The Life Table of Psyllids (Hemiptera:Triozidae) on Tomato Leaves

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Abstract: *Bactericera cockerelli* is a very destructive pest that transmits *Candidatus liberibacter* solanacearum (Lso). An effective strategy does not exist to control the *Candidatus liberibacter* species for plant protection. The management practices that do exist practice on limiting the spread of infection. When irradiation technology has been used, it has shown a great promise to disinfest pests. It is currently not clear how eBeam dosage impacts the psyllids life cycle. This experiment focuses on the life cycle of psyllids under laboratory conditions without eBeam treatment. It is meant to set the foundation for further research at Texas A&M University. Seeds were germinated and transplanted at the Texas A&M Institute for Plant Genomics and Biotechnology. Psyllids from a colony provided were placed on tomato leaves and the developmental times of 60 psyllids were documented. The average developmental time for an egg to become an adult was 21 days. The average developmental time for each instar stage was between 3 to 4 days. Further research will be conducted by Texas A&M University to evaluate the effects of eBeam irradiation at various doses on psyllid growth, developmental time and reproduction.

Keywords: Psyllids, life table, tomato, eBeam

Psyllids, sometimes called jumping plant lice, are phloem feeding insects that can transmit bacteria like *Candidatis liberibacter* that cause severe plant diseases. Although not observed in the United States before the year 2000, psyllid-vectored diseases are now rapidly expanding geographically, threatening both potato and citrus production (Liefting et al., 2009, Bove, 2006). *Bactericera cockerelli* (Hemiptera: Triozidae) is known as the potato/tomato psyllid. These psyllids have an extensive host range that includes species in 20 families and vectors the bacterial pathogen *Candidatus liberibacter solanacearum* (Lso). The same bacterial pathogen is the causal agent of Zebra Chip disease in solanaceous crops. There are currently no effective strategies available to control *Candidatus liberibacter* species for plant protection. The existing management practices to limit the spread of infection rely on timely detection and control of the insect vector with the use of insecticides (Levy et al., 2013). This method of chemical-based pest control has resulted in insect resistance developments and unpleasant environmental and human health impacts. The utilization of irradiation technology has demonstrated great promise to disinfest pests from a variety of agricultural products (Hallman, 2012). Irradiation technology may include electron beam (eBeam) irradiation, X-rays or gamma radiation. When eBeam is used against insect pests, it is effective on all the developmental stages of insects. It is not clear how relative eBeam dosage impacts the psyllid's growth, life cycle, and reproduction. This experiment focuses on the life cycle of psyllids under laboratory

conditions without eBeam treatment (control) which is meant to set the foundation for further research at Texas A&M University.

Materials and Methods

Tomato seeds were first germinated at the Texas A&M Institute for Plant Genomics and Biotechnology. Two plastic containers with the dimensions of about 12 inches in length, 9 inches wide, and 3 inches deep were obtained. Two paper towels were placed at the bottom of each container and water was added, just enough to get the two paper towels wet. Standing water was removed from the containers and ten tomato seeds were placed in each of the containers. Two rows of seeds were made in each container with five seeds in each row about 2 inches apart. Two paper towels were placed on top of the seeds in each container and water was carefully added again. A sponge was then used to press the paper towels against each other and absorb any excess water. If standing water was still present it was removed from the containers. These containers were placed in a growth room to germinate. They were checked every day for exactly one week. During this germination period it was crucial to make sure the seeds had enough water. Water was added to the containers about twice during the germination week. After germinating, the seeds were transplanted into pots. LP5 Soil (Sun Gro Horticulture, Massachusetts), ten 1-liter pots, a traditional sized thermoformed tray, and a gallon water jug were obtained to plant the seeds. Each of the ten pots were filled with soil all the way to the top. The pots were placed on the tray. Half a gallon of water was poured in to the tray and the other half was divided into the individual pots. Two holes were made in each pot about one inch deep and a germinated seed was put in each. The plants were maintained for five weeks in a growth chamber with a temperature of 27ºC and 60% humidity. The plants were checked on every day. They were watered when needed and kept as healthy as possible. Some of the pots had two separate tomato plants growing in them. Two weeks after being transplanted, one plant was carefully removed from the soil of each of the pots that had two plants. Ten petri dishes (Fisher Scientific, Pennsylvania) were obtained and a 2x3 inch piece of filter paper was placed in each. Ten leaves were cut from the five-week-old tomato plants. Half a cotton ball was wrapped around the stem of each leaf and a 2x3 piece of aluminum foil was wrapped around the cotton ball. Once all the leaves were prepared, one leaf was placed in each petri dish, on top of the filter paper. Water (1.25ml) was then added to the filter paper and the cotton ball. A psyllid colony was being maintained by the Texas A&M Institute for Plant Genomics and Biotechnology. This is where the psyllids were obtained from. Sixty late fourth instar psyllids were obtained from the insect colony provided. Six psyllids were placed on each leaf in the ten petri dishes. These petri dishes were then placed in a growth room and observed every day to create a life table of the psyllids.

Results

The average developmental time from eggs to adults was found to be 21 days. They were in the egg stage for 5 days. Each instar stage was between 3 and 4 days (Table 1).

Table 1: The average developmental time for each stage of psyllids

Stage	Average Developmental time
Eggs	5 days
First instar	4 days
Second instar	3 days
Third instar	3 days
Fourth instar	4 days
Fifth instar	3 days
Eggs to adults	21 days

Discussion

This experiment helps us understand the lifecycle and average developmental time from stage to stage of psyllids on tomato plants. This data could later be compared to the life table of eBeam treated psyllids. Further research will be conducted by Texas A&M University to evaluate the effects of eBeam irradiation at various doses on psyllid growth, developmental time and reproduction. In doing so, the research can continue to determine whether sublethal doses of eBeam irradiation negatively influence psyllid-vectored disease transmission. This will define the fitness cost in psyllids induced by eBeam which, will be useful information for USDA-APHIS in making improvements irradiation phytosanitary treatments to prevent disease spread. Once this system is understood enough, it could be used as a model for better understanding plant-pathogen-insect vector interactions such as the triangular association in citrus greening. Potentially, this system could also be used for biocontrol through sterilization and introduction of large numbers of eBeam-treated citrus psyllids to block reproduction of wild populations.

References

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