Ecology of Bactrocera latifrons Populations in Hawaii

Nicanor J. Liquido
Biocontrol, Biology, and Field Operations Research Unit
Tropical Fruit and Vegetable Research Laboratory, Hilo
Agricultural Research Service, United States Department of Agriculture

The frugivorous tephritid fruit fly complex in Hawaii consists of four known species introduced at various times over the past century: the melon fly, *Bactrocera cucurbitae* (Coquillett), in 1895; the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), in 1910; the oriental fruit fly, *Bactrocera dorsalis* (Hendel), in 1945; and *Bactrocera latifrons* (Hendel), about 1983. The presence of this pest complex has imposed strong constraints on the development and diversification of agriculture in Hawaii and has provided a large reservoir of unwanted and increasingly frequent introductions of fruit flies into the continental United States. Because of their polyphagous feeding habits and ecological adaptiveness, these fruit flies continue to threaten the multi-billion dollar fruit and vegetable industry of the southern-situated states of the contiguous United States. Many aspects of the biology and ecology of melon fly, oriental fruit fly, and Mediterranean fruit fly that are necessary in the suppression and eradication of these species have been well studied. On the contrary, because of the "less economic importance" status of *B. latifrons*, biological information necessary for population management, suppression, and eradication is not available.

B. latifrons is native to South and Southeast Asia, and has been recorded in China, Hawaii, India, Laos, Malaysia, Pakistan, Sri Lanka, Taiwan, and Thailand. Following its detection in Honolulu in 1983, it was reported to be confined to the island of Oahu, with a narrow range of host plants. Subsequent life history studies showed that *B. latifrons* has a much lower reproductive potential than other dacine pests found in Hawaii, and was deemed less competitive than oriental fruit fly, melon fly, and Mediterranean fruit fly. Recent surveys revealed that *B. latifrons* is distributed on all of the accessible, major islands of the Hawaiian chain.

This paper summarizes information on host plants of *B. latifrons* and some ecological attributes of *B. latifrons* populations in Hawaii.

Table 1 summarizes the infestation intensity of *B. latifrons* in 11 solanaceous and 4 cucurbitaceous host plants. On the island of Hawaii, *Solanum nigrum* L. yielded the highest number of *B. latifrons* per 100 g of infested fruit, followed by *Capsicum annuum* L., *Lycopersicon Lycopersicum* cv. *cerasiforme* (Dunal), *Capsicum frutescens* L., *Solanum pseudocapsicum* L., *Solanum nigrescens* Mart. & Galleotti, *Physalis peruviana* L., *Lycopersicon pimpinellifolium* (Jusl.) Mill., *Coccinea grandis* (L.) Voigt, and *Solanum melongena* L. *Benincasa hispida* (Thunb.) Cogn., *Cucumis sativas* L., and *Lagenaria siceraria* (Mol.) had very low levels of infestation by *B. latifrons*. On the island of Maui, *Solanum torvum* Sw., *L. Lycopersicum* cv. *cerasiforme,* and *L. pimpinelli-folium* had the highest number of *B. latifrons* larvae per 100 g of fruit.

Based on infestation intensity data (number of larvae per 100 g fruit and percentage collections with *B. latifrons* infestation) and intensity of collections (directly proportional with the available host biomass during the conduct of the study), I contend that the most important host plants of *B. latifrons* in feral habitats in Hawaii are *L. pimpinellifolium, S. sodomeum, S. nigrum,* and *S. torvum. Capsicum* spp., *L. Lycopersicum,* and *S. melongena* appear to be the most favored host plants under commercial cultivation and dooryard situations.

The following generalizations can be made on the ecological attributes of *B. latifrons* and their adaptive significance in establishing widespread populations in a new geographic area, like Hawaii:

First, *B. latifrons* is able to complete a generation in approximately 20 days. Thus, a colonizing population depending on host availability and weather conditions has a high probability of establishment in a new area.

Second, *B. latifrons* females mate early, have a short preoviposition period, and lay few eggs per day over a relatively long oviposition period. This means that the total number of eggs can be quite numerous but well distributed over the females' adult life. Ecologically, it translates to an efficient allocation or use of host resource that may maximize the rate of reproductive success (i.e., less competition among cohorts resulting in more

Table 1. Host plants of *Bactrocera latifrons* (Hendel) on Hawaii and Maui.

Family Scientific name	Common name; fruit position	Total fruits collected	*B. latifrons*/100 g fruit Mean	Std. error
HAWAII				
Solanaceae				
Capsicum annuum L.	Chili, bell, sweet, cayenne peppers			
	fruit on shrub	5066	30.09	15.59
	fruit on ground	1231	13.91	6.25
C. frutescens L.	Tabasco, bush red peppers	2180	18.99	
Lycopersicon Lycopersicum (L.) Karst. ex Farw.	Common tomato; fruit on shrub	541	1.09	0.70
	fruit on ground	403	7.54	
L. L. cv. *cerasiforme* (Dunal)	Cherry tomato; fruit on shrub	1715	20.02	19.88
	fruit on ground	1477	0.32	0.21
L. pimpinellifolium (Jusl.) Mill.	Currant tomato	1946	3.09	1.16
Physalis peruviana L.	Poha	1351	3.41	
Solanum melongena L.	Common eggplant; fruit on shrub	567	1.28	0.29
	fruit on ground	1169	0.40	0.12
S. nigrescens Mart. & Galeotti	Dull popolo	552	5.46	
S. nigrum L.	Popolo	10,476	37.32	16.97
S. pseudocapsicum L.	Jerusalem cherry	1681	10.89	5.67
S. sodomeum L.	Sodom apple	9853	2.64	0.58
Cucurbitae				
Benincasa hispida (Thunb.) Cogn.	Tunka, tankoy, zit-kwa	12	0.63	
Coccinea grandis (L.) Voigt	Ivy gourd, scarlet-fruit gourd	313	2.79	
Cucumis sativus L.	Cucumber	14	0.09	
Lagenaria siceraria (Mol.) Standl.	Ipu, upu	3	0.10	
MAUI				
Solanaceae				
Lycopersicon Lycopersicum	Common tomato	246	0.18	
L. L. cv. *cerasiforme*	Cherry tomato; fruit on shrub	462	0.34	
	fruit on ground	543	1.37	
L. pimpinellifolium	Currant tomato	249	1.34	
Solanum melongena	Common eggplant; fruit on shrub	344	0.44	
	fruit on ground	571	0.08	
S. sodomeum	Sodom apple	5451	0.08	
S. torvum Sw.	Turkey berry	3273	0.92	

individuals reaching reproductive, adult stage).

Third, *B. latifrons* has a limited host range. Validated (i.e., with field infestation data) host plants of *B. latifrons* mostly belong to the families Solanaceae and Cucurbitaceae. Existence under natural field conditions with a limited host range may have adapted *B. latifrons* life history traits to periods of reduced host availability.

Fourth, *B. latifrons* maintains a relatively low population density even when available host biomass is abundant. This biological attribute is probably related to the fact that *B. latifrons* lays few eggs per day and that egg production remains constant irrespective of the cycle of host deprivation and host availability. Ecologically, this prevents *B. latifrons* from overusing or depleting its food resource; thus, preventing any possibility of population "crash" and local extinction.

Fifth, *B. latifrons is* capable of establishing population clusters in marginal habitats (e.g., arid and windswept range and ranch lands) where other tephritids are less or not successful. As shown in this study, *B. latifrons* is the dominant fruit feeder in wild hosts (such as L. *pimpinellifolium, S. nigrum, S. nigrescens, S. sodomeum,* and *S. torvum*) that occur in disturbed, abandoned agricultural fields and less-managed ranch lands.

I contend that the above ecological attributes will allow *B. latifrons* to colonize, compete, and establish in areas where suitable hosts are present and physical conditions tolerable, even when other fruit flies are present. It is therefore recommended that the current status of *B. latifrons* as a fruit fly of lesser economic importance be reevaluated and its potential threat to the agriculture of Hawaii and the mainland United States be carefully examined.