Infestation Rates of *Drosophila melanogaster* in Tropical Mangos on the Island of Dominica from May 25th to June 9th 2006.

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Abstract:

The Caribbean is host to a large number of tropical fruits. One of these, the mango, is an important host to a large number of insects, including *Drosophila melanogaster.* Over three weeks, thirty-eight mangos were collected from the ground or picked from trees to measure infestation levels. In part one, nine mangos from the ground and nine mangos from a tree were collected and placed into individual containers. After nine days the ground mangos contained an average of 24.7 maggots while the tree mangos contained no maggots. In part two, ten mangos from the ground and ten mangos from the tree were collected. These were divided into two groups of five mangos to test the affects ants would have on infestation rates and one of each type of mango was placed into a single container. After seven days the ground mangos contained an average of 13.8 maggots while the tree mangos contained an average of 11.1 maggots. In all of the ant containers, no maggots were recorded for any of the tree mangos. However the no ant tree mangos contained an average of 17.8 maggots per mango. In the ground mangos for the ant containers, an average of six maggots were recorded while the no ant ground mangos contained an average of 18.6 maggots per mango

Introduction:

Drosophila melanogaster is a species of small Diptera, generally 3 millimeters long, found on decaying or rotting fruit. Drosophila flies are commonly used in genetics research since they are small and have a short life cycle of around two weeks. Throughout the island of Dominica, mangos are a staple ingredient in the diet of many locals. One of the key decomposers of rotting and decaying mangos are *Drosophila melanogaster*. In this experiment, infestation rates of *Drosophila* maggots were compared for tree and ground mangos in a variety of ways. Tree mangos were picked from various mango trees while ground mangos were collected off the ground surrounding the mango trees. The first part compared the fruit condition to the level of infestation at the start and finish of a nine-day fermentation period in individual containers for both ground and tree mangos. The second part compared tree to ground mangos when one of each was placed in a single container and separated with a cardboard divider over a seven day period. Half the containers had ant bridges to each mango to measure the effects that ants might have on Drosophila infestation numbers.

Materials and Methods:

PART ONE:

Tropica*l* Mangos were collected on the Springfield research station along the route to Mount Joy for ground groups A while the tree group A of mangos was collected at the Cabrits National Park. These mangos were used to rear out *Drosophila melanogaster* maggots. The maggots were collected and raised to the adult stage to verify their identity. Nine tree and ground Mangos were transported in two and half-gallon ziplock bags and directly placed into small square Rubbermaid containers with one inch of mixed sand located at the bottom. The lids provided were punctured five times using a two-inch nail to allow airflow to occur. The lids were then taped in place with masking tape to prevent further decomposition by other species. In ground and tree groups A, Mangos were allowed to sit in the container for seven days undisturbed. On the eighth day, tape was removed from the containers and the mangos and soil were inspected for maggots and puparia. On the ninth day, the soil and mangos were dissected and the maggots were removed and counted. This was accomplished by creating a sifting apparatus from a Dixie cup, masking tape, and small square fish net. The mangos were dissected using two large tweezers to remove the outer skin, which in turn allowed both skin and inner portions to be inspected. Thirty minutes total was spent dissecting each of the containers' components. Generally fifteen minutes was spent on the soil while the other fifteen minutes was spent on the mango itself. After the mango dissection had occurred, ground mangos 1-3, 4-6, and 7-10 were placed in cylindrical containers for eight more days with taped ziplock bags acting as lids to rear the rest of the fruit flies out. Each set of containers had a different size of soil material. The first container had fine ground sand that had previously been sifted out from the first nine mangos. The second container had course rocks for soil while the third container had a mixture of soil from containers one and two. The Rubbermaid containers were then cleaned with fresh water and prepared for part two of the experiment. Below is a chart describing the color, condition, and size of the various mangos used for Part A.

Mango Conditions for Ground Group A

Number	Color	Condition	Size	Decay present
Ground 1A	Green	No faults, freshly Fallen	Medium	No
Ground 2A	Pale Green	No faults	Medium	No
Ground 3A	.25 Green, .75 yellow	Two openings	Large	No
Ground 4A	.25 Green, .75 yellow	One opening	Medium	No
Ground 5A	.1 Green, .9 yellow	No faults	Medium	No
Ground 6A	Green top, mostly yellow	No faults	Medium	No
Ground 7A	Green top, mostly yellow	One large opening	Medium	No
Ground 8A	.9 yellow, .1 brown	No faults	Medium	Yes
Ground 9A	.5 yellow, .5 brown	One Opening	Small	Yes

Mango Conditions for Tree Group A

Number	Color	Condition	Size	Decay present
Tree 1A	Green	No faults	Medium	No
Tree 2A	Green	No faults	Medium	No
Tree 3A	Green	No faults	Medium	No
Tree 4A	Green	No faults	Medium	No
Tree 5A	Green	No faults	Medium	No
Tree 6A	Green	No faults	Medium	No
Tree 7A	Green	No faults	Medium	No
Tree 8A	Green	No faults	Medium	No
Tree 9A	Green	No faults	Medium	No

PART TWO:

For ground and tree groups B, ten mangos were collected for both groups on the trail to Mount Joy. Coconuts, sticks, and rocks were used to knock down the unripe mangos for tree group B. Each Rubbermaid container had a small taped cardboard divider placed in the middle to allow one ground and one tree mango to decompose together. For the first five containers, a similar method was used as part one. One inch of soil was placed in each container to act as pupation material. Two mangos were placed in each container and then sealed for seven days after which they would be inspected for maggot infestation. For the last five containers, small two- inch by

two-inch holes were cut at the same height as the divider on both sides. Sticks were taped together to create ant bridges which would demonstrate the affects of ants on infestation rates in decomposing mangos. Three inches of sand was placed in each of the last five containers to allow room for the mango and the stick. The containers were sealed with masking tape in a similar fashion to part one. The containers were allowed to sit for two days on the platform before moving them to various locations around the station where they remained undisturbed for five more days. After the allowed time had expired, all containers were gathered and inspected for maggots. Below is a chart describing the color, condition, and size of the various mangos used throughout part B of this experiment.

Mango Conditions for Ground Group B

Number	Color	Condition	Size	Decay Present
Ground 1B (No Ant)	.5 yellow, .5 brown	Two Openings, various holes	Medium	Yes
Ground 2B (No Ant)	.5 green, .5 yellow	No faults	Small	No
Ground 3B (No Ant)	.1 Green, .9 yellow	Small opening	Medium	Yes
Ground 4B (No Ant)	.75 yellow, .25 brown	Large opening, many small openings	Medium	Yes
Ground 5B (No Ant)	.25 yellow, .75 brown	Large opening at top	Small	Yes
Ground 6B (Ant)	.5 green, .5 yellow	No faults	Small	No
Ground 7B (Ant)	.75 yellow, .25 brown	Large black spots	Medium	Yes
Ground 8B (Ant)	.75 yellow, .25 brown	Large hole and cut	Medium	Yes
Ground 9B (Ant)	.5 yellow, .5 brown	Four large openings	Medium	Yes
Ground 10B (Ant)	.25 yellow, .75 brown	One large opening	Large	Yes

Mango Conditions for Tree Group B

Number	Color	Condition	Size	Decay Present
Tree 1B	Green	No faults	Large	No
Tree 2B	Green	No faults	Medium	No
Tree 3B	Green	One large opening	Medium	No
Tree 4B	Green	No faults	Extra small	No
Tree 5B	Green	No faults	Medium	No
Tree 6B	Green	No faults	Small	No
Tree 7B	Green	No faults	Medium	No
Tree 8B	Green	Small brown spots	Medium	No
Tree 9B	Green	No Faults	Medium	No
Tree 10B	Green	No faults	Extra Small	No

Data and Results:

PART ONE:

Observations on the condition of the mango as well as maggot location and additional species after the nine-day period have been listed in bulleted format below. The results for part one have been recorded as the number of maggots caught and seen in each mango. Ground group A was plotted against Tree group A in regards to maggot numbers found in the fruit and soil in a thirty minute dissection period after a nine day fermentation period.

Observations for Ground Group A

1. **Ground #1A** had no visible maggots in the soil or on the exterior of the fruit. The mango was primarily yellow with a few random green spots. There were no openings or holes observed on the mango.
2. **Ground #2A** had no visible maggots in the soil but did have maggots on the fruit. The mango was half-brown and half-yellow with noticeable decay. Large openings were present.
3. **Ground #3A** had visible maggots in both the soil and on the fruit. The mango was three-fourths brown and one-fourth yellow with noticeable decay. Large openings were present along with small brown and black beetles.

4. **Ground #4A** had visible maggots in both the soil and on the fruit. The mango was entirely brown and noticeable decay. Large openings were present along with small brown and black beetles. A large number of small fruit flies were also observed. Small pupae cases were found in the soil.
5. **Ground #5A** had one visible maggot in the soil and many on the fruit. The mango was entirely brown with noticeable decay. Large openings were present along with small brown and black beetles. A large number of small fruit flies were also observed. Two small parasitic wasps were found ovipositing on top of the soil after the mango had been removed.
6. **Ground #6A** had no visible maggots in the soil but did have maggots on the fruit. The mango was primarily brown and yellow with decay present. Large openings were present along with a large number of small brown and black beetles and small fruit flies.
7. **Ground #7A** had visible maggots in the soil and on the fruit. The mango was entirely brown with noticeable decay. Large openings were present along with small brown and black beetles. A large number of small fruit flies were also observed. Three small parasitic wasps were found ovipositing on top of the soil after the mango had been removed.
8. **Ground #8A** had visible maggots in the soil and on the fruit. The mango was half-yellow and half-brown with noticeable decay. Large openings were present along with small brown and black beetles in the soil and in the mango. A large number of small fruit flies were also observed.
9. **Ground #9A** had no visible maggots in the soil and few maggots in the fruit. The mango was entirely brown and decayed. A large opening was present along with a few brown and black beetles. A small number of small fruit flies were also present.

Observations for Tree Group A

1. **Tree #1A** had no visible maggots in the soil or on the exterior of the fruit. The mango was one-fourth yellow and three-fourths green with a few dark brown spots. There were no openings or holes observed on the mango.
2. **Tree #2A** had no visible maggots in the soil or on the exterior of the fruit. The mango was one-fourth yellow and three-fourths green with a few dark brown spots. There were no openings or holes observed on the mango.

3. **Tree #3A** had no visible maggots in the soil or on the exterior of the fruit. The mango was one-fourth yellow and three-fourths green with a few dark brown spots. There were no openings or holes observed on the mango.
4. **Tree #4A** had no visible maggots in the soil or on the exterior of the fruit. The mango was half-yellow and half-green. There were no openings or holes observed on the mango.
5. **Tree #5A** had no visible maggots in the soil or on the exterior of the fruit. The mango was half-yellow and half-green. There were no openings or holes observed on the mango.
6. **Tree #6A** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely green. There were no openings or holes observed on the mango. A medium sized puparium was located in the large particle sized soil.
7. **Tree #7A** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely green. There were no openings or holes observed on the mango
8. **Tree #8A** had no visible maggots in the soil or on the exterior of the fruit. The mango was one-fourth yellow and brown and three-fourths green. There were no openings or holes observed on the mango
9. **Tree #9A** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely green. There were no openings or holes observed on the mango. One adult Tephritid was found on the upper layer of the soil.
10.

Number of Maggots Caught and Seen per Mango in Ground Group A

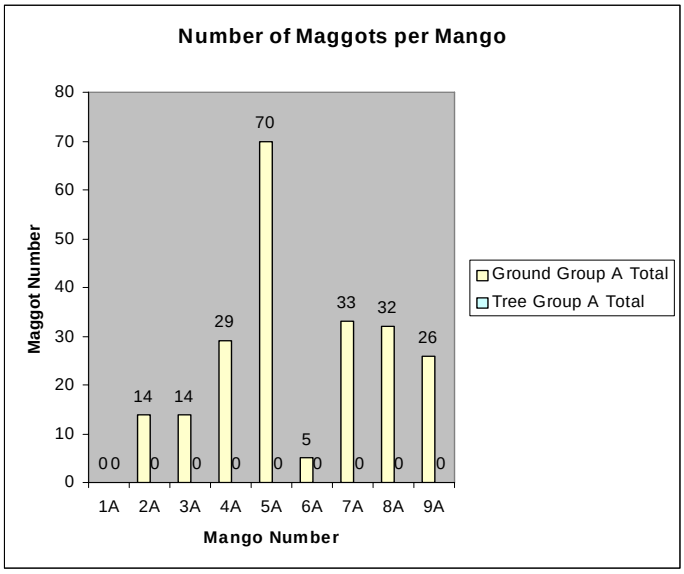
Ground Group A

Mango Number	Number Seen	Number Caught	Total
Ground 1A	0	0	0
Ground 2A	5	9	14
Ground 3A	3	11	14
Ground 4A	4	25	29
Ground 5A	37	33	70
Ground 6A	2	3	5
Ground 7A	12	21	33
Ground 8A	11	21	32
Ground 9A	10	16	26
Average	9.3	15.4	24.7
Total	84	139	223

Number of Maggots Caught and Seen per Mango in Tree Group A

Tree Group A

Mango Number	Number Seen	Number Caught	Total
Tree 1A	0	0	0
Tree 2A	0	0	0
Tree 3A	0	0	0
Tree 4A	0	0	0
Tree5A	0	0	0
Tree 6A	0	03	0
Tree 7A	0	0	0
Tree 8A	0	0	0
Tree 9A	0	0	0
Average	0	0	0
Total	0	0	0



PART TWO:

Observations on the condition of the mango as well as maggot location and additional species after the seven-day period have been listed in bulleted format below. The results for part two have been recorded as the number of maggots caught and seen in each mango. Ground group B was plotted against Tree group B in regards to maggot numbers found in the fruit and soil in a thirty-minute dissection period after a seven-day fermentation period.

Observations for Ground Group B and Tree Group B with No Ant Bridges

1. **Ground #1B** had visible maggots in the soil or on the exterior of the fruit. The mango was entirely brown with noticeable decay. Large openings were present along with small brown and black beetles. A small number of small fruit flies were also observed. Seven large larvae were found in the interior of the mango. **Tree #1B** had no visible maggots in the soil and only one maggot on the exterior of the fruit. The mango was primarily green with a few brown spots. There were no faults or openings found on the mango. Sixteen maggots were found on the upper lid only on the tree side of the container.
2. **Ground #2B** had no visible maggots in the soil or on the exterior of the fruit. The mango was one fourth brown and three fourths yellow with a few spots of decay. There were no noticeable openings found on the mango but small brown and black beetles were present. A small number of small fruit flies were also observed. **Tree #2B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely green with no observable faults or openings.
3. **Ground #3B** had no visible maggots in the soil or on the exterior of the fruit. The mango was one fourth yellow and three fourths brown with noticeable amounts of decay. Large holes and openings were present as well as small brown and black beetles. A small number of small fruit flies were also observed. Five small parasitic wasps were caught on the ground side of the container. **Tree #3B** had no visible maggots in the soil or on the exterior of the fruit. The mango was one half-green and one half-brown with a large opening on the bottom of the mango. Mold was observed growing around the opening along with small brown and black beetles.
4. **Ground #4B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely brown with noticeable decay. Large holes and openings were present as well as small brown and black beetles. A small number of small fruit flies were also observed. Two maggots were observed on the ground portion of the lid. Thirty-two large larvae were found in the interior of the mango. **Tree #4B** had a few visible maggots in the soil but none on the exterior of the fruit. The mango was primarily green with a few brown spots. Small puparia were found in the soil.
5. **Ground #5B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely brown with noticeable decay. Large holes and openings were present as well as small brown and black beetles. A small number of small fruit flies were also observed. Eighteen large larvae were found in the

interior of the mango. **Tree #5B** had no visible maggots in the soil or on the exterior of the fruit. The mango was primarily green with a few brown spots. Small puparia were found in the soil.

Observations for Ground Group B and Tree Group B with Ant Bridges

6. **Ground #6B** and **Tree #6B** were washed out do to excessive rain. The containers were completely filled with water up to the ant bridge holes. The soil was not sorted but the mangos were dissected and no maggots were found in either mango.
7. **Ground #7B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely brown with noticeable decay. Large holes and openings were present as well as small brown and black beetles. A few ants were seen in the container on the ground side. **Tree #7B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely green. Small brown and black beetles were found in the soil.
8. **Ground #8B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely brown with noticeable decay. Large holes and openings were present as well as small brown and black beetles. A small number of small fruit flies were also observed. Six large larvae were found in the interior of the mango. **Tree #8B** had no visible maggots in the soil or on the exterior of the fruit. The mango was primarily green with a few brown spots.
9. **Ground #9B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely brown with noticeable decay. Large holes and openings were present as well as small and large brown and black beetles. A large number of small fruit flies were also observed. Seven large larvae were found in the interior of the mango. A spider was observed creating a web in the left-hand corner of the ground mango section of the container. **Tree #9B** had no visible maggots in the soil or on the exterior of the fruit. The mango was entirely green. Small puparia were found in the soil.
10. **Ground #10B** and **Tree #10B** were washed out do to excessive rain. The containers were completely filled with water up to the ant bridge holes. The soil was not sorted but the mangos were dissected and no maggots were found in either mango.

Number of Maggots Caught and Seen per Mango in Ground Group B

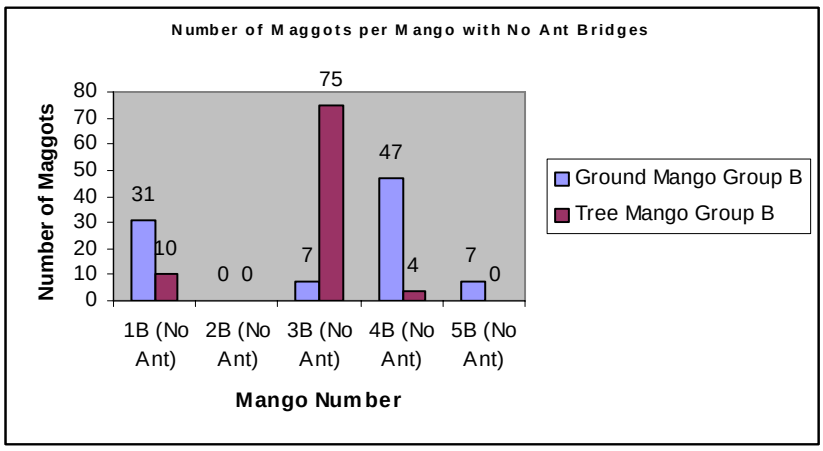
Ground Group B

Mango Number	Number Seen	Number Caught	Total
1B (No Ant)	11	20	31
2B (No Ant)	0	0	0
3B (No Ant)	2	5	7
4B (No Ant)	15	32	47
5B (No Ant)	1	6	7
6B (Ant)	*	*	*
7B (Ant)	0	0	0
8B (Ant)	2	9	11
9B (Ant)	1	6	7
10B (Ant)	*	*	*
Average	4	9.8	13.8
Total	32	78	110

Number of Maggots Caught and Seen per Mango in Tree Group B

Tree Group B

Mango Number	Number Seen	Number Caught	Total
1B (No Ant)	1	9	10
2B (No Ant)	0	0	0
3B (No Ant)	30	45	75
4B (No Ant)	1	3	4
5B (No Ant)	0	0	0
6B (Ant)	*	*	*
7B (Ant)	0	0	0
8B (Ant)	0	0	0
9B (Ant)	0	0	0
10B (Ant)	*	*	*
Average	4	7.1	11.1
Total	32	57	89



Discussion:

PART ONE:

In part one of this experiment nine mangos were collected from the ground plus nine mangos were picked from a tree. After nine days, the mangos were dissected in order to count the number of maggots found in a thirty minute time period. Maggot numbers were recorded for each mango to compare the differences in infestation rates between mangos that were on the ground and mangos that were unripe in the tree. Infestation rates were also compared to the beginning and final levels of decomposition for ground group A. Maggots that were recorded were in the third instar larval form and were between three to four millimeters in length. After nine days the ground mangos contained an average of 24.7 maggots while the tree mangos contained no maggots. Obviously there is a strong correlation for mangos being infested after falling from the tree.

However ground mango #1A, which was located on the ground, had no observable maggots in either the soil or the fruit. This could indicate a grace period where mangos can remain on the ground without becoming infested while they become ripe. The three highest infestation rates occurred in ground 5A, ground 7A, and ground 8A with ground 5A being the highest. These three mangos were in the middle to higher ranges in regards to ripeness and decomposition and probably were on the ground for longer periods of time than ground 1-4 A. There is an interesting outlier in Ground 6A, which is within the middle range mangos, yet had some of the lowest infestation numbers. Small parasitoid wasps were found in containers ground 5A and 7A. The data indicates that these containers contain the highest number of maggots which would provide larger numbers of hosts for the wasps. As the ripeness and length of time on the ground increases, the mangos attract more Drosophila up until a certain point where the fly population number decreases or has already left indicated by a bell curve on Graph A.

PART TWO:

In part two of this experiment ten mangos were collected from the ground plus ten mangos were picked from a tree. These were divided into two groups of five to compare the infestation rates seen in ant infested and non-ant infested mangos. One of each mango was placed into a container with a cardboard divider to keep the specimens separate. After seven days, the mangos were dissected in order to count the number of maggots

found in a thirty minute time period. Maggot numbers were recorded for each mango to compare the differences in infestation rates between mangos that were on the ground and mangos that were unripe in the tree. Maggots that were recorded were in the third instar larval form and were between three to four millimeters in length. After seven days the ground mangos contained an average of 13.8 maggots while the tree mangos contained an average of 11.1 maggots. This data indicates a different result than found in group set A. Although the ground mangos still averaged a higher maggot per mango ratio, the tree mangos average is within two maggots of the ground mangos average. This could have occurred due to the huge outlier found in Tree #3B. Unlike the data recorded for any of the other tree mangos in either group A or group B, Tree #3B had 75 total maggots. Tree #3B was also the only tree mango picked to have a large opening down the side. This dramatically skewed the results when comparing infestation rates for tree and ground mangos. IF Tree #3B is removed from the data set, the average for maggots per mango drops to two for group B of the tree mangos.

When comparing the ant and no ant container, the experiment would need further investigation. Two of the five containers were washed out due to excessive rain over the seven-day fermentation period. The three remaining ant containers were compared to the five no ant containers with dramatic results. In all of the ant containers, no maggots were recorded for any of the tree mangos. However the no ant tree mangos contained an average of 17.8 maggots per mango. In the ground mangos for the ant containers, an average of six maggots were recorded while the no ant ground mangos contained an average of 18.6 maggots per mango. Due to the two inch by two-inch holes created for the ant bridges, a greater diversity of arthropods was present which in turn reduced the niche space for the *Drosophila melanogaster maggots.*

Conclusion:

For both group A and group B, the mangos collected from the ground contained a higher average of maggots than the mangos picked from the tree. Even when ground and tree mangos were placed in a single container, the ground mangos maintained a higher average. When ant bridges were placed in the container, the average maggot per mango ratio dropped even further. By introducing external factors, the maggots were forced to compete against beetles, spiders, and other flies for a similar niche space. This in turn reduced their overall number and resulted in a lower average.

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