MORTALITY OF *Toxotrypana curvicauda* (DIPTERA: TEPHRITIDAE) IN PAPAYAS EXPOSED TO FORCED HOT AIR

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Papaya is grown throughout the tropical regions of the world for its melon shaped fruit which has an orange or red flesh, that is eaten fresh, dried, or made into juice. Papaya fruit fly, *Toxotrypana curvicauda* Gerstaecker, is a specialist on papayas. The papaya fruit fly is found from Mexico south to Brazil, on some Caribbean islands and in South Florida. There are no postharvest quarantine treatments available for Florida papayas. Hot air, hot water, and fumigation with EDB have been studied in Hawaii as commodity treatments for papayas infested with a number of fruit fly species. EDB has been banned as a carcinogen, and hot air has been found to damage the fruit less than hot water immersion. This study was conducted to determine if hot air would be feasible as a commodity treatment for papayas infested with immature stages of the papaya fruit fly.

MATERIALS AND METHODS: Papayas with naturally occurring infestations were collected on the USDA-ARS Research Station in Miami, and from a mixed grove of papayas and guavas in western Dade county. The papayas were sorted into groups of 10-12 of similar sizes which were randomly assigned to treatments or control. Three control groups were held to estimate the fly population present. A forced hot air machine described by Sharp et al. (1994) was used to treat the papayas. Treatments consisted of 30, 60, 90, 120, 150, 180 and 210 minutes of forced hot air at 48°C. After treatment all treated fruit were allowed to cool at ambient air temperatures (≈25°C) and then were placed in holding cages, larvae emerging from fruits were collected and counted. The experiment was repeated 12 times.

RESULTS AND DISCUSSION: From 10-12 papayas in each replication, an average of 5.28 larvae per papaya (S.E. Mean 0.92) emerged from untreated papayas, with a range of 0.08 to 24.4 larvae per papaya. The estimated treated population totaled 697.3 over the 12 replications (Table 1). The treatment caused 45% mortality in the first 30 minutes (Fig. 1). In two replications larvae survived 60 minutes of treatment and in one replication 18 larvae survived 150 minutes of treatment (Table 1). The center temperatures of the heated papayas reached 46°C after about 90 minutes of treatment (Fig. 1, 557 g papaya).

Using different models on the mortality data gives different predictions of probit 9. Probit gave a prediction of 167.5 minutes, Logit 87.7 minutes, Gompertz 267.9 minutes,

Gaussian Cumulative 120.6 minutes, and the best fitting linear equation ($y=a+b\ln x/x^2$) 123 minutes. Ignoring one data point from replicate 4 would give 100% mortality at about 90 minutes, but the true figure is probably close to 167.5 minutes. The treatment should probably be continued until the center temperature of the coldest fruit reaches 46°C and remains there for at least 10 minutes.

Mangan and Ingle (1992, 1994) found that heating mangoes and grapefruit with forced hot air until the core reached 48°C (157 to 200+ minutes) would give probit 9 mortality of West Indian fruit fly, and Mexican fruit fly, respectively. Sharp et al. (1991, 1994) found that heating mangos and grapefruit with forced hot air from 101 to 214 minutes would achieve probit 9 mortality of *Anastrepha suspensa*. Armstrong et al. (1995) found that heating papayas with forced hot air would achieve probit 9 for Mediterranean fruit fly, Melon fly, and oriental fruit fly, in 210 ± 15 minutes. This indicates that the papaya fruit fly is similar in its tolerance to heat to the other tephritid species that have been tested.

REFERENCES CITED

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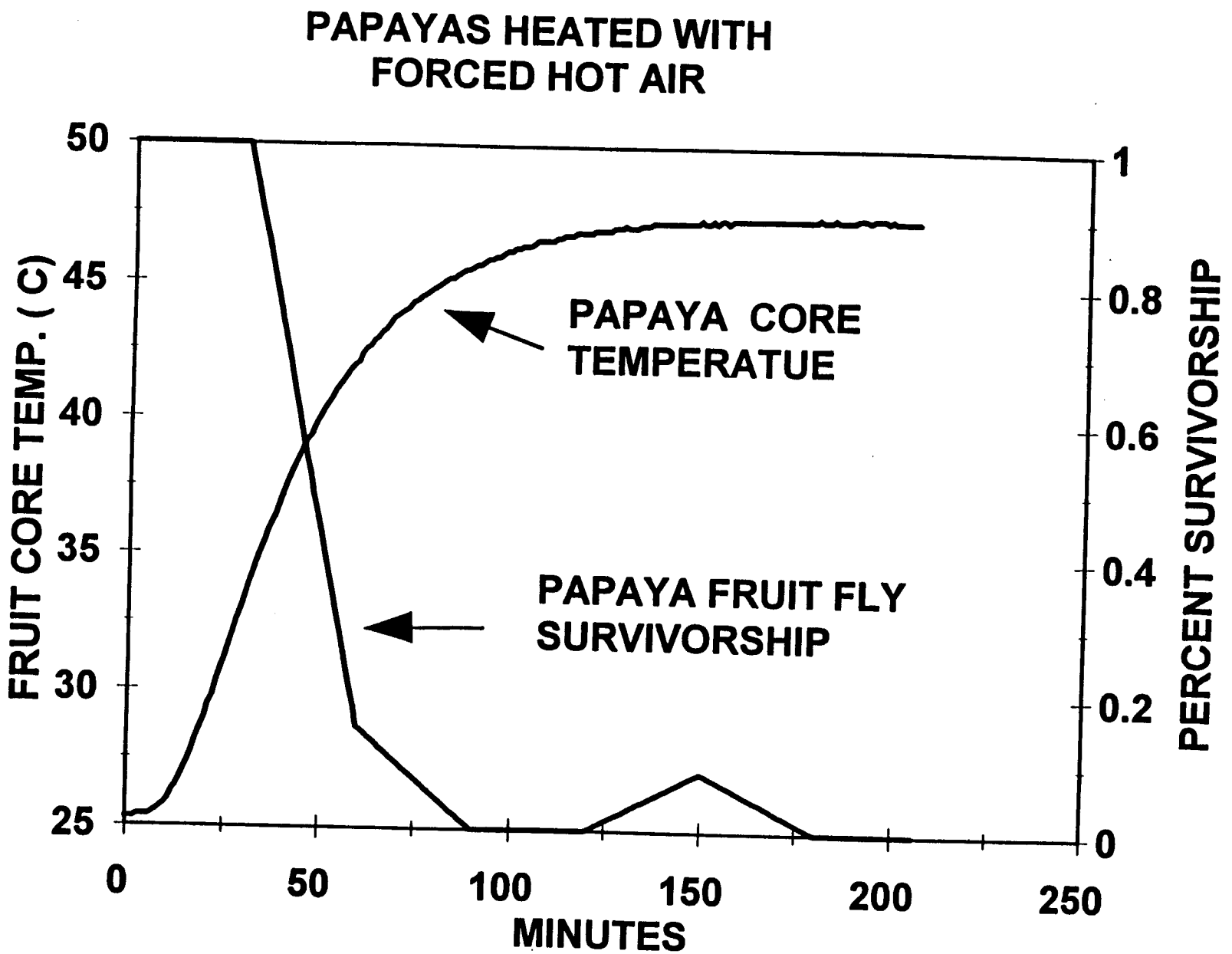
TABLE 1. TOTAL LARVAE RECOVERED FROM PAPAYAS AFTER TREATMENT WITH HOT AIR.

Time min.	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	Total
30	48	0	2	42	132	11	0	0	6	43	89	10	383
60	0	0	0	9	22	0	0	0	0	0	0	0	31
90	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	18	0	0	0	0	0	0	0	0	18
180	0	0	0	0	0	0	0	0	0	0	0	0	0
210	0	0	0	0	0	0	0	0	0	0	0	0	0
Ctl.	25	40	1	72	81	80	10	26	166	28	39	45	613
Ctl.	7	22	0	154	59	66	22	30	124	99	5	15	603
Ctl.	0	11	0	293	147	27	29	28	142	37	30	132	876


PAPAYAS HEATED WITH
FORCED HOT AIR
FRUIT CORE TEMP. (C)
50
45
40
35
30
25
PERCENT SURVIVORSHIP
1
0.8
0.6
0.4
0.2
0
PAPAYA CORE
TEMPERATUE
PAPAYA FRUIT FLY
SURVIVORSHIP
0
50
100
150
200
250
MINUTES