

Mango Resistance to Fruit Flies. II Resistance of the Alfa Cultivar

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ABSTRACT: The percentage of infested mango fruits of five selected mango varieties was evaluated during three years under field conditions. Three varieties with field resistance to fruit flies had less than 10% of fruits infested. Tommy Atkins, the susceptible commercial check, had 42,9% and the susceptible check had 98,9 % of infested fruits. The three field resistant varieties plus the susceptible commercial check, Tommy Atkins, were further tested in laboratory, under caged conditions, with artificial infestation of *Anastrepha obliqua*. The attempts of oviposition and the number of pupae developed from each fruit were evaluated. Under caged conditions, the cultivar Alfa maintained its field resistance and Espada Stahl and IAC 111 lost the field resistance and were as susceptible as Tommy Atkins. The attempts of oviposition were positively and highly correlated with the number of pupae developed in the fruits. Non preference for oviposition was confirmed as the main mechanism of resistance of mango fruits to fruit flies. In the absence of a more susceptible variety (no choice test) the cultivar Alfa has kept the resistance.

Key Words: *Mangifera indica*, Varietal resistance, *Anastrepha obliqua*, Non preference, Mango breeding.

INTRODUCTION

Fruit flies are a serious problem for the mango crop, being *Anastrepha obliqua* a pest of major concern in the State of Sao Paulo, Brazil (Rossetto et al, 1996a). Control requires population monitoring, bait spraying and thermic treatment of the fruits for the export market. Often, Fenthion sprays are applied on tree canopies being the interval from spray to harvest at least 21 days long. This is troublesome for the grower and presents a potential residue problem for the consumer. Fruit fly infestation is a concern for the growers as it increases production costs, leads to residue problems and is a barrier to the export market. In backyards the problem is even more severe. Adult flies feed in the neighborhoods and when they come to the target tree they are ready to lay their eggs. Under these conditions the poisoned baits are helpless. People in general are not equipped to apply pesticides and it would not be recommended in backyards within inhabited areas. One control option is fruit bagging, but it

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would be unfeasible in tall trees. Under these conditions a naturally resistant variety, with good quality and yield, would be a major achievement for fruit fly management. There is a large variability among mango varieties to fruit flies infestation, compatible with quality and yield (Joel, 1980; Carvalho et al., 1996; Rossetto et al., 2006). The selection and breeding of mangoes with good quality and yield and besides these traits, with resistance to fruit flies, is a possible goal. This paper is part of a series with the objective to identify, select and breed fruit fly resistant mango cultivars. It also aims to study the mechanisms and causes of the resistance. This is part of a broader programme of mangoes selection (Rossetto et al., 1996b - www.iac.sp.gov.br/Manga/Manga.htm) for crowns and rootstocks, concerning the resistance to diseases and pests.

MATERIAL AND METHODS

Field evaluation for fruit fly resistance was made by cutting 30 mature fruits of each variety on both sides of the stone and fruits

with any sign of fruit fly larvae were considered infested. The percentage of infested fruits was considered for variety comparison. Five varieties were evaluated during three years in Votuporanga, SP, Brazil. In order to make the statistical analysis of variance, the data in percentage was transformed into $\arcsen\sqrt{x/100}$. For the analysis, the interaction between varieties and years was used as the error to test the significance of varieties and years. Three varieties which showed field resistance, Alfa, Espada Stahl and IAC 111, plus Tommy Atkins used as susceptible check, were further tested in cage test with artificial infestation. Matured mangoes of these four varieties were hung from the top of a transparent plastic cage (Figure 1), in a 4 x 4 Latin Square Design, with a total of 16 fruits. Prior to be placed inside the cage, the fruits were submitted to 300 Gy of gamma radiation, in order to eliminate any previous field infestation. 32 sexually mature *A. obliqua* females, were maintained in the cage with the fruits for 2 h. The flies were reared in the CENA/

USP lab. Adult flies inside the cage were fed with a mixture of 3 parts of sugar and one part of hydrolyzed protein, and they also had access to water. The attempts of oviposition of the female flies were registered for each fruit for 2 hours. The fruits were removed from the cage and placed on individual trays containing grinded vermiculite. After 20 days the vermiculite was sifted and the developed pupae were separated and counted. The trial was repeated twice and a joint analysis was made considering it as 4 treatments and 8 replications. For the analysis of variance, the numbers of attempts of oviposition and numbers of pupae developed were transformed into $\sqrt{x+0,5}$. A non-choice test was also made using the same procedure, placing ten fruits of Alfa in one box and 10 of Tommy Atkins in another box, with 20 female flies per box. The formula $m \pm t.s/r^{1/2}$ (m = mean; t = the t table value at 5%; s = standard deviation and r = number of replications), was used to place a confidence interval in the attempts of oviposition means of Alfa and Tommy Atkins in the non-choice test.



Figure 1. Acrylic cage with mango fruits hung from the top, used to test varieties under artificial infestation of *A. obliqua*.

RESULTS AND DISCUSSION

The varieties Alfa, Espada Stahl and IAC 111 showed significant field resistance to fruit flies compared to Tommy Atkins and the F1 from mother Sensation was highly susceptible (Table 1). Under artificial infestation in cage conditions however, Alfa maintained its field resistance and Espada Stahl and IAC 111 had their resistance broken and became as susceptible as Tommy Atkins (Tables 2 and 3). It means that there is a field resistance which may be different from the resistance under artificial infestation in cage conditions. In the field there are plant factors besides the fruit factors and in the cage the population pressure of fruit flies was higher.

Painter (1951) classified the mechanisms of plant insect resistance into non-preference, antibiosis and tolerance. There is a positive coefficient of correlation $r = 0,85$ between the means of attempts of oviposition (Table 2) and the means of numbers of pupae developed (Table 3). The results show that there is a mechanism of non-preference for oviposition of the adult female fly in relation to different mango varieties. This confirms the previous observations and conclusions of

Rossetto et al. (2006). In the non choice test Alfa had an average of 9.2 ± 4.36 attempts of oviposition, whereas Tommy Atkins had 38.3 ± 23.52 . This difference was significant, what means that Alfa kept at least part of its resistance even in the absence of a more susceptible variety. The cultivar Alfa released by EMBRAPA (Pinto, 2000) is the most resistant cultivar to fruit flies among the tested ones, besides its known resistance to anthracnose, good quality and yield. The methods used in

Table 1. Percentage of infested fruits of five mango varieties over a three years period. Votuporanga, SP, Brazil.

VARIETIES	2003	2004	2005	MEAN
Espada Stahl	5.0	0.0	1.3	2.10 a*
IAC 111	3.3	13.3	2.5	6.36 a
Alfa	10.0	7.1	5.0	7.37 a
Tommy Atkins	56.7	43.3	28.8	42.93 b
F1 (Sensation x ?)	96.7	100.0	100.0	98.90 c

* Means followed by the same letters do not differ by Tukey at 5%.

Table 2. Attempts of oviposition of *Anastrepha obliqua* on four mango varieties under artificial infestation inside an acrylic cage.

VARIETIES	I	II	III	IV	V	VI	VII	VIII	MEANS
Alfa	1	3	2	18	2	3	1	7	4.62 a*
IAC 111	13	52	36	12	47	34	30	55	34.87 b
Espada Stahl	28	31	50	44	21	36	64	32	37.00 b
Tommy Atkins	10	50	21	15	43	38	44	55	34.50 b

* Means followed by the same letters do not differ by Tukey at 5%.

Table 3. Number of pupae of *Anastrepha obliqua* developed from four mango varieties after artificial infestation inside an acrylic cage.

VARIETIES	I	II	III	IV	V	VI	VII	VIII	MEANS
Alfa	7	14	4	19	0	1	0	1	5.75 a*
IAC 111	2	45	26	12	16	42	20	36	24.87 b
Espada Stahl	24	73	102	105	15	33	48	24	53.00 b
Tommy Atkins	14	19	17	42	47	45	69	60	40.37 b

* Means followed by the same letters do not differ by Tukey at 5%.

this work to evaluate mango varieties for resistance to fruit flies should also be useful to evaluate the resistance of other fruits like oranges, guavas, peaches and pears, contributing for the solution of the fruit flies problem in these crops.

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