

Antibiosis to Caribbean Fruit Fly in Avocado Germplasm

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Abstract. Seventeen avocado selections from the U.S. Dept. of Agriculture Miami National Clonal Germplasm Repository were bioassayed for antibiosis to Caribbean fruit fly eggs and larvae. Two colony-reared strains of flies were used. Fourteen of the selections did not support any development of immature stages to the adult stage. The results support the contention that highly resistant cultivars would not pose a high risk of spreading Caribbean fruit fly to foreign markets even without postharvest disinfestation treatment.

Avocado cultivars (*Persea americana* Mill.) exported from Florida to some foreign markets are quarantined against possible Caribbean fruit fly [*Anastrepha suspensa* (Loew)] infestation. There is a need for resistant commodities in quarantine protocols (Armstrong, 1994; Jang and Moffit, 1994). The 73 avocado cultivars marketed from Florida in 1993 (Manchester, 1993) have not been evaluated for resistance to Caribbean fruit fly infestation. Therefore, experiments were designed to evaluate antibiosis of avocado germplasm to the Caribbean fruit fly in Florida.

The Miami National Clonal Germplasm Repository was the source of germplasm bioassayed for resistance. The repository contains >300 accessions represented by >170 avocado cultivars and seedlings (pollen source not known) of diverse origin (Strauss, 1984). Fruit of 18 trees that had not been treated with insecticides for 2 months before experimentation were selected for study based on fruit availability in 1993 (Table 1). Each cultivar or seedling was represented by one tree, except 'Lula',

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which was represented by two.

The combination of cultivar or seedling and fruit maturity stage (early harvested mature or late-harvested mature) made up 25 treatments (Table 1). Treatments were arranged in a completely randomized design with five replications. Early and late-harvested referred to the first and the second half, respectively, of the harvesting period according to Manchester (1993). For cultivars or seedlings without published standards (11), only mature fruit were harvested (visual observation). Mature fruit were those that had reached a growth stage that ensured proper completion of ripening. Harvested fruit conformed to the U.S. No. 1 grade (Blood, 1957). 'Tonnage', 'Waldin', 'Lula', 'West Indian Seedling', 'Trapp', and 'Brooks Late' were harvested under Florida market maturity standards (i.e., calendar date, weight, and diameter) (Manchester, 1993). To determine if they were mature when harvested and bioassayed, replicated samples from each treatment were held [$25 \pm 2\text{C}$; $60\% + 10\%$ relative humidity (RH); 14 ± 0.5 h light/ $10 + 0.5$ h dark, natural and artificial light (\pm range)] for 1 week after harvest to determine ripening potential according to Wolfe et al. (1946). Proper ripening was determined by evaluation of the flavor by M.K.H. and two other persons with experience in assessing ripeness of commercial cultivars.

Two tangential slices were cut from the widest part of each fruit within 1 h of harvest. Slices measured $\approx 3.0 \times 6.0$ cm and weighed 9.0 ± 2.0 g (mean \pm SE) and included peel and flesh to a maximum depth of 1 cm. Slices from each fruit were inoculated with laboratory reared fruit fly eggs from either an agar diet strain or a corncob diet strain. Both strains had been reared in isolation at the Miami Agricultural Research Service Station for >800 generations (Hennessey, 1994).

The cut surface of each slice was scored to a depth of 3 mm in two places before inoculation to facilitate larvae burrowing. Before being used for inoculations, the eggs were incubated for 3 days in a chamber ($26 \pm 2\text{C}$; $85\% \pm 5\%$ RH; 14 ± 0.5 h light/ 10 ± 0.5 h dark, natural and artificial light) and kept moist with an antifungal solution (0.1 % sodium benzoate, 0.3% furcelleran, 0.4% 10% hydrochloric acid, and 99.2% water). A 1-cm^2 piece of blotting paper wetted with antifungal solution and containing 10 viable (opaque white and having normal size and shape when viewed at 10 magnifications) Caribbean fruit fly eggs was placed on the cut surface of each slice. Agar and corncob diets served as controls. Five control replications each of 10 agar and 10 corncob eggs on agar and corncob diets, respectively, were bioassayed alongside treated slices.

Treated fruit slices and controls were housed in 65-ml clear polystyrene cups with 4-cm openings and snap-on lids. Lids had a 1-cm^2 hole covered with nylon screen for ventilation. About 1 ml of antifungal solution was handmisted over slices and eggs, cups were capped, and then placed in a translucent plastic box in the incubation chamber.

After 3 days, 1 g of vermiculite was placed in the cups with each sample to provide a pupation medium for emerging larvae. After 7 days, pupae and prepupae were removed from the control containers, placed on 1 g of vermiculite in petri dishes (10 cm in diameter), and placed in the incubation chamber until emergence of the adults. Likewise, prepupae and pupae from treatments were handled similarly to controls after 13 days.

Percentage of adult emergence from eggs was the criterion for measuring antibiosis

(Cowley et al., 1992). The percentage of adult emergence in a treatment was calculated as follows: the percentage of eggs (either agar or corncob strain) developing into adults in a replication (individual slice) divided by the mean percentage of eggs developing into adults from control replications (individual agar or corncob diet cups; $n = 5$). Analyses of variance were performed using nontransformed percentage of emergence of adults from agar and corncob as dependent variables (analyzed separately) and treatment as the independent variable. Where significant F values were found ($P < 0.05$), Fisher's least significant difference test was used to separate means.

Table 1. Emergence of two strains of Caribbean fruit fly adults from avocado germplasm.

| Genotype | Miami accession | Maturity stage | % Emergence | |
|----------------------|-----------------|----------------|------------------|------------------|
| | | | Agar | Corncob |
| Antigua Market | M11939 | Early | 0 | 0 |
| | | Late | 0 | 0 |
| Brooks Late | M22618 | Early | 0 | 0 |
| Brooksville seedling | M25870 | Late | 0 | 0 |
| Collinson seedling | M7827 | Early | 0 | 0 |
| | | Late | 0 | 0 |
| Dade | M673 | Late | 19.4 | 6.7 |
| General Bureau | M19331 | Early | 0 | 0 |
| Irwing 59 | M20715 | Late | 0 | 0 |
| Lula 1 | M7828 | Early | 0 | 0 |
| Lula 2 | M7828 | Early | 0 | 0 |
| | | Late | 2.4 | 0 |
| Nabal | M656 | Late | 0 | 0 |
| Queen 8 | M20722 | Late | 0 | 0 |
| Tenerife | M17690 | Early | 0 | 0 |
| | | Late | 0 | 2.9 |
| Tonnage | M19847 | Early | 2.8 | 6.7 |
| | | Late | 0 | 2.6 |
| Trapp | M19849 | Late | 0 | 3.0 |
| Utuaado | M19768 | Early | 0 | 0 |
| | | Late | 0 | 0 |
| Waldin | M19850 | Early | 0 | 0 |
| Wester | M675 | Early | 0 | 17.4 |
| West Indian seedling | M3335 | Early | 2.0 | 0 |
| | | Late | 4.8 | 0 |
| LSD | | | 6.4 ^x | --- ^y |

^xF = 3.06; df = 24; $P \leq 0.0001$.

^yF = 1.35; df = 24; $P \leq 0.156$; LSD not reported.

All fruit ripened properly. Therefore, we concluded that they had been harvested in a mature, marketable condition.

There was a significant difference ($P < 0.05$) among treatments in antibiosis to the agar diet strain (Table 1). No adult emergence was detected in 20 of the 25 agar treatments. 'Dade' late acted least antibiotic. The difference in antibiosis among treatments bioassayed with the corncob strain was nonsignificant ($P > 0.05$; Table 1). Nineteen of the 25 corn-cob treatments produced no adult emergence.

The results support the contention that the cultivars that had high antibiosis to the agar strain of fruit flies (e.g., those with 0% emergence, Table 1) would not pose a high risk of introducing Caribbean fruit fly into foreign markets even without postharvest disinfestation treatment. The cultivars that had high antibiosis to the agar strain would also be likely candidates for further resistance tests. 'Dade' could serve as a susceptible standard in subsequent antibiosis tests.

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