11.4 Integration of Biopesticides with Natural Enemies for Control of Tropical Fruit Flies (Diptera: Tephritidae)

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Fruit flies (Diptera: Tephritidae) include some of the most economically important pests attacking soft fruits worldwide including the oriental fruit fly, Bactrocera dorsalis (Hendel). The Daniel K. Inouye U. S. Pacific Basin Agricultural Research Center has been a world leader in promoting biological control of Bactrocera spp that includes classical, augmentative, conservation, and integrated pest management approaches (Vargas et al., 2012). With the rapid spread of B. dorsalis throughout Africa and a related species, carambola fruit fly, Bactrocera carambolae Drew & Hancock, to South America, biological control has been a significant component in reducing population levels. In addition, for use against such serious pests as B. dorsalis, the Hawaii Fruit Fly Area-Wide Pest Management (AWPM) Program developed and integrated biologically-based pest control technologies that include sanitation, GF-120 Naturalyte Fruit Fly Bait, and lures that are economically viable, environmentally sound and sustainable. The integration of environmentally friendly insecticides with natural enemies was emphasized throughout a 10 year demonstration program (Vargas et al., 2016). Two of the most common B. dorsalis natural enemies in Hawaii are Fopius arisanus (Sonan) and Diachasmimorpha longicaudata (Ashmead) (Hymenoptera: Braconidae). Spatial models and ecological information on these two species was summarized in Vargas et al. (2013). In the present study we compared the impact of some commonly used pesticides with biopesticides and cover sprays with bait sprays on these two species.

The efficacies of insecticides against fruit fly adults and parasitoid wasps were compared at the Kona University of Hawaii Experimental Station, Kainaliu, HI. Nine different insecticides (AI/trade name) and or protein bait treatments were evaluated including a water control, Spinosad (GF-120 Naturalyte Fruit Fly Bait), Malathion (Malathion + Nu-Lure Insect Bait (Malathion 5 EC w/ Nu-Lure), Spinosad (Entrust SC), Spinetoram (Radiant SC), Malathion (Malathion 5 EC), Fenpropathrin (Danitol 2.4 EC), Zeta-Cypermethrin (Mustang), Lambda-Cyhalothrin (Warrior II with Zeon Technology), and Tefluthrin (Force CS). Treatments were applied at label rates. Tests were conducted on guava, Psidium guajava L. (Myrtaceae) foliage. Twigs with guava leaves were sprayed until dripping, allowed to weather for 1 day, and then exposed for 24 hours to a fixed
population (20-50 parasitoids) of wasps inside cages (Keiser, 1968; Vargas and Souder 2017).

The effects of the nine insecticides on *B. dorsalis* mortality were reported previously (Vargas and Souder, 2017). Several conclusions were obvious: 1) GF-120 Fruit Fly Bait gave excellent control of *B. dorsalis*, 2) Bait sprays with the same insecticide usually produced higher mortality than with the foliar spray (e.g., GF-120 vs Entrust and Malathion + Nu-Lure vs Malathion), 3) There was considerable variability with foliar sprays; however, many were as effective as current recommended fruit fly treatments, others were not. For example, in initial trials, when compared to GF-120 and Malathion + Nu-Lure, foliar sprays of Warrior II, Mustang, and Malathion gave comparable control; while foliar sprays of Force, Entrust SC, and Radiant SC gave lesser control (Vargas and Souder, 2017).

With respect to the male and female mortality of parasitoids to the same nine insecticides (Fig. 11.4.1 and Fig. 11.4.2), two conclusions were apparent. First, lower mortalities occurred with the biopesticides and second, only GF-120 Naturalyte Fruit Fly Bait was effective against the pest *B. dorsalis* and not detrimental to either *F. arisanus* or *D. longicaudatus*. These data support the recommendation of GF-120 Naturalyte Fruit Fly Bait as part of an integrated pest management approach (sanitation, protein baits and lures) for control of *B. dorsalis* in Hawaii (Vargas et al., 2016).

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**Fig 11.4.1.** Mortality of *Fopius arisanus* exposed to nine different insecticide formulations.
Further research is underway to evaluate other insecticides used for control of Asian citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae), and development of a systems approach for growers on the U.S. mainland (i.e., California, Texas, and Florida) in response to costly fruit fly quarantines. Findings on the impact of these cover sprays on natural enemies such as *F. arisanus* and *D. longicaudata* will also be included in developing recommendations.

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**References**


