Backyard Composting of Infested Fruit: A Potential Pathway for Introduction of *Anastrepha* Fruit Flies (Diptera: Tephritidae) into Florida

Paul E. Kendra[1], Michael K. Hennessey[2], Edward M. Jones[2], Wayne S. Montgomery[1] and Nancy D. Epsky[1]

[1]USDA-ARS, Subtropical Horticulture Research Station, Miami, FL

[2]USDA-APHIS-PPQ, Plant Epidemiology and Risk Analysis Laboratory, Raleigh, NC

Introduction

Tephritid fruit flies in the genus *Anastrepha* are serious pests of tropical and subtropical fruit crops throughout the Americas. The Caribbean fruit fly (*A. suspensa*, Fig.1), indigenous to the Bahamas and Greater Antilles, is now common in peninsular Florida where it has become a quarantine pest of citrus and a production pest of guava. The Mexican fruit fly (*A. ludens*) and West Indian fruit fly (*A. obliqua*), though not established in Florida, pose additional invasive threats due to proximity of populations in Mexico and the Caribbean basin.

If infested fruit evades detection/quarantine measures and is discarded directly into the environment, there is a risk of pest introduction. With current emphasis on environmentally-friendly practices, there is increased interest in residential composting of organic materials generated in the home and garden. This study was designed to estimate the likelihood of exotic fruit flies entering south Florida through backyard composting of infested fruit.

Fig. 1

***Anastrepha suspensa* (Loew)** ♀

Methods

Fig. 2

Infestation. Under lab conditions (25^{0}C, 70% RH) ~3500 mated females of *A. suspensa* were placed into an oviposition cage with 120 ripe grapefruit (*Citrus paradisi*) and allowed to lay eggs for 7d (Fig.2). Fruit was then randomly divided into 3 treatments: "Compost" (50 fruits), "Controls" (50 fruits) and "Inspection" (20 fruits). All fruit was held in the lab and "Inspection" fruits were cut open at 2-3d intervals to monitor larval development (Fig.3A). When the majority of the larvae had reached the 3rd instar (Fig.3B), field tests were initiated.

Field Tests. For each test, 10 replicate compost piles (1.5 m^3) were constructed from wood chips and fresh grass clippings (1:1 mixture). Five infested fruit were placed on each pile, left exposed for 5d, and then covered with conical screen cages (Fig.4A). Adult fly emergence was recorded for 30d (Fig.4B), as well as compost temperature (6" depth) and weather conditions. Berlese samples were collected at the completion of the tests to assess presence of natural enemies.

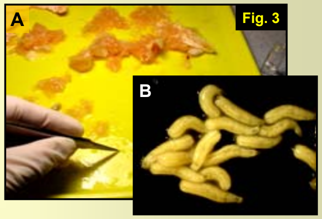

Fig. 3

Fig. 4

Controls. Under lab conditions, 10 replicate control bins were set up to accompany each field test. For each bin, 5 infested fruit were placed on a layer of vermiculite (Fig.5), pupae were sifted weekly, and fly emergence was recorded for 30d.

Date replicates. Field tests and controls were replicated four times during the fall-winter-spring of 2004-2005.

Fig. 5

Results & Discussion

Adult Emergence. Table 1 presents the average number of flies emerged and the percent emergence from compost pile fruit relative to control fruit. Fly emergence was expressed as a percentage for each replicate test to account for different levels of infestation. The overall percent emergence of adults (males and females combined) was 10.8%, indicating 89% mortality due to the composting conditions. Thus, percent emergence can also be regarded as relative survival of the pest when host fruit is discarded onto outdoor compost piles.

TABLE 1			Rep 1	Rep 2	Rep 3	Rep 4	Mean
Number Emerged	Compost	Males	22	1	7	15	11.3
		Females	33	1	24	33	22.8
		Both	55	2	31	48	34.0
	Control	Males	393	196	163	55	201.8
		Females	579	235	176	117	276.8
		Both	972	431	339	172	478.5
Percent Emerged	Compost/Control (x 100)	Males	5.6	0.5	4.3	27.3	9.4
		Females	5.7	0.4	13.6	28.2	12.0
		Both	5.7	0.5	9.1	27.9	10.8
Mean Compost Temperature, 6" (^{0}F)			109.3	122.0	102.8	82.9	

Mortality Factors. Though not a major focus of this study, several factors contributing to pest mortality were identified through Berlese sampling and daily monitoring of compost piles.

- **Biotic:** Predators and parasitoids in compost (*Solenopsis* ants, Staphylinid beetles, Macrochelid mites, Carcinophorid earwigs, and Braconid wasps), competitors in host fruit (Nitidulid beetles), and fungus on both fruit and compost material.
- **Abiotic:** Compost temperature -- Increased compost temperature resulted in decreased adult emergence (Table 1). (No trends in emergence were observed with respect to the weather conditions monitored: air temperature, relative humidity, and precipitation.)

TABLE 2		Compost Pile 1	2	3	4	5	6	7	8	9	10	Mated Females #	% Emerged
Rep 1	Males	0	0	2	2	5	3	2	1	3	4		
	Females	0	0	3	3	4	6	5	5	6	1		
	Max. Mated Females	0	0	3	3	4	6	5	5	6	1	33	5.7
Rep 2	Males	0	1	0	0	0	0	0	0	0	0		
	Females	0	0	1	0	0	0	0	0	0	0		
	Max. Mated Females	0	0	0	0	0	0	0	0	0	0	0	0
Rep 3	Males	0	0	0	0	0	2	2	0	0	3		
	Females	0	0	0	0	0	10	4	2	0	8		
	Max. Mated Females	0	0	0	0	0	10	4	0	0	8	22	12.5
Rep 4	Males	0	2	4	0	0	0	5	3	1	0		
	Females	3	5	6	0	3	1	8	3	4	0		
	Max. Mated Females	0	5	6	0	0	0	8	3	4	0	26	22.2
											Mean	20.3	10.1

Risk of Pest Introduction. We defined risk as the presence of a single mated female in a suitable habitat. For this study, a female was considered potentially mated if at least 1 male emerged from the same compost pile. Based on these criteria, the risk of *Anastrepha* introduction through composting of infested fruit was estimated to be ~10% (Table 2).

Recommendation. To reduce the risk of pest introduction, fruit should be placed internally and active composting maintained. Keeping piles moist and turning them often will promote biological activity, rapid breakdown of organic material, and maximum compost temperatures.