Title:
Spotted Wing Drosophila (SWD), *Drosophila suzukii*, infestation risk to tomatoes

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This work was supported by the USDA National Institute of Food and Agriculture, Hatch project 1001709. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the National Institute of Food and Agriculture (NIFA) or the United States Department of Agriculture(USDA).

Cooperator(s):

Abstract:
Spotted Wing Drosophila (SWD), *Drosophila suzukii*, an invasive fruit fly originally from Asia, appeared in NY in 2011 and has become of major concern to small fruit growers. Unlike other fruit flies, it has a serrated ovipositor that allows it to penetrate intact fruit and lay eggs often just prior to harvest. The larvae will hatch and develop within the fruit with no initial external damage to the fruit. Current pesticide control measures target the adult but there is great risk of developing resistance; resistance has already been reported on the West Coast. Known hosts of SWD include soft skinned fruit like raspberries, cherries, blueberries, peaches and strawberries. Even though the wild host range of SWD includes nightshades (*Solanum spp*.) the expansion of spotted wing drosophila onto other soft skinned fruit or vegetables is still unknown and no research has been conducted to evaluate the threat of SWD to tomatoes, *Solanum lycopersicum*, which are a major crop in NY.

Fifteen tomato varieties were used to determine the likelihood of SWD to lay eggs in tomatoes in the field as well as in the lab. The penetration force or skin firmness for all varieties, with the addition of two varieties from 2013, was determined and compared to known hosts of SWD. No SWD emerged from any intact tomatoes collected from the field. Four percent of cracked tomatoes collected from the field had SWD emerge. When adult SWD were placed on intact tomatoes in the lab under a no choice situation 12% of the tomatoes had some SWD emerge. There was a slight correlation between skin firmness and SWD emergence.

Background and justification:
The USDA Annual Vegetable Summary of 2013 showed that 2,900 acres of fresh market tomatoes were planted in NY in 2013. This was a slight decrease from 2011 but an overall increase of over 7% since 2009 and was valued at $32 million. The sudden arrival of Spotted Wing Drosophila in NY in 2011 caused small fruit growers much concern and compelled this research into whether tomatoes might serve as a host to SWD. With the great variation in tomato varieties it is possible that thinner-skinned tomatoes are at risk. This research provides a better understanding of

which varieties are at risk from SWD thereby decreasing insecticide applications to lower risk varieties. This also addressed one of the priorities listed by the SWD IPM working group: determining damage to different crops.

Objectives:

1. Plant 15 varieties of tomatoes at the NYSAES Research North farm.

2. Monitor for SWD in tomato plot.
3. Using a TA.XT Plus analyzer determine the skin firmness of the 15 tomato varieties as well as four known cultivated hosts and eight known wild hosts.
4. Collect SWD emergence data from the 15 tomato varieties, both cracked and intact fruit, grown in the field.
5. Conduct no-choice tests on the 15 tomato varieties, both cracked and intact fruit, collected from the field.
6. Collect emergence data from the no-choice tests and determine if there is a correlation between skin firmness or tomato variety and SWD emergence.

Procedures:

1. Started fifteen tomato varieties (see Table 1) on 5/15/14 in the greenhouse and transplanted to the NYSAES's Research North farm on 6/21/13. Each tomato variety was spaced 18 inches apart in a randomized complete block design consisting of three replicates. Sprayed all tomatoes on July 1, 10, and 30 with 2 pts/A Chloronil ® 720 using a one gallon handheld sprayer to control for late blight, *Phytophthora infestans*. These dates were based on forecasting from the late blight DSS. Suckered and staked all tomato varieties on 7/10/14. On August 4, 13, 26, after fruit began to develop, the higher rate of 2.75 pts/A Chloronil® 720 was sprayed on all tomatoes. On August 26th late blight was detected in the tomato plot and all infected plant material was removed. On August 28th and September 5th sprayed 2.5 pts/A Ridomil Gold® Bravo SC on infected tomatoes and removed additional late blight infected plant material. On September 10th sprayed 1.5 pts/A Previcur® Flex in combination with 2.75 pts/A Chloronil® 720. I then began a seven day rotation between Ridomil Gold® Bravo SC and the combination of Previcur® Flex/Chloronil® 720 until the end of this study.
2. To monitor for the presence of SWD, one apple cider vinegar trap was placed in the tomato plot on 7/16/14 and monitored weekly for the duration of this study.
3. Tomato fruit was collected for all 15 varieties as they ripened throughout the growing season. A TA.XT plus texture analyzer was used to evaluate the skin firmness or penetration force in grams of the different varieties as well as the skin firmness of known cultivated hosts and known wild hosts (see Figure 2).
4. Intact fruit from 11 varieties and cracked fruit from14 varieties was brought into the lab and placed into rearing containers to see if any SWD would emerge. Rearing containers consisted of a plastic deli container with mesh lids into which tomatoes were placed. Containers were monitored for at least

three weeks to determine if any SWD emerged. See Table 1 for sample sizes for each variety.

5. Intact and cracked fruit from the fifteen tomato varieties were placed into individual rearing containers. In addition to the fruit, adult male and female SWD and a cotton ball soaked in water, to provide water to adult SWD, were placed in the rearing container. Adults remained in containers for one week to allow for oviposition and then removed. The containers were then monitored for an additional three weeks to determine if any adult SWD emerged. See Table 1 for sample sizes for each variety.
6. The results from objectives 3, 4, and 5 were used to determine if a correlation existed between skin firmness and SWD emergence.

Table 1. List of tomato varieties and sample sizes used to determine SWD emergence.

Variety	Intact	Cracked	Intact +SWD	Cracked +SWD
Brandywine	0	3	1	3
Garden Peach	5	8	4	9
Golden Sweet	5	8	4	8
Isis Candy	5	9	4	8
Lemon Drop	5	8	3	7
Little Lucky	0	2	0	3
Matt's Wild Cherry	5	8	3	8
Pruden's Purple	0	5	2	4
Purple Russian	5	8	4	7
Red Pearl	4	9	4	6
Striped German	0	3	1	8
Sun Gold	5	10	4	9
Super Sweet 100	5	9	4	6
Yellow Pear	5	10	4	8
Yellow Perfection	5	8	4	6

Results and Discussion:

SWD was first detected with the use of apple cider vinegar trap on 9/5/14 at which point fruit collections began.

Fifteen tomato varieties were used to determine the likelihood of SWD to lay eggs in tomatoes in the field as well as in the lab. The penetration force or skin firmness for all varieties was determined and compared to known hosts of SWD using a TA.XT plus analyzer (See Figure 1).

The average penetration force for all fruit is shown in Figure 2 below. All known hosts (wild and cultivated) with the exception of garden asparagus had a lower penetration force than the average tomato penetration force (red line). The average

penetration force for all tomato varieties was 13 times greater than that of raspberries, one of the more susceptible fruits to SWD oviposition.

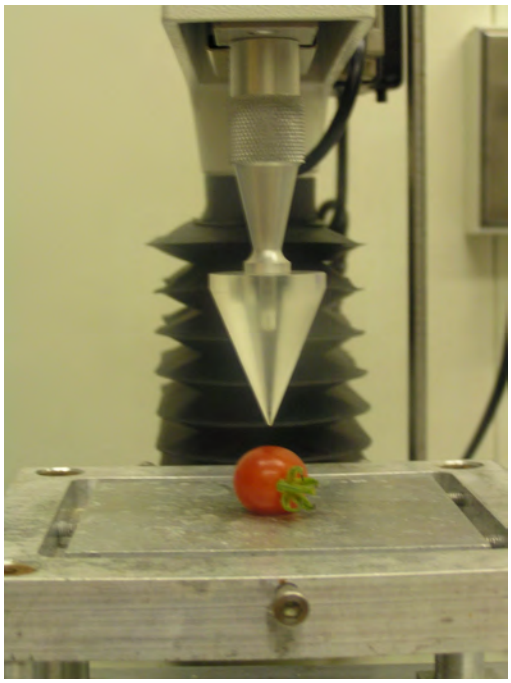

Figure 1. The variety *Matt's wild cherry* on TA.XT plus prior to skin firmness test.

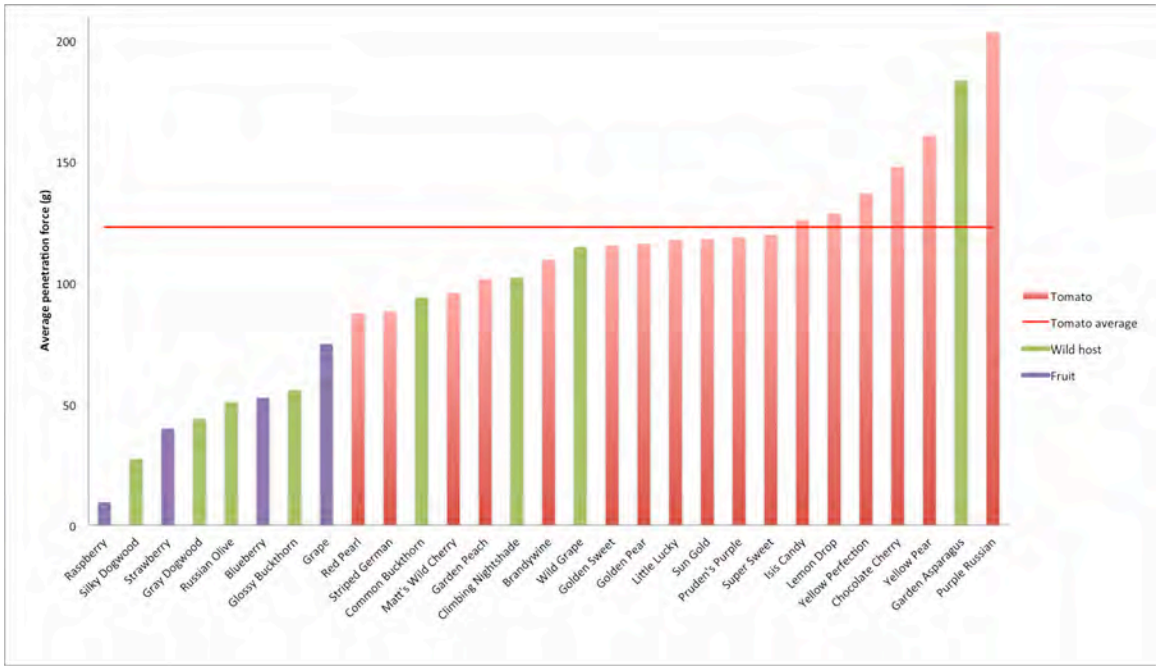

Figure 2. Average force (g) required to penetrate the skin of seventeen different tomato varieties, eight known wild hosts and 4 known cultivated fruit hosts of SWD. The solid red line indicates the average penetration force of all tomatoes.

No SWD emerged from any intact tomatoes collected from the field. Four percent of

cracked tomatoes collected from the field had SWD emerge. When adults SWD were placed on intact tomatoes in the lab 12% of the tomatoes had SWD emerge and when SWD were placed on cracked tomatoes in the lab 61% had SWD emerge. There was a slight correlation between penetration force and SWD emergence for both intact and cracked fruit. The proportion of tomato fruit with SWD emergence decreased as the skin firmness or penetration force increased. (see Figure 3).

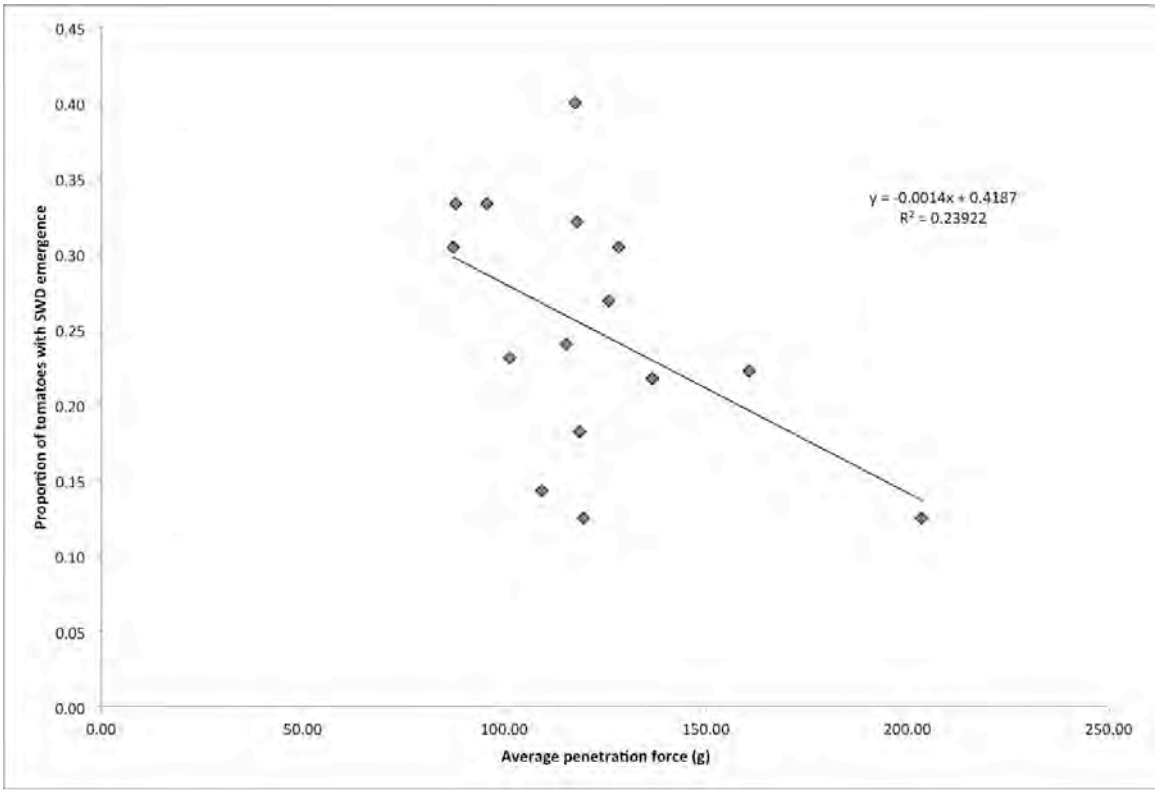

Figure 3. Graph showing the correlation between the average penetration force and the proportion of tomatoes with SWD emergence (R^2 = .239, $F_{1, 13}$ = 4.09, p=. 06) for both intact and cracked fruit that had adult SWD placed into rearing cups.

Spotted wing drosophila is a pest of small fruit and has received a lot of attention in the last few years since its first detection in NY in 2011. It can lay eggs an develop on soft skin fruit but the results form this experiment suggest that tomatoes will not be at great risk. Intact tomatoes grown in the field have not had any SWD emerge however cracked tomatoes in the field provide for a suitable oviposition site. It is therefore recommended that cracked tomatoes that are no longer marketable be removed from the field to decrease the potential of SWD laying and developing. This is especially true for growers with more susceptible fruit, such as raspberries or strawberries near by.

Project location(s):
NYSAES Research North Farm Geneva Ontario, NY
Samples of resources developed:

SWD rearing containers containing different varieties of tomatoes.