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Mango Types Evaluation in Fruit Flies Attack Rate (*Bactrocera Dorsalis*) at Mango Production Centers in Three Districts of West Java Province

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Abstract.

Mango is a type of tropical fruit that is widely cultivated in Indonesia. One of the pests that attack mangoes is the fruit fly Bactrocera dorsalis. This study aims to identify the level of fruit fly attacks on various types of mango in the field. The research was conducted at mango production centers in three districts in West Java, namely Cirebon Regency, Majalengka Regency, and Indramayu Regency. Sampling was carried out from November 2019 to January 2020. The research method used was a survey method, and the research location was divided into four clusters based on the altitude and proximity of the location. The variables observed were the attack rate and the number of pupae per kg of fruit. The results showed that there were 27 types of mango from all survey locations, four of them were found in all clusters. The four types of mangoes are Gedong Gincu, Harumanis, Cengkir, and Kweni. Fairly high attack rates were found in Kidangsari, Golek, and Kyozo while high average pupa counts were found in Cultivation, Meat, and Kopek.

Keywords: Bactrocera dorsalis, flies attack, mango, production centers, tropical fruit

1. Introduction

Mango is one of the leading fruit commodities in Indonesia. Judging from production data, mango ranks second after bananas (BPS, 2021). In West Java Province, three districts that are centers of mango production are Cirebon Regency, Indramayu Regency, and Majalengka Regency. (Center for Agricultural Data and Information Systems, 2014). Apart from being a farming commodity, mangoes in this area have also become part of daily life. Therefore, many types of mangoes have different regional names from one.

Two types of mango that are widely cultivated and have been marketed at home and abroad are Arumanis and Gedong Gincu (Tasliah et al., 2016). Another type that also has a fairly high economic value is Cengkir or Dermayu. However, apart from these three species, many

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other species are grown and maintained in the three areas. Less commercial types of mangoes are usually used as fringe crops.

One of the problems in mango farming is the attack of fruit flies (Bactrocera dorsalis). This fly attacks almost all types of mangoes and causes losses because the fruit falls before being harvested or the fruit is damaged when it reaches consumers(Sarjan et al., 2010). Fruit flies are also one of the obstacles to the export of fresh mangoes to foreign countries (Astriyani et al., 2016). The implementation of non-tariff export-import policies related to Sanitary and Phytosanitary (SPS) is an obstacle to the entry of Indonesian mangoes into the world market (Sugianti et al., 2012).

The losses due to fruit fly attacks on mangoes in Indonesia are not widely known. Based on information from farmers, fruit flies can reduce yields by 1-2% in the dry season while in the rainy season it can increase up to 40% (Rini Indriyanti et al., 2014). Understanding the behavior of flies in the garden is the basis for controlling this pest (Sarwar, 2015). The results showed that the fruit fly B. dorsalis was present in the mango garden throughout the season while Ceratitis cosyra will the population decreases when the mango enters the vegetative stage (Bota et al., 2018). The presence of fruit flies in orchards in Pakistan is influenced by minimum and maximum temperatures and the availability of ripe fruit, especially mangoes and guavas.(Khan & Naveed, 2017). In addition to temperature, the humidity factor is also a determining factor in the abundance of fruit flies in the garden (Haryono et al., 2016).

In Malaysia, B. dorsalis is the dominant fly species in mango plantations(Salmah et al., 2018). The same type of fly also dominates mango plantations in Aceh(Meuna et al., 2016). While in Buleleng Regency, it is dominated by B. papaya (Badriasih et al., 2019).

Various studies that have been carried out in Indonesia generally aim to identify the types of flies that attack mango plants. However, very little information is available on the rate of fruit fly infestation in the types of mango grown by Indonesian farmers. This study aims to identify the level of fruit fly attacks on various types of mangoes in mango production centers in three districts in West Java Province, Indonesia. It is hoped that from this research it will be known the types of mangoes that are resistant to fruit fly attacks. This information can be used for breeding programs for mangoes that are resistant to fruit fly attacks or as a basis for determining fruit fly control techniques.

2. Research methods

2.1. Location Selection

This research is survey research conducted from October 2019 to January 2020. The research locations were chosen deliberately, namely sub-districts which are centers of mango production in three districts. From each sub-district, a village with a mango plantation of at least 50 ha was selected. Research locations are grouped (clusters) based on the height of the place. Clusters I and II are areas with an altitude of 100 m above sea level. This area is in the south, at the foot of Mount Ciremai. Clusters III and IV are located at an altitude of < 100 m above sea level. This area is located in the central and northern parts, of the northern coast of Java Island (Figure 1). In addition, the grouping is also based on the proximity of the location.

To determine the number of mango samples, from each village a garden area of 10% was selected from the total area of the garden in that village. From each hectare, 2 mangoes were taken, which were being harvested at the time of the survey. The type and size of the mango are not specified. Likewise the level of maturity.

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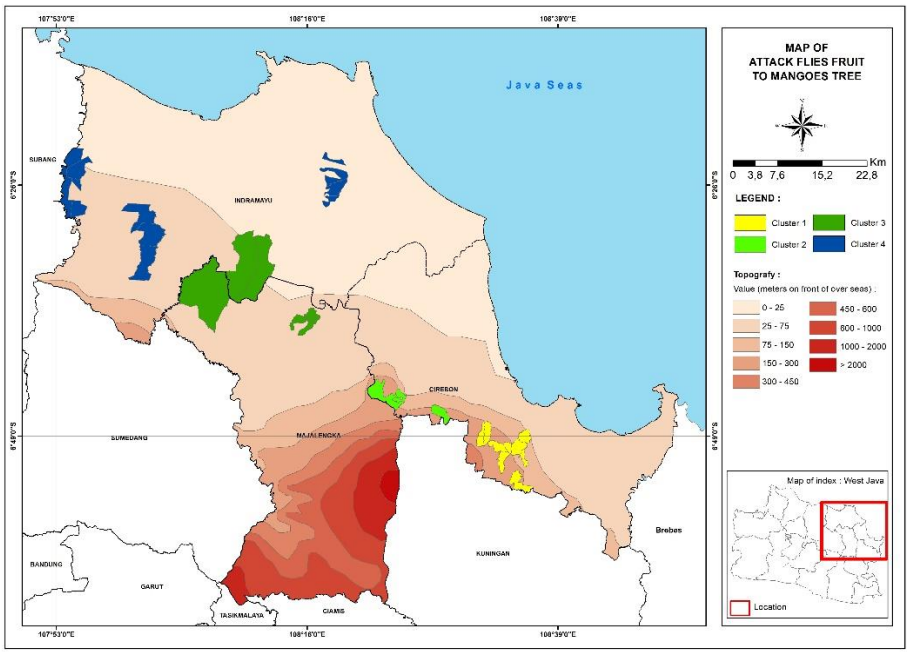

Figure 1. Survey Location Map

2.1. Observation in the Laboratory

Harvested fruit is stored for 2 days to ensure the female fly's puncture marks. The fruit is then separated by type. Furthermore, each type of mango is separated between the ones that have puncture marks and those that don't exist. The fruit with puncture marks was weighed and stored in a transparent plastic container filled with a mixture of soil and sand (1/1 v/v). The size of the container is adjusted to the number and size of mangoes. The container is then covered with gauze. Each type of mango from a different location is stored in a different container. The intensity of the attack is calculated by the formula:

$$I = \frac{Number\ of\ Fruit\ Affected\ by\ Disease}{Total\ fruit\ count} \times 100\%$$

Based on the intensity of attack, mango plants were grouped into three groups, namely: resistant (R) = 0 – 33%; moderate/moderate (M) = >33% - 67%; and sensitive (S) = > 67%.

The fruit was left in the box for 14 days and on the 36th day the fruit was removed and the sand mixture was sifted to count the number of pupae formed.

3. Results and Discussion

3.1. Diversity of Mangoes

In the samples taken during the survey, 27 mango cultivars were found, both local and newly introduced varieties. However, not all types exist in every cluster. Only four types of mango were found in all clusters (Figure 2). The highest diversity was found in cluster 1, which was 17 types of mango. While in cluster 2 there are 12 types of mango, and in clusters 3 and 4 there are 13 types of mango each (Table 1).

Table 1. Types of Mango Found in Each Cluster

Cluster 1	Cluster 2	Cluster 3	Cluster 4
1. sweet	1. sweet	1. sweet	1. sweet
2. Gedong Gincu	2. Gedong Gincu	2. Gedong Gincu	2. Gedong Gincu
3. Cup/Dermayu	3. Cup/Dermayu	3. Cup/Dermayu	3. Cup/Dermayu
4. Golek	4. Lalijiwo	4. Golek	4. Lalijiwo
5. Lalijiwo	5. Where else	5. Kweni	5. Where else
6. Where else	6. Meat	6. Elephant	6. Kidangsari
7. Meat	7. Kidangsari	7. Father	7. Kepudang
8. TO	8. Kweni	8. Coconut	8. Kweni
9. RC	9. Cultivation	9. Apple	9. Elephant
10. Kidangsari	10. Shrimp	10. Kyozo	10. Coconut
11. Kepudang	11. Elephant	11. hang out	11. Apple
12. Kopek	12. Father	12. police chief	12. Kyozo
13. Kweni	13. Lahang		13. Yellow Gedong
14. Cultivation			
15. Irwin			
16. Honey Golek			
17. bobbin			

The types of mango found in all clusters were Arumanis, Gedong Gincu, Cengkir, and Kweni. The species found in the three clusters were Lalijiwo, Manalagi, Kidangsari, and Gajah. The types found in the 2 clusters were Golek, Meat, Cultivation, Bapang, Coconut, Apple, and Kyozo.

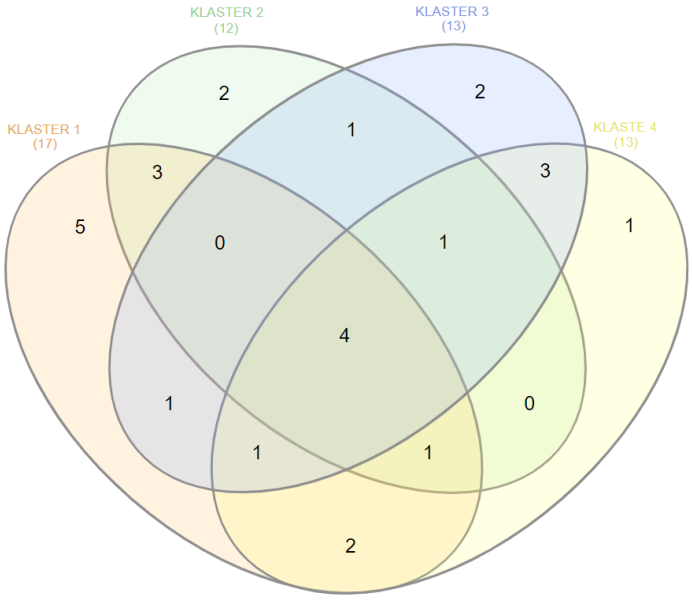

Figure 2. Number of mango species found at the research site

In addition to the various types of mango, the number of samples for each type of mango also varies. This is because the selling value of each type of mango is different. In general, farmers will maintain the types of mangoes that have a fairly high economic value, if sold in the

form of fresh fruit. Species that are not of economic value will be discarded or used only as fringe crops. Some types that have no economic value that is maintained are usually considered to have other uses.

Harumanis, Cengkir, and Gedong Gincu Most have grown in monoculture gardens or only the three types and are cultivated intensively. In intensive cultivation, mango will be harvested gradually according to the level of maturity. Thus the fruit produced has a fairly good quality so that it can be marketed in big cities such as Jakarta or even exported to various countries. Intensive mango cultivation was found in Clusters 1, 2, and 3. In Cluster 4, Harumanis and Cengkir dominated mango cultivation. Both types of mango are generally harvested simultaneously when most of the fruit is 70% - 80% ripe. Therefore, the harvested fruit is generally of poor quality and can only be marketed in local markets.

3.2. Attack Intensity

The type of mango that was most attacked was the Golek mango while the least attacked was the Apple mango. Gedong Gincu, Cengkir, and Harumanis mangoes have moderate attack rates (Table 2). The three types of mangoes are commercial mangoes, so they are generally grown in gardens where pest control is intensively carried out using pesticides. Meanwhile, Golek is generally planted in gardens that are not maintained intensively or usually in gardens around housing.

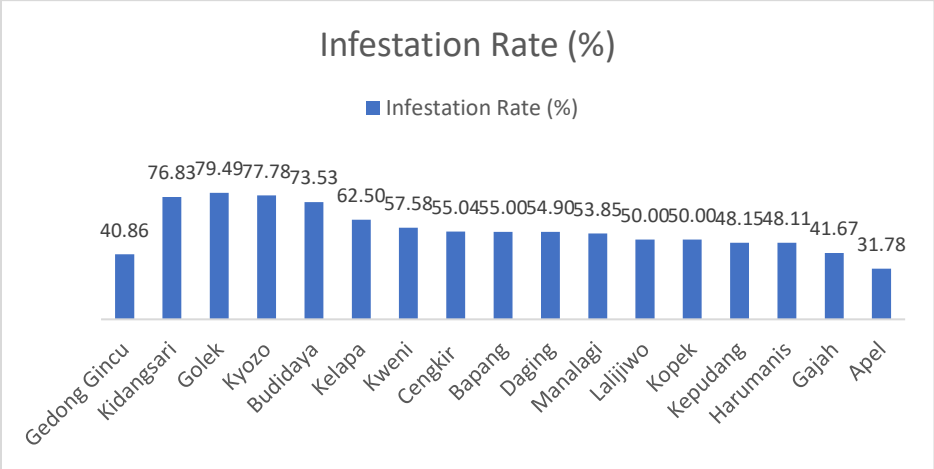

Figure 3. The intensity of Fruit Flies Attack on Various Types of Mango

Table 2. The intensity of Fruit Flies in All Clusters

No.	Mango Type	Attack Intensity (%) in Cluster:							
		1		2		3		4	
1.	Arumanis	47.27	M	35.56	M	52.24	M	50.88	M
2.	Gedong Gincu	54.61	M	46.15	M	29.95	R	36.14	M
3.	Cup/Dermayu	48.62	M	67.11	M	47.30	M	63.28	M
4.	Golek	93.75	S	-		69.57	S	-	
5.	Lalijiwo	28.57	R	100.00	S	-		60.00	M
6.	Where else	66.67	M	-		65.00	M	31.82	R
7.	Meat	58.33	M	46.67	M	-		-	
8.	Kidangsari	88.89	S	60.00	M	-		52.17	M

9.	Kopek	62.50	M	-		-	0.00	R
10.	Kweni	70.59	S	68.00	M	33.33 M	38.89	M
11.	Cultivation	100.00	S	70.00	S	-	-	
12.	Elephant	-		50.00	M	0.00 R	75.00	S
13.	Father	-		100.00	S	33.33 M	-	
14.	Coconut	-		-		52.94 M	16.67	R
15.	Apple	-		-		100.00 S	21.92	R
16.	Kyozo	-		-		100.00 S	71.43	S

The results showed that fruit flies attacked almost all types of mangoes found, with varying levels of attack between clusters. The attack rate on Arumanis, Gedong Gincu, and Cengkir was almost the same in all clusters, ranging from 30 - 60% while Kweni was quite diverse, between 30-40% in Clusters 3 and 4 to 70% in Clusters 1 and 2 (Figure 3).

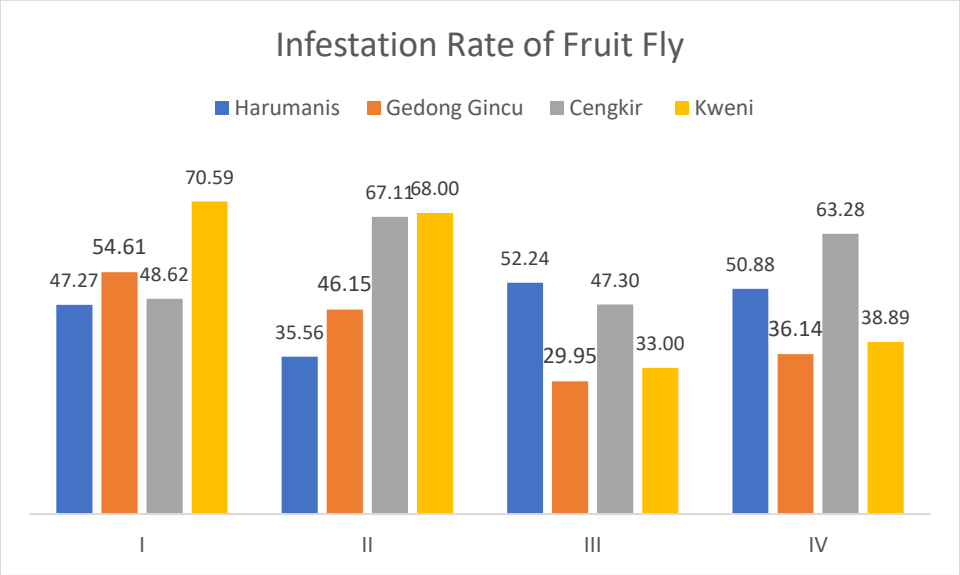

Figure 4. Fruit Flies Attack Rates Against Four Types of Mango in Each Cluster

Fruit fly attack rate is positively correlated with fruit fly abundance in the garden (Astriyani et al., 2016). Meanwhile, the presence of flies in the garden is influenced by biotic and abiotic factors. The results of the study in Mozambique showed that the abundance of fruit flies was positively correlated with the minimum temperature and phenological stadia of mango but negatively correlated with the daily average temperature.(Bota et al., 2018b). However, this was not proven in this study. Clusters 3 and 4 are lowlands with higher average temperatures than clusters 1 and 2. However, the intensity of attack on each type of mango varies. When viewed on the type of Kweni, at a higher temperature the intensity of the attack decreases.

If you look at Figure 4, something is interesting about the intensity of fruit fly attacks on Kweni. In clusters 1 and 2, the intensity of fruit fly attacks on Kweni was higher than that of the other three mango species. However, in Clusters 3 and 4 the intensity of attack on Kweni was lower than the other three types of mango. This shows that if fruit flies cannot attack the three types of mangoes, they will attack Kweni.

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Table 4. The intensity of Mango Attack and the Number of Pupae Formed

Rank	Cluster 1			Cluster 2			Cluster 3			Cluster 4		
	Mango Type	Attack intensity (%)	Number of pupae/kg fruit	Mango Type	Attack intensity (%)	Number of pupae/kg fruit	Mango Type	Attack intensity (%)	Number of pupae/kg fruit	Mango Type	Attack intensity (%)	Number of pupae/kg fruit
1	Cultivation	100.00	10.17	Lalijiwo	100.00	0.00	Kyozo	100.00	0.00	Kyozo	71.43	0.00
2	Golek	93.75	0.48	Cultivation	70.00	0.14	Coconut	73.08	0.00	Kweni	67.86	0.00
3	Kidangsari	88.89	0.14	Kweni	68.00	0.00	Golek	69.57	0.00	cup	63.28	0.00
4	Kweni	70.59	0.24	cup	67.11	0.00	Where else	65.00	0.00	Lalijiwo	60.00	0.00
5	Where else	66.67	0.00	Kidangsari	60.00	0.00	Apple	52.94	0.00	Kepudang	52.17	0.00
6	Kopek	62.50	16.67	Meat	46.67	0.00	Arumanis	52.24	0.13	Arumanis	50.88	1.03
7	Meat	58.33	14.63	Gedong Gincu	46.15	3.14	cup	47.30	18.71	Apple	49.79	0.00
8	Gedong Gincu	54.61	13.38	Arumanis	35.56	0.00	Gedong Gincu	39.00	3.14	Gedong Gincu	36.14	0.38
9	cup	48.62	6.25				Kweni	33.33	0.00	Where else	31.82	0.00
10	Arumanis	47.27	6.36				Father	33.33	0.00	Coconut	16.67	0.30
11	Lalijiwo	28.57	5.93				police chief	25.00	0.00	Kopek	0.00	0.00

3.3. Average Number of Pupae

A large number of pupae were produced by the Meat, Kopek, and Cultivated mango species, which averaged more than 10 pupae/kg fruit. Meanwhile, in Harumanis and Cengkir, the number of pupae produced was relatively less, at 3.81 and 4.13 per kg of fruit, respectively. If you look at the data in Table 4, the intensity of attack on Cultivated mangoes in Cluster 1 is very high, namely 100% with an average pupa produced of 10.17 pupa/kg fruit. However, in Cluster 2, the number of pupae produced was less (0.14 pupa/kg fruit).

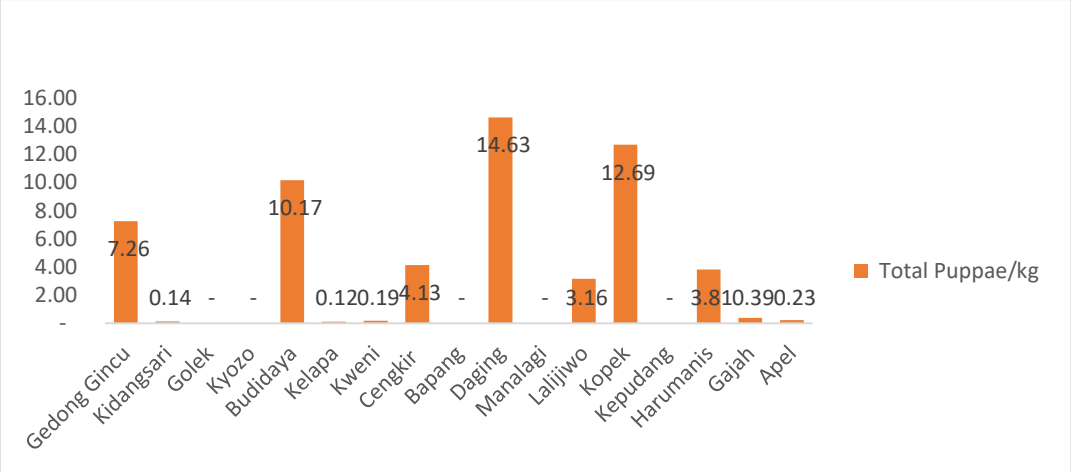

Figure 5. Average Number of Pupae per Kg of Mango Fruit

The Kweni mango, whose attack intensity was in the moderate category (see Figure 5), produced relatively few pupae (0.19/kg fruit). The type of mango that produces the most pupae is Meat, then Kopek and Cultivation. Gedong Gincu produced an average of 7.26 pupae/kg fruit (Figure 6). Kopek, Cultivation, and Gedong Gincu are types of mango with relatively small fruit sizes while Meat has the largest fruit size.

There was no significant correlation between attack intensity and the number of pupae per kg of fruit (r = - 0.094). This shows that not all types of mango are suitable for the development of fruit fly larvae. Many factors can inhibit the development of larvae in mangoes. Research result Choudhary et al. (2018) showed that sensitive mangoes had lower sugar content than resistant ones. In addition, there are differences in the content of ascorbic acid, flavonoids, and phenols in various types of mango which have different levels of resistance to fruit flies.

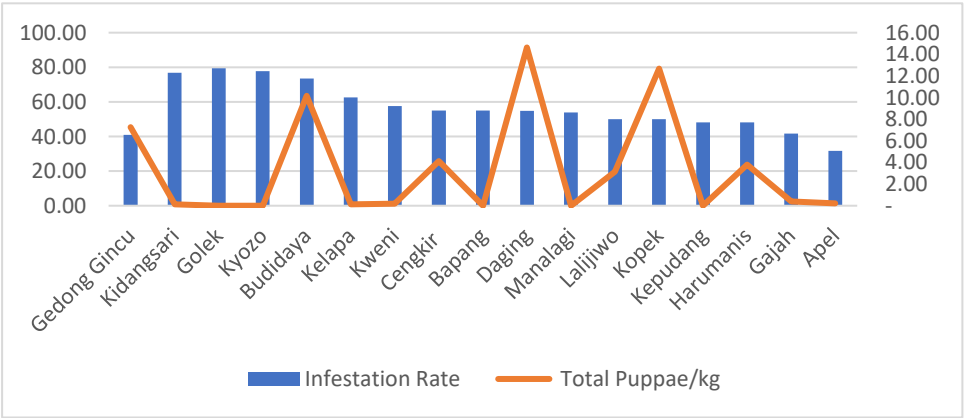

Figure 6. Attack Rate and Average Number of Pupae per kg Fruit

4. Conclusion

There were 27 types of mango found in all survey locations, but only four types of mango were found in all clusters, namely Gedong Gincu, Harumanis, Cengkir, and Kweni. The first three cultivars are mango species that have high economic value.

The level of attack of fruit flies on mangoes is quite diverse, both in different types of mangoes and in different locations. There was no correlation between the attack rate and the number of pupae per kg of fruit. Fairly high attack rates were found in Kidangsari, Golek, and Kyozo while high average pupa counts were found in Cultivation, Meat, and Kopek.

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