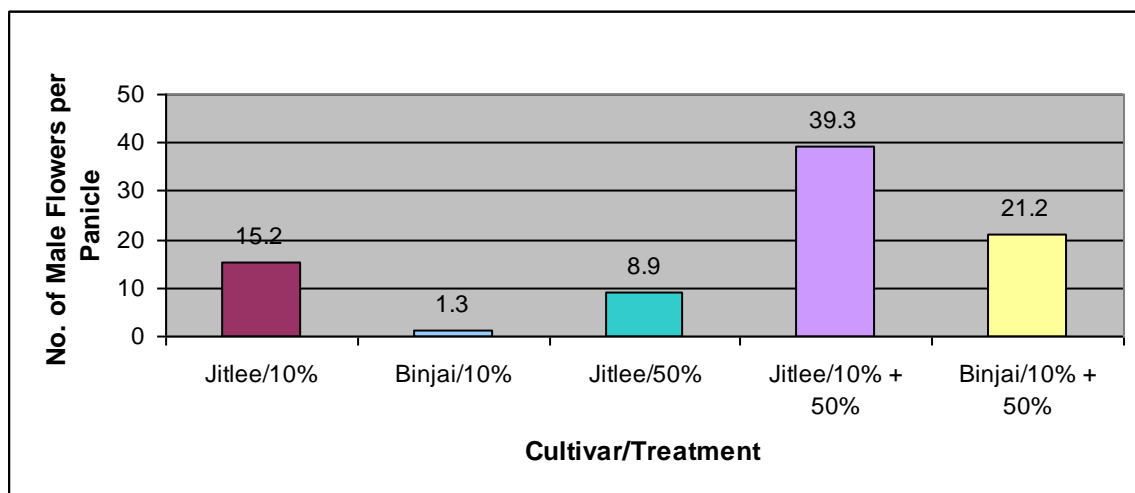


Table 7. Average number of male flowers produced by 'Jitlee' panicles treated with 540 ppm Na⁺IAA.

Treatment	Date of Treatment	Days After Treatment			
		0	7	8	9
Treated	8/4/2004	0	1.0	0.9	0.2
Control	8/4/2004	0.1	0.4	1.9	0.1

Figure 7. Average number of male flowers produced at 7, 8, and 9 days after 'Jitlee' panicles were treated with 540 ppm Na⁺IAA.

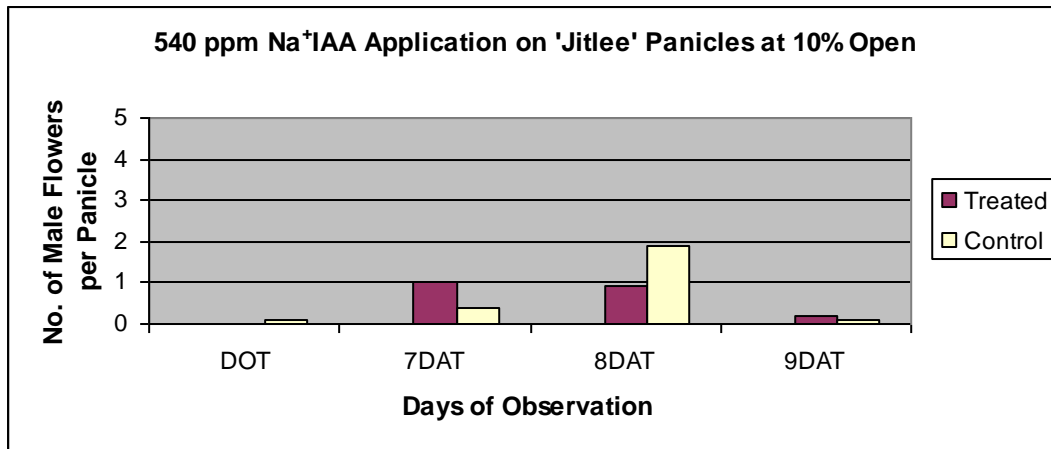


Table 8. Average number of male flowers produced by ‘R167’ and ‘R134’ panicles when treated with 90 ppm AI of commercial formulations containing NAA.

Cultivar	Treatment			
	Control	Tre-Hold®	Fruitone®	K-Salt™ Fruit Fix
R167'	0	48.09	26.83	21
R134'	0	29.93	56	30

Figure 8. Average number of male flowers produced seven days after panicles were treated with commercial formulations of NAA.

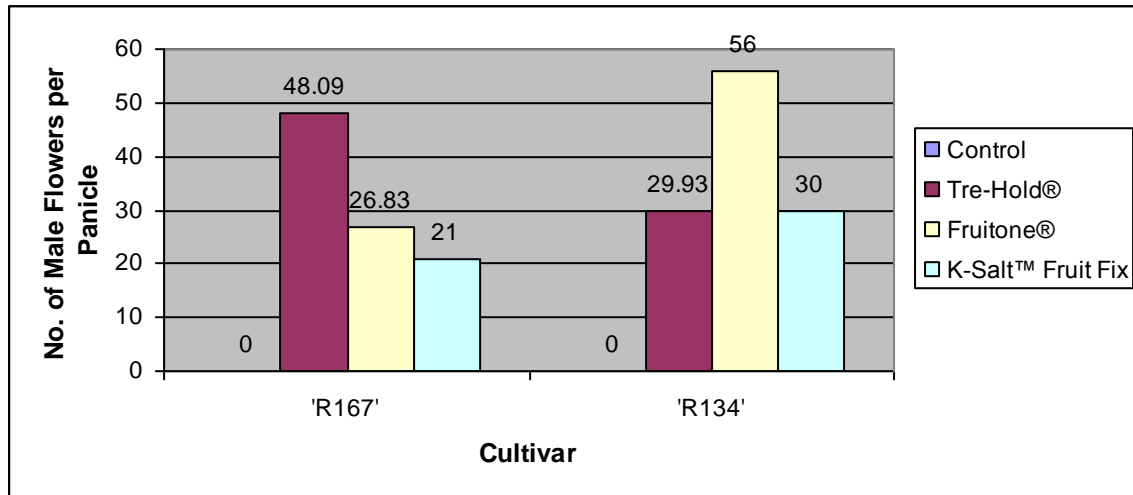


Figure 9. Photograph of a dehiscing anther with pollen grains.

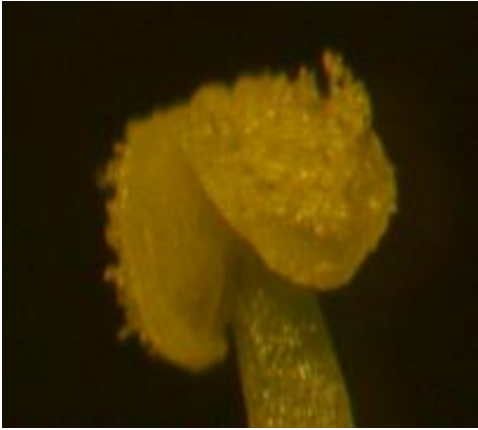
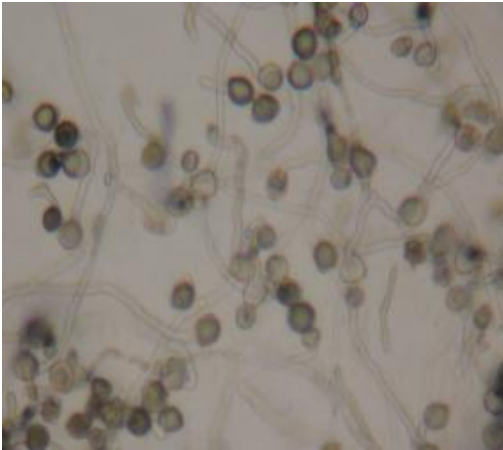
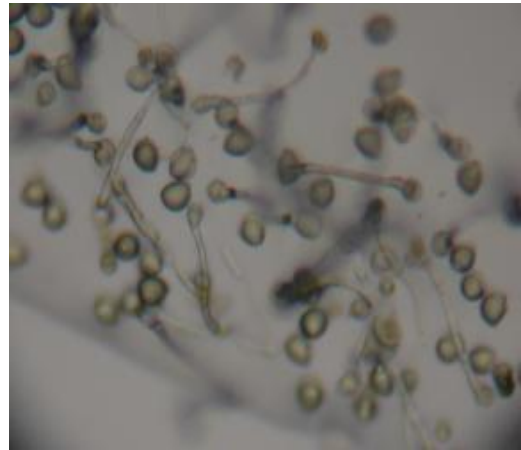


Figure 10. Photographs of germinated male pollen grains from a non-induced male flower (left) and K^+ NAA-induced male flower (right).



‘Silengkeng’



‘Rongrien’