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Research of Infestation to Several Kinds of Fruits by the Melon Fly, *Bactrocera cucurbitae* (COQUILLETT) and the Oriental Fruit Fly, *B. dorsalis* (HENDEL) (Diptera : Tephritidae)

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Abstract: Infestation to several kinds of fruit, mainly grown in Japan, by the melon fly (MF), *Bactrocera cucurbitae* and the oriental fruit fly (OFF), *B. dorsalis*, were examined in the laboratory. The fruits were exposed to gravid females of MF and OFF in a rearing cage and the developments of the flies were observed. As a result, adults of MF emerged from pears, apricots, Japanese apricots, cherries, strawberries, avocadoes, akebias and Barbados cherries, while OFF emerged from pears, apples, apricots, Japanese apricots, cherries, strawberries, grapes, avocadoes, akebias, papaws, Barbados cherries and *Myrica rubra*, although the number of emerged flies and the larval period were different among the kinds of tested fruit.

Key words: *Bactrocera cucurbitae, Bactrocera dorsalis*, Host range, Tephritidae

Introduction

Concerning the host plants of the melon fly (MF), *Bactrocera cucurbitae* and the oriental fruit fly (OFF), *B. dorsalis*, various kinds of cultivated fruit are considered to be hosts for each species (McBRIDE and TANADA, 1949 ; WHITE and ELSON-HARRIS, 1992). However, with respect to the suitability as host plants of the fruit fly species, these fruits vary in infestation rate from heavily infested to rarely infested under the natural conditions. Therefore, it is difficult to evaluate to what extent a certain host fruit will contribute to the maintenance of the population of MF or OFF.

Adventive populations of OFF in Hawaii infested many kinds of fruit including species not known to be infested under circumstances in the native land (ANONYMOUS, 1947-1950). From the standpoint of plant quarantine, it seems valuable to assess the kinds of fruit and the extent of damage to them by these fruit flies beforehand, in case they invade the mainland of Japan.

Meanwhile, the interception of OFF from the fruits that were carried from foreign countries into Japan, and which were not included in the list of import prohibited items based on the Plant Protection Law of Japan, were reported (APPPC, 1991).

The purpose of this paper is to make sure the status of several kinds of fruit mainly grown in Japan as hosts of MF or OFF under laboratory conditions.

Materials and methods

1. Insects

MF and OFF tested in this experiment were obtained from the colonies of strains that had been maintained at the Yokohama Plant Protection Station (YPPS) and the Naha Plant Protection Station (NPPS). These strains have been reared artificially by the methods of ICHINOHE and NOHARA (1976) for more than six years, under the permission of the Minister of Agriculture, Forestry and Fisheries. MF strains were originally collected from the Amami Islands and the Yaeyama Islands of the Southwestern Islands, while OFF strains were from the Amami Islands and the Okinawa Islands of the Southwestern Islands and the Ogasawara Islands, Japan. At present, both MF and OFF were eradicated from the above-mentioned islands by the eradication program against these flies in Japan during the years of 1968 to 1993.

2. Fruits

The kinds of tested fruit were as follows; pear, *Pyrus* spp. (three varieties), apple, *Malus* spp., apricot, *Prunus armeniaca*, Japanese apricot, *Prunus mume*, cherry, *Prunus* spp., strawberry, *Fragaria*×*ananassa*, grape, *Vitis* spp., avocado, *Persea americana*, akebia, *Akebia quinata*, papaw, *Asimia triloba*, kiwi fruit, *Actinidia chinensis*, Barbados cherry, *Malpighia grabra*, *Myrica rubra*, mango, *Mangifera indica* (control for OFF) and bitter gourd, *Momordica charantia* (control for MF). The tests of Barbados cherry and *Myrica rubra* were conducted at NPPS and those of other fruits were done at YPPS.

3. Method of the infestation test

Fruits were exposed to ten gravid females of MF or OFF (10 to 30 day-old after adult emergence) in a screen-net cage (ca. 15×25×20 cm) for twenty-four hours. Then, they were kept in a plastic container or a wooden box with a lid of screen net to observe the larval development and their situations (e.g., rot).

The amount of tested fruits per one replication was approximately 200 g for small-sized fruit or one whole fruit for large-sized fruit. Two types of fruit were prepared (i.e., one was punctured by insect pins (several punctures) and another was kept intact). The test for each type of fruit was replicated three times. Tested fruits were used at usual maturity for sale.

4. Rearing and storage conditions

Table 1 shows the experimental conditions under which MF and OFF were reared and tested fruits were stored in the laboratories of YPPS and NPPS.

Table 1. Experimental conditions of the laboratories of the Yokohama Plant Protection Station (YPPS) and the Naha Plant Protection Station (NPPS)

Condition	YPPS	NPPS
Temperature	26°C±1°C	27°C±1°C
Photoperiod*	16L8D	14L8D
Humidity	70-80% R.H.	70-80% R.H.

* Twilight phases of one hour are included in the beginning and the end of light phase.

Results

The results are shown in Tables 2 and 3 for MF and OFF, respectively.

Adults of MF emerged from pear, apricot, Japanese apricot, cherry, strawberry, avocado, akebia and Barbados cherry. The suitability of these fruits as hosts of MF may not be equal because the delays of development and/or smaller number of emerged adults were or was recorded in some fruits (i.e., pears, avocado, cherry and akebia), as compared with those of bitter gourd as a control. No adults emerged from apple, kiwi fruit, grape, papaw and *Myrica rubra*.

Adults of OFF emerged from all tested fruits except kiwi fruit. As compared with the

Table 2. Infestation and development of the melon fly, *B. cucurbitae* on several kinds of fruit under laboratory conditions

Fruit	No. adults emerged (Mean±S.D.)			Developmental period of immature stages (Mean±S.D.)[a]
	Fruit kept intact	Fruit injured	Total	
Pear (Kousui)	0*	29.0± 30.4	14.5± 25.9	14.0±0
Pear (20 centuries)	0.7± 0.9*	51.7± 6.6	26.2± 25.9	15.5±2.6
Pear (European)	0*	76.0± 61.6	38.0± 57.8	9.5±0.5
Apple	0*	0	0	−
Apricot	314.7±128.2 ns	308.0± 37.2	311.3± 94.5	7.0±0
Japanese apricot	12.3± 10.3*	14.3± 13.4	13.3± 12.0	8.0±0
Cherry	6.7± 4.9*	5.0± 2.4	5.8± 4.0	12.0±0
Strawberry	19.3± 9.0*	11.3± 16.0	15.3± 13.6	9.0±0
Grape	0*	0	0	−
Avocado	0.3± 0.5*	2.0± 1.6	1.2± 1.5	−
Akebia	26.7± 8.7*	18.3± 11.1	22.5± 10.8	17.2±1.9
Papaw	0*	−	0	−
Kiwi fruit	0*	0	0	−
Barbados cherry	97.0± 38.9 ns	136.0± 25.8	116.5± 38.3	−
Myrica rubra	0*	0	0	−
Bitter gourd	123.3± 34.1	−	123.3± 34.2	7.3±0.5

*: There is a significant difference ($p<0.05$: Mann-Whitney's U test) compared with bitter gourd.
ns: No significance ($p>0.05$)
[a]: Minimum days required for the collection of matured larvae

Table 3. Infestation and development of the oriental fruit fly, *B. dorsalis* on several kinds of fruit under laboratory conditions

Fruit	No. adults emerged (Mean±S.D.)			Developmental period of immature stages (Mean±S.D.)[a]
	Fruit kept intact	Fruit injured	Total	
Pear (Kousui)	58.7± 83.0 ns	41.3± 48.6	50.0± 68.5	12.0±0
Pear (20 centuries)	153.3±138.2 ns	267.3±119.4	210.3±141.2	13.0±0
Pear (European)	1.0± 0.8*	6.3± 7.6	3.7± 6.0	8.0±0
Apple	156.0± 62.4 ns	317.0± 40.4	236.5± 96.1	15.2±0.4
Apricot	143.3± 21.0 ns	109.0± 57.9	126.2± 46.8	7.0±0
Japanese apricot	34.3± 13.7*	28.3± 18.6	31.3± 16.6	7.8±0.4
Cherry	214.3± 41.9 ns	227.3± 18.0	220.8± 32.9	8.0±0
Strawberry	79.3± 17.0*	82.0± 6.4	80.7± 12.9	7.3±0.5
Grape	19.7± 11.1*	22.0± 9.4	20.8± 10.4	9.2±0.4
Avocado	56.7± 50.2*	53.0± 28.6	54.8± 40.9	9.2±1.0
Akebia	69.3± 19.7*	47.0± 27.8	58.2± 26.5	14.5±2.2
Papaw	41.0± 35.2*	—	41.0± 35.2	8.0±0
Kiwi fruit	0*	0	0	—
Barbados cherry	248.7± 61.1 ns	206.7± 11.8	227.7± 48.7	—
Myrica rubra	62.7± 33.5*	146.3± 20.2	104.5± 50.1	—
Mango	164.7± 39.2	—	164.7± 39.2	8.0±0

*: There is a significant difference ($p<0.05$: Mann-Whitney's U test) compared with mango.
ns: No significance ($p>0.05$)
[a]: Minimum days required for the collection of matured larvae

results of MF, a larger number of adults emerged from those fruits. However, the delay of development was observed in some fruits (i.e., apple, pears and akebia) as compared with that of mango as a control.

Discussion

MF infested pear, apricot, Japanese apricot, cherry, strawberry, avocado, akebia and Barbados cherry under the laboratory conditions. Among the fruits infested by MF, almost equal number of adult flies emerged from apricot and Barbados cherry as compared with bitter gourd. It was suggested that these fruits might have sufficient suitability as hosts of MF.

Meanwhile, as for OFF, the results show the flies infested all the fruit except kiwi fruit. More kinds of fruit were infested by OFF and more numbers of adults emerged than those of MF, probably because of the reflection of polyphagy of OFF.

The following two components may be assumed for the evaluation of suitability of fruit as a host of fruit flies;

1. The attractiveness of fruits that could be quantified by the number of eggs deposited by female flies.

2. The nutritional suitability of fruit that could be quantified by mortality, developmental period of immature stages and body size of adults, etc.

More analytical and valid bioassay under the laboratory conditions will be expected for the evaluation of general suitability (including the above-mentioned two components) of the tested fruits as hosts of MF or OFF.

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