MEXICAN BROMELIAD WEEVIL REPORT
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We measure production of the fly colony by the number of fly puparia collected weekly. Figure 1 shows puparia collection from July 2011 to June 2012. There are peaks and valleys because the fly population did not stabilize after the introduction of freshly collected material in Honduras. Environmental conditions are optimal for fly reproduction and development and no mechanical malfunctions have caused problems. We are receiving plenty of pineapple tops from our sources, and we have plenty of healthy weevils for growing in the tops and exposing to the flies. Since the weevil and fly populations are naturally low in their native habitat during the first six months of the year, the low production in the laboratory colony may be a reflection of innate reduced reproduction regardless of environmental conditions. We have made some environmental changes in the rearing conditions that we expect will improve conditions for fly growth and will increase fly numbers. One of these is to expose the fly cage to natural light in the glass-covered greenhouse during working hours only, in case a mechanical malfunction shuts down the greenhouse's air-conditioning system; if this were to happen, we can then quickly move the fly cage back to an environmentally stable rearing room.

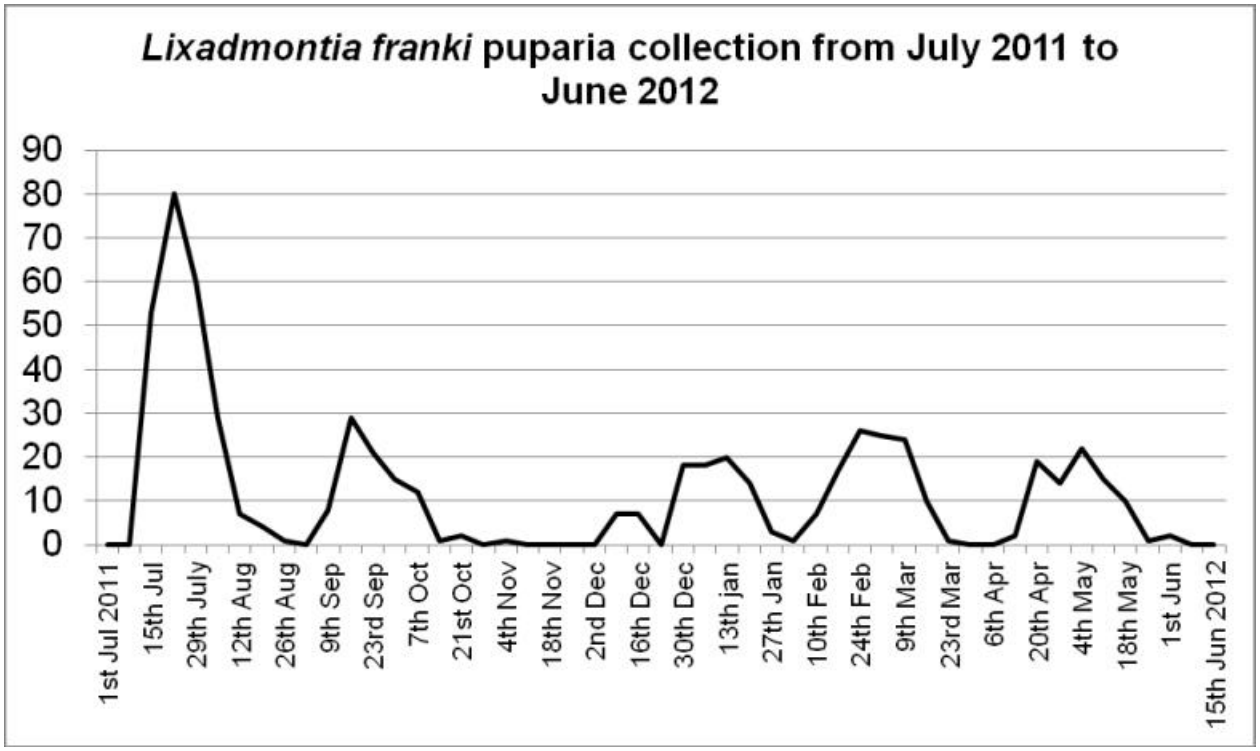

Figure 1: *Lixadmontia franki* puparia collected weekly from laboratory colony from July 2011 to June 2012.

Our old method of setting up weevil larvae to be exposed to the flies for parasitism was putting pineapple tops in a cage and adding 12-15 gravid female weevils. The females oviposited for 2 weeks, then were removed. The tops were left for two more weeks to allow the larvae growing inside the tops to be the proper age for parasitism by the fly. The tops were then placed in a larger cage with gravid *L. franki* flies; the tops remained in the cage for 10 days, then were removed and the larvae monitored for parasitism.

Problems with this method were:

1. Female weevils placed in the cage to oviposit often escaped from the cages or died, which resulted in loose weevils in the facility and pineapple tops with reduced oviposition.
2. Because females oviposited for two weeks, larvae in an infested pineapple top at the time of exposure were variably aged and not all were at the proper age for being parasitized.
3. The number of weevil larvae in a given pineapple top at the time of exposure could only be estimated.

We developed a new method where, instead of putting gravid females on tops to oviposit, we keep egg-laying females in individual 7-dram vials and provide them with pineapple leaf pieces on which to oviposit. Leaf pieces with eggs are collected and reared until eggs hatch. Neonate larvae within leaves are placed on pineapple tops by slipping the leaf pieces with the mining first instar weevil into the axils of the pineapple top's leaves. Three to four larvae are put on a top. The tops are allowed to develop another week, and then they are placed in the cage for exposure to flies. The new method allows for better control over the weevil egg-laying population, reduces the range of instars within a top, and allows us to calculate with much greater certainty the number of larvae per top.

Metamasius callizona temperature studies

Data collection was completed for studies determining the weevil's temperature-dependent development and oviposition rate across nine temperatures, temperature tolerance, and mortality of adult weevils at three temperatures. Growth and development occurred at 18, 20, 22, 25, 28, and 30° C. Larval development was similar at 25, 28, and 30° C. Pupal development was similar at 28 and 30° C. At 15° C, there was some larval hatching, but no survival beyond 2nd instar. At 33° C, there was larval hatching and growth, but no pupation. At 35° C, no eggs hatched.

The oviposition rate of *M. callizona* was tested at 15, 18, 22, 25, 28, 33, and 35° C. Eggs were collected from 10 gravid females for 11 days. The number of eggs collected at temperatures ranging from 22 to 33° C were statistically similar at 0.3-0.5 eggs per day per female. The number of eggs collected from weevils at 15, 18, and 35° C were similar (<0.1 egg per day per female). At the two colder temperatures, the weevils oviposited infrequently; at the highest temperature, the weevils oviposited infrequently and died prematurely. By the 11th day, all adults in the 35° C group were dead.

Metamasius callizona eggs, larvae, pupae, and adults were tested for temperature tolerance at -2, 0, 5, 10, 16, 22, 25, 28, 32, and 35° C for 1, 2, or 4 days of exposure, and 0° C for 6 and 8 days for adults. Pupae and eggs were the least cold tolerant. Eggs did not hatch at 5° C with 4-day exposure, nor at 0° C with 2-day exposure. Larvae did not suffer until -2° C with 2-day exposure. Adults are very cold hardy; at -2° C with 4-day exposure, 82% survived, yet at 0° C with 8-day exposure, 56% survived. Adult emergence rate began declining at 0° C with 1-day exposure. The bromeliads that are attacked by the weevil range from central to south Florida. Winters within this range are usually mild and it is unlikely that winter cold will be regulatory or

catastrophic to the weevil population in Florida. Likewise, the weevil was little affected by high temperatures. Egg hatch declined after 2 and 4 days at 32 and 35° C, and pupal survival declined significantly after 4 days at 35° C.

A publication showing the results of these studies is in the process of being written.

Central American versus Florida form of *T. utriculata* on the growth and development of *M. callizona*

In Florida, *Tillandsia utriculata* is being rapidly destroyed by the weevil. Unlike the Florida form of *T. utriculata*, the *T. utriculata* growing in Central America with the weevil are not destroyed by the weevil. It may be that the Florida form of *T. utriculata* is more susceptible to attack by the weevil than the Central American form. We have conducted some preliminary studies to test this hypothesis. Initial data have been collected and are in the process of being analyzed.

Metamasius callizona fertility

We have just begun testing *M. callizona* fertility. Sixty newly emerged adults have been collected and paired. We are now observing the pairs daily for first egg lay. Once the first egg is laid, the males will be removed and eggs will be collected and monitored for hatching. Information from this study will help us better understand the ecology of the weevil, as well as improve our larval hatching rate from the eggs we collect in the above method for exposing weevil larvae to the flies.

Fly releases

We have been unable to make more releases because the fly colony is still recovering and there are not enough flies to make a release.

Publications

Cooper, T. M., J. H. Frank, and R. D. Cave. Loss of *Tillandsia utriculata* and its phytotelmata in the Enchanted Forest Sanctuary (Florida, USA) due to an invasive bromeliad-eating weevil and the effect on forest ecosystems. Acta Oecologica (submitted March 2012, accepted pending revision June 2012).

Talks and posters

Cooper, T. M. February 2012. Mexican bromeliad weevil project. Colloquium on Plant Pests of Regulatory Significance, University of Florida, Gainesville, FL.

Cooper, T. M., J. H. Frank, and R. D. Cave. May 2012. The invasive species *Metamasius callizona* (Mexican bromeliad weevil): problems and prospects. International Congress XXV Anniversary Mexican Agribusiness Society and XLVIII Annual Meeting International Congress XXV Anniversary Mexican Agribusiness Society and XLVIII Annual Meeting of the Caribbean Food Crops Society, Riviera Maya, Mexico.

Cooper, T. M., Frank, J. H., and Cave, R. D. June 2012. The invasive species *Metamasius callizona*: Problems and prospects. Sarasota Bromeliad Society, Sarasota, FL.