The invasive species *Metamasius callizona* (Mexican bromeliad weevil): Problems and prospects

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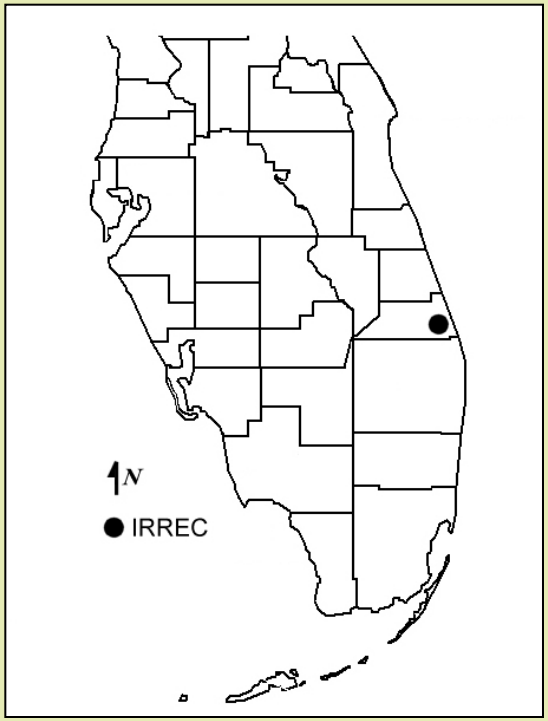


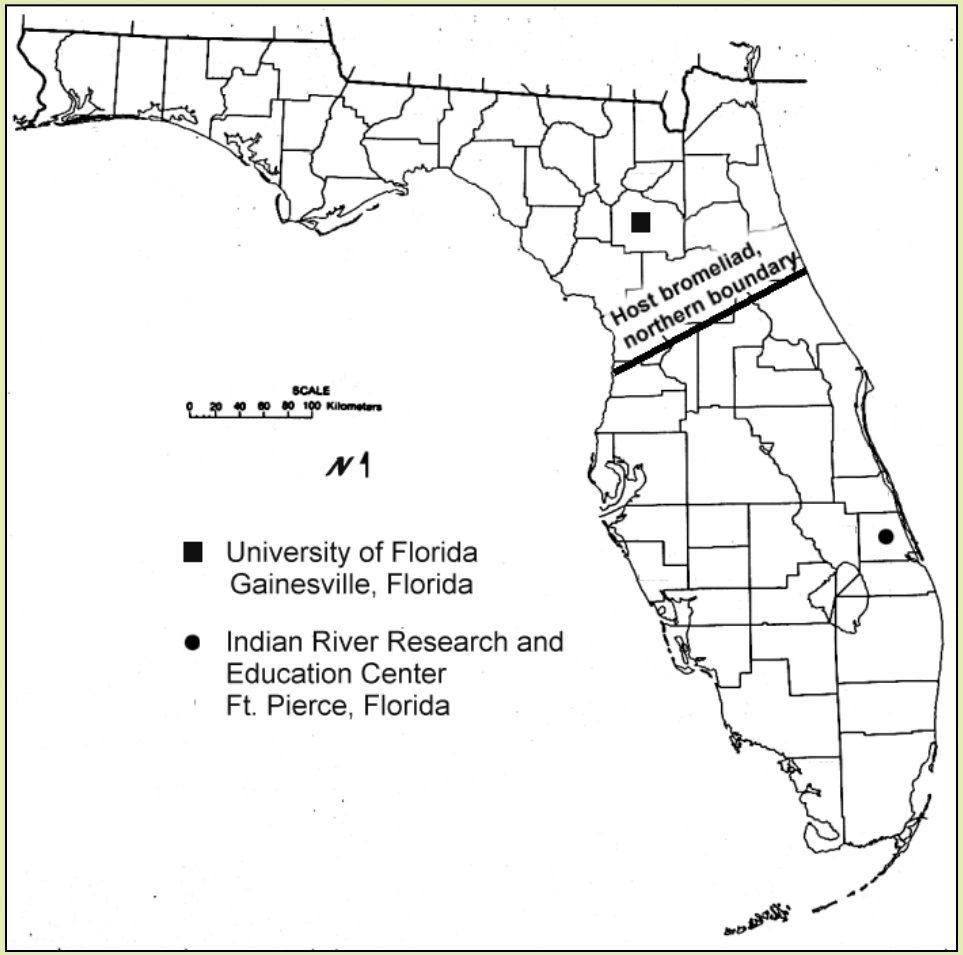
The Mexican bromeliad weevil, *Metamasius callizona*

Native to Mexico, Guatemala, and Belize.

Found established on native bromeliads in Florida in 1989.

The weevil is invasive in Florida.

The weevil is well established in Florida



Host bromeliads have a northern limit to their range: frost line.

Weevil has spread to nearly fill its new potential range.

The weevil is causing great damage to native bromeliad populations in Florida.

Weevil life stages

Adult and egg.

Larva.

Pupa.

Pupal chambers.

Tillandsia utriculata: Killed by the weevil

May 2003

June 2003

M. callizona damage on bromeliads






Florida's native bromeliads

Guzmania monostachia

Florida's native bromeliads

Florida's native bromeliads

Florida's native bromeliads

Catopsis berteroniana

Catopsis nutans

Tillandsia flexuosa

Tillandsia floribunda

Florida's native bromeliads

Tillandsia simulata

Florida's native bromeliads

Tillandsia paucifolia

Florida's native bromeliads

Florida's native bromeliads

Tillandsia fasciculata

Florida's native bromeliads

Tillandsia utriculata

Ecological losses

Bromeliads are ecologically important.

Tank bromeliads: Hold pools of water in leaf axils that support aquatic ecosystems (called PHYTOTELMATA).

The organisms that live in the phytotelmata may be obligate or facultative.

Accumulative amount of water can be substantial.

Ecological losses

"**Twenty-one native species**, consisting of **12 bromeliads** and at least **9 (perhaps 19) invertebrates** are at risk of extinction in Florida and in the USA. At least 6 of them **(1 bromeliad and 5 invertebrates) seem to be precinctive species**."

Frank and Fish 2008

Also lost are: Habitat Water sources
Refugia Hunting grounds.

Loss of *Tillandsia utriculata* and *T. utriculata* – contained water = PHYTOTELMATA

***Tillandsia utriculata* at the Enchanted Forest Sanctuary**

	time = 6 months	time = 25 months
% T. ut. population remaining (99% of deaths caused by weevil):	13%	2.4%
Amount of bromeliad water lost (liters):	13,577	2,772

Total: 16,350

How to control the weevil?

CLASSICAL BIOLOGICAL CONTROL

Begun by Howard Frank, University of Florida.

Since 1992, 16 expeditions to several countries, including Mexico, Belize, Guatemala, Honduras, Panama, Peru, and Paraguay.

Collected several species of bromeliad-eating weevils and monitored for parasitism.

Search for a classical biological control agent

Original fly host:
M. quadrilineatus

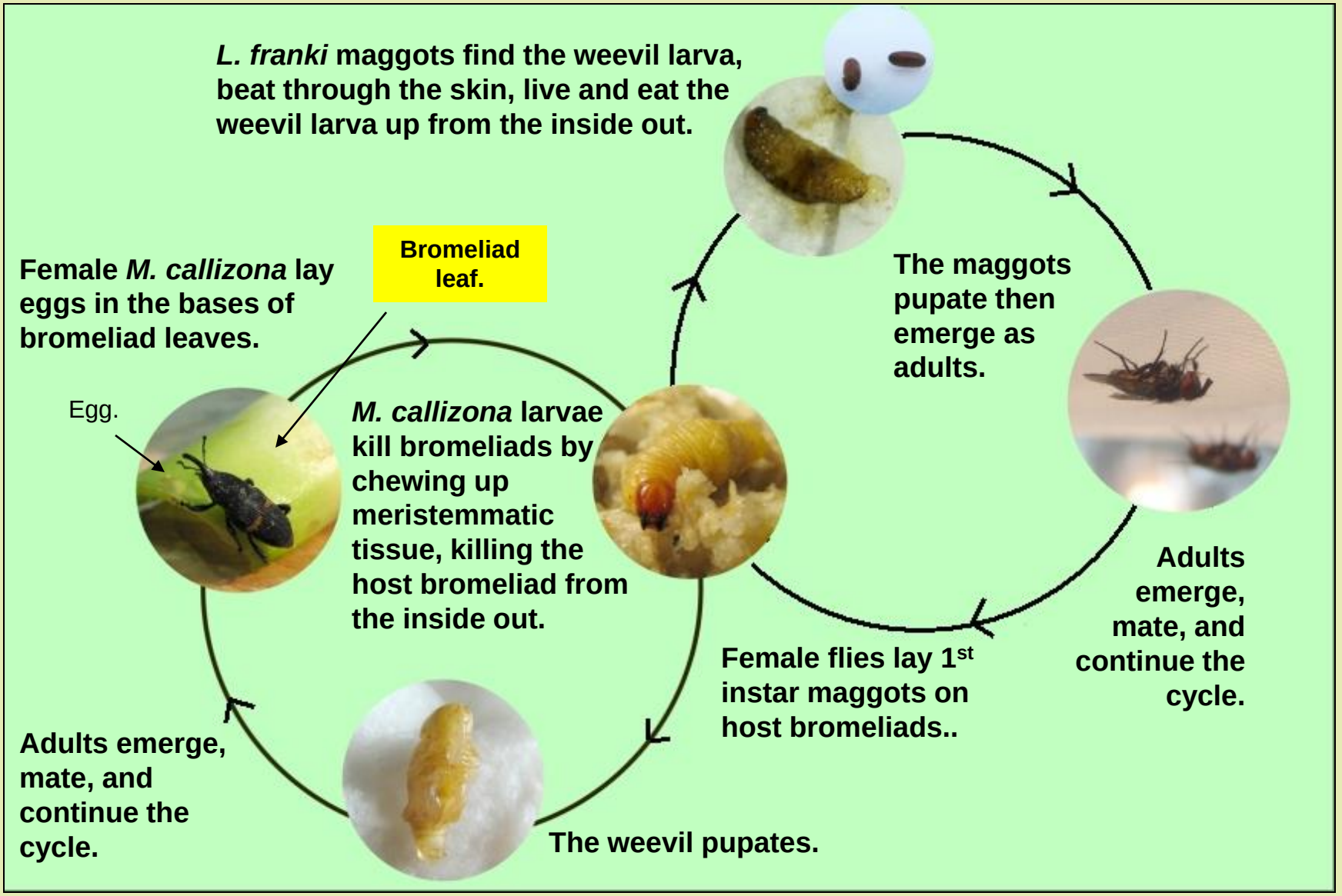
In 1993, a parasitoid fly, *Lixadmontia franki*, was found on a related species of bromeliad-eating weevil, *M. quadrilineatus*, in Honduras.

The Fly

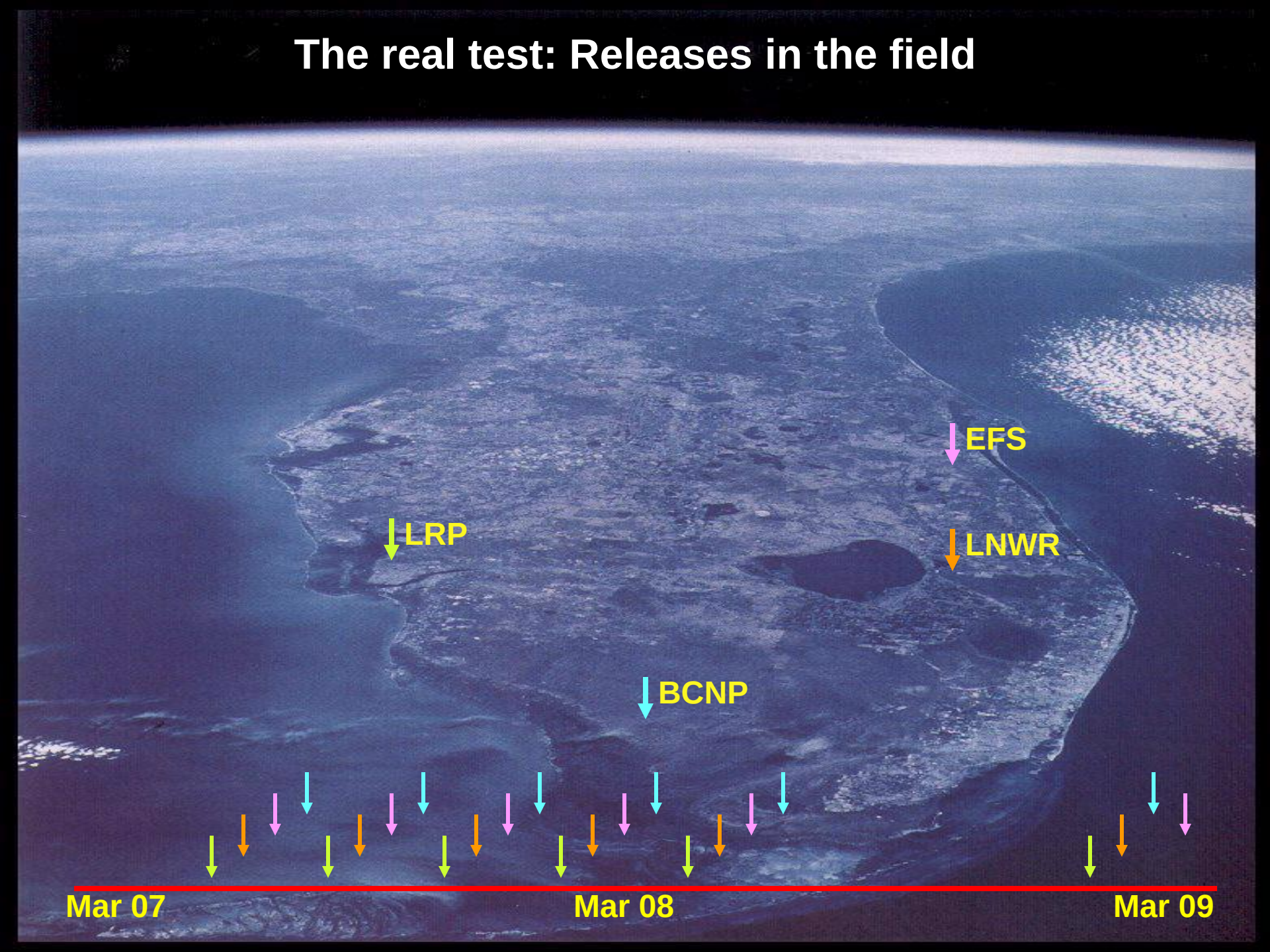
Lixadmontia franki

Described by Wood and Cave in 2006.

Bromeliads, *M. callizona*, and *L. franki* life cycles.



The real test: Releases in the field



Post-monitoring: Sentinel plants

Post-monitoring: Sentinel plants

Maggot enters weevil larva.

Maggot pupates.

FLY RELEASE

Females ready to larviposit.

Fly emerges.

Fly mates.

Fly's maggots are mature.

5 weeks.

Flies larvipositing.

Sentinel plants in field.

7 weeks.

Results: Two F2 flies recovered from LRP

Lake Rogers Park

Release: **29 June 2007**

Sentinel plants out: **7 August 2007**

Retrieved: **21 August 2007**

The Biggest Problem with the Fly

REARING THE FLY

Host plant effect on weevil growth and development: Bottom up control?

In Florida, the weevil has much greater abundance and causes much greater damage to *T. utriculata* than to *T. fasciculata*.

Florida *T. utriculata*

T. fasciculata

The Florida form of *T. utriculata* is rapidly being destroyed by the weevil in Florida, but in Central America, *T. utriculata* does not suffer from destruction by weevil.

Central American *T. utriculata*

Pineapple tops

Host plant effect on weevil growth and development: Bottom up control?

Why is the Central American *T. utriculata* resistant to the weevil?

Can that resistance be bred into the Floridian form of *T. utriculata*?

Floridian *T. utriculata*

Central American *T. utriculata*

Are the Central American and Floridian forms of *T. utriculata* really the same species?

Morphologically, yes.

But it has never been demonstrated by DNA analysis.

We are collecting samples throughout Florida and Central America to make DNA tests.

Collaborating with Douglas Soltis, Pamela Soltis, and Ryan Moraski at the Florida Museum of Natural History.

Floridian *T. utriculata*

Central American *T. utriculata*

Host Plant Effect: Preliminary Research

Host plants being tested:

T. utriculata$_{\text{Fla}}$

T. fasciculata$_{\text{Fla}}$

T. utriculata$_{\text{Cen Am}}$

pineapple leaf

Comparisons were made using Analysis of Variance and Tukey's method of multiple comparisons.

All tests were done at 25° C and 60% humidity with 14:10 L:D.

Tests:

***Oviposition rate**

***Proportion of egg hatch, pupation, and adult emergence**

***Developmental time**

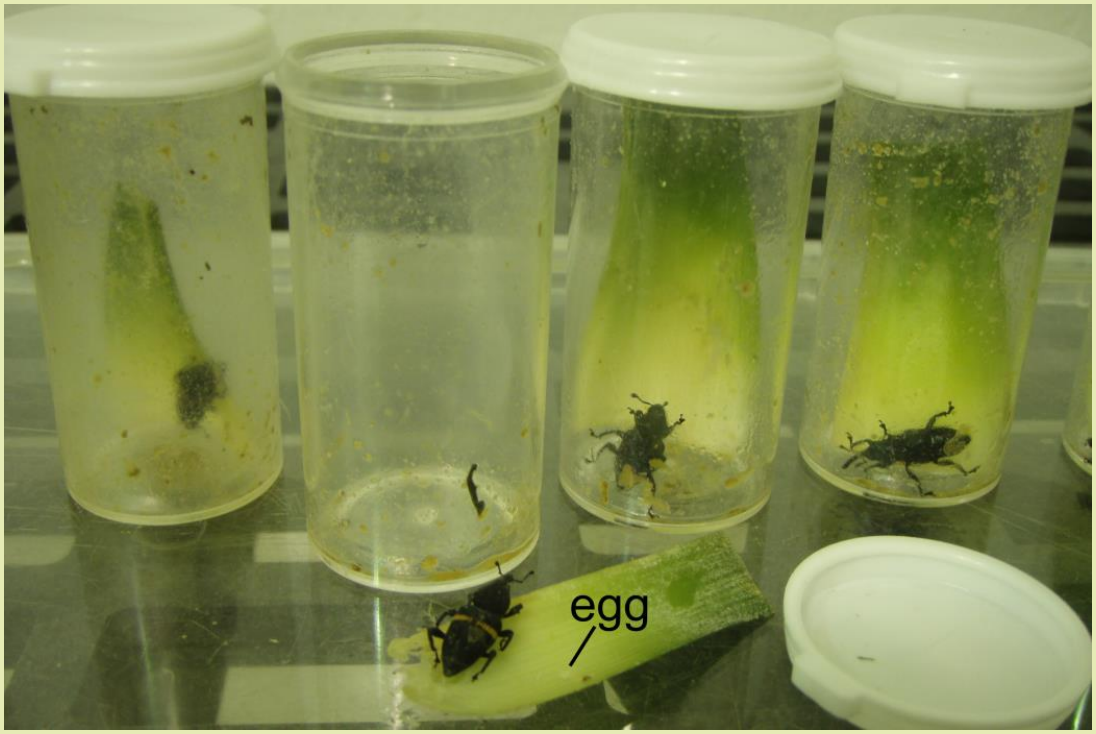
***Adult size**

***BRIX analysis**

(sugar content)

Oviposition rate

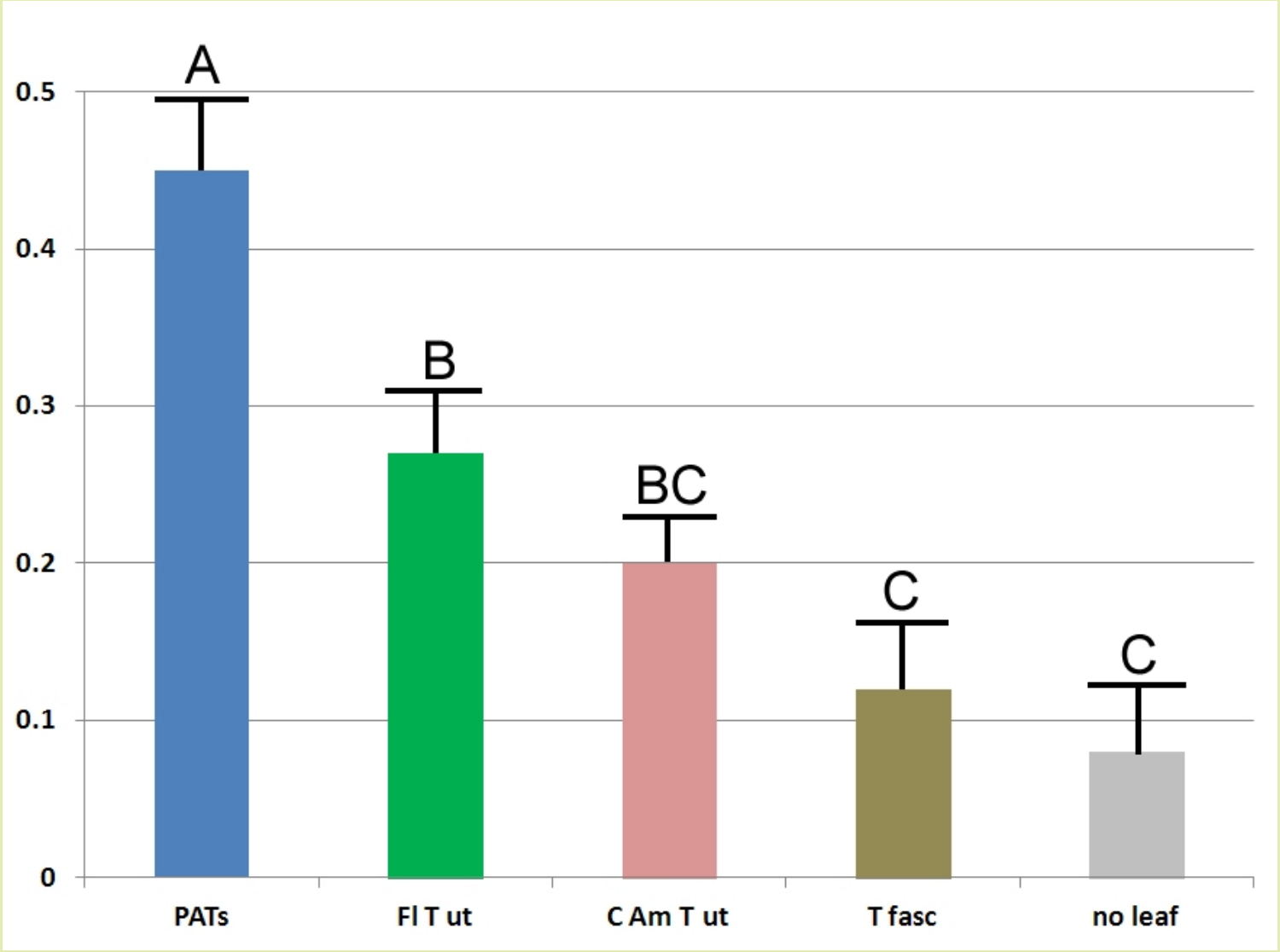
For each host bromeliad, 30 gravid *M. callizona* were kept in 7 dram vials.



The females were given a fresh piece of their assigned bromeliad leaf daily for 5 days. The leaves were checked for eggs; the number of eggs collected per female was recorded.

The average number of eggs laid per ♀ in 24 hours for each host bromeliad were compared.

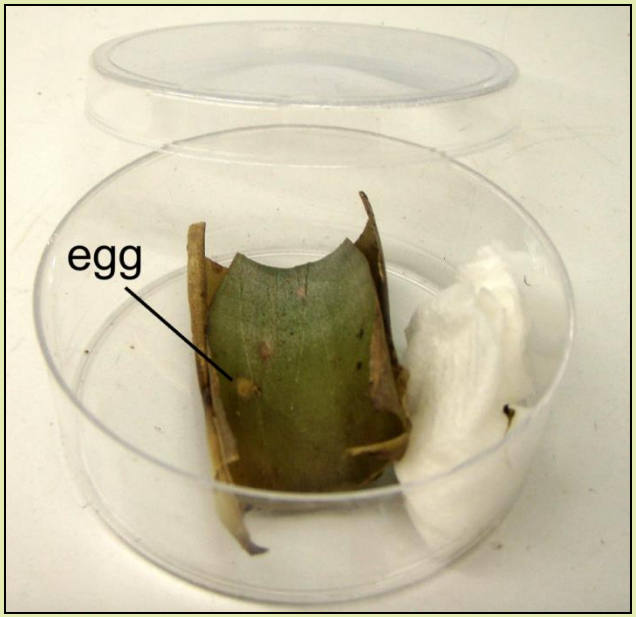
Average number of eggs laid per ♀ in 24 hours



***P*-value = 0.000**

Egg hatch, pupation, and adult emergence

The collected eggs were set in Petri dishes with moist paper towel and monitored for larval hatching.

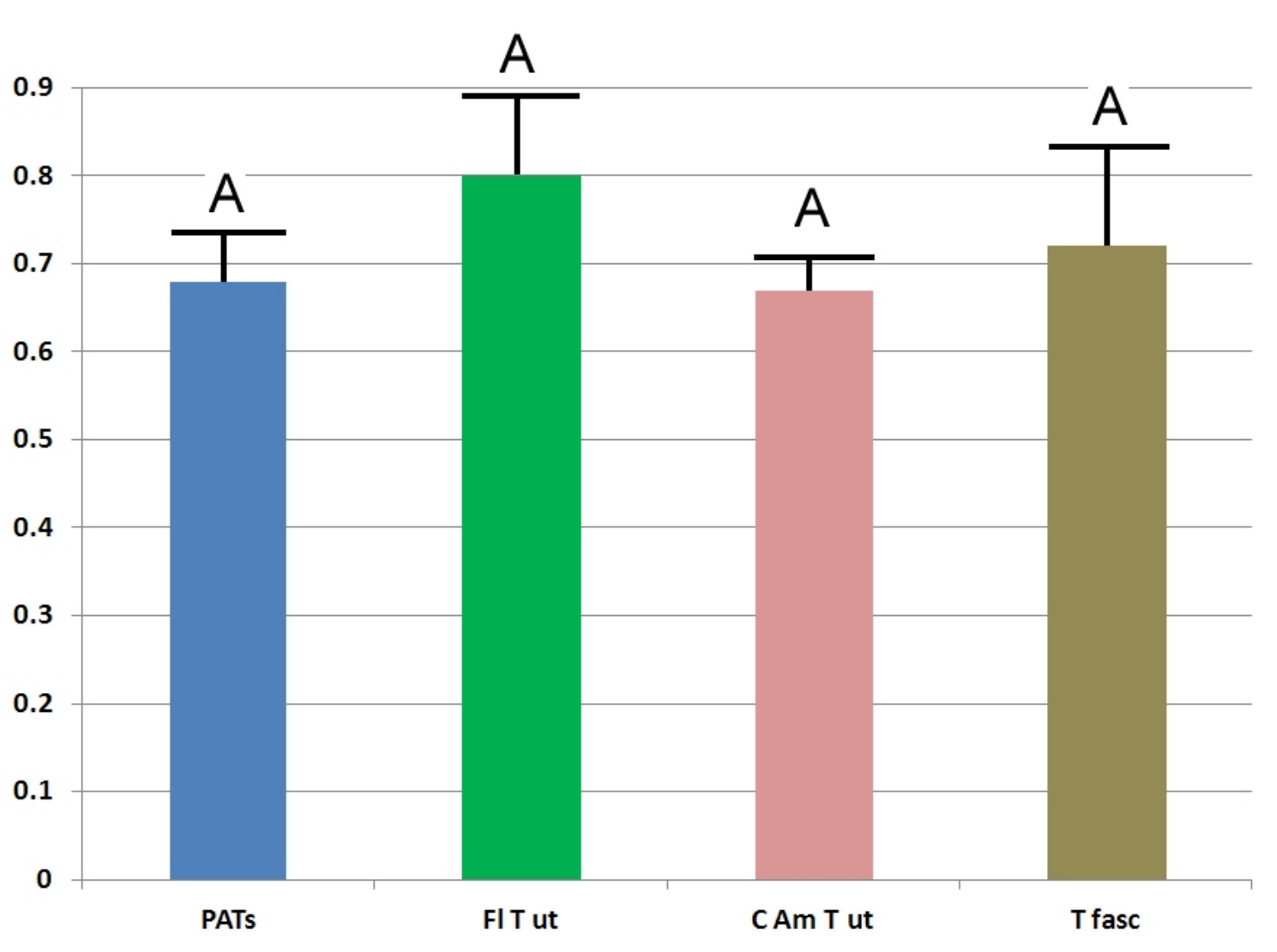


Larvae that hatched from the eggs were fed their assigned bromeliad until dead or pupated.

Pupae were monitored for adult emergence.

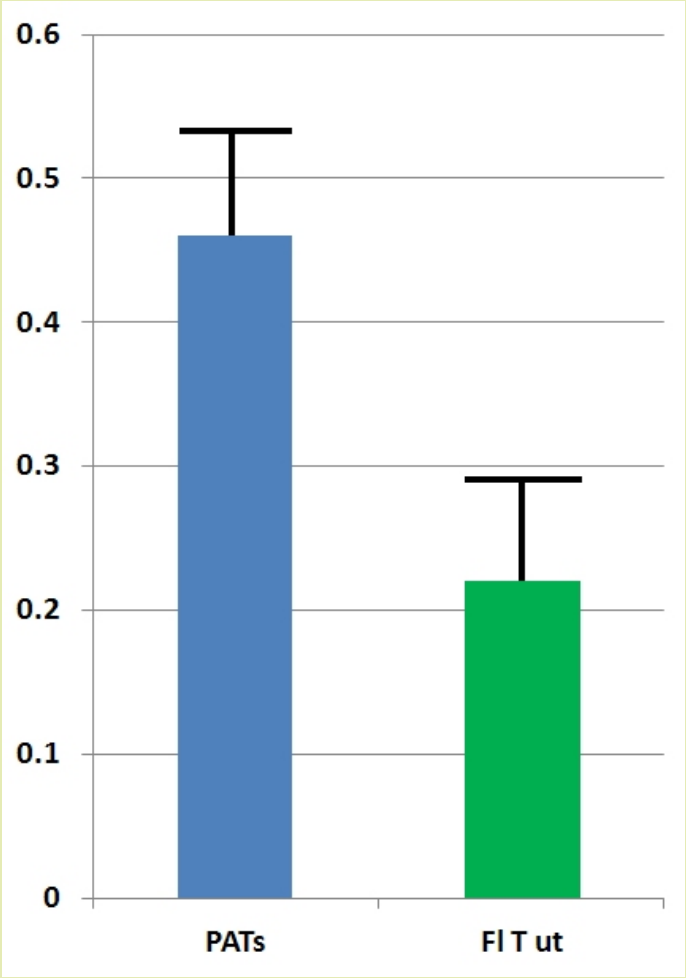
Determine: Proportion egg hatch, pupation, and adult emergence; and development time, from egg to pupa and from pupa to adult.

Proportion of eggs that hatched



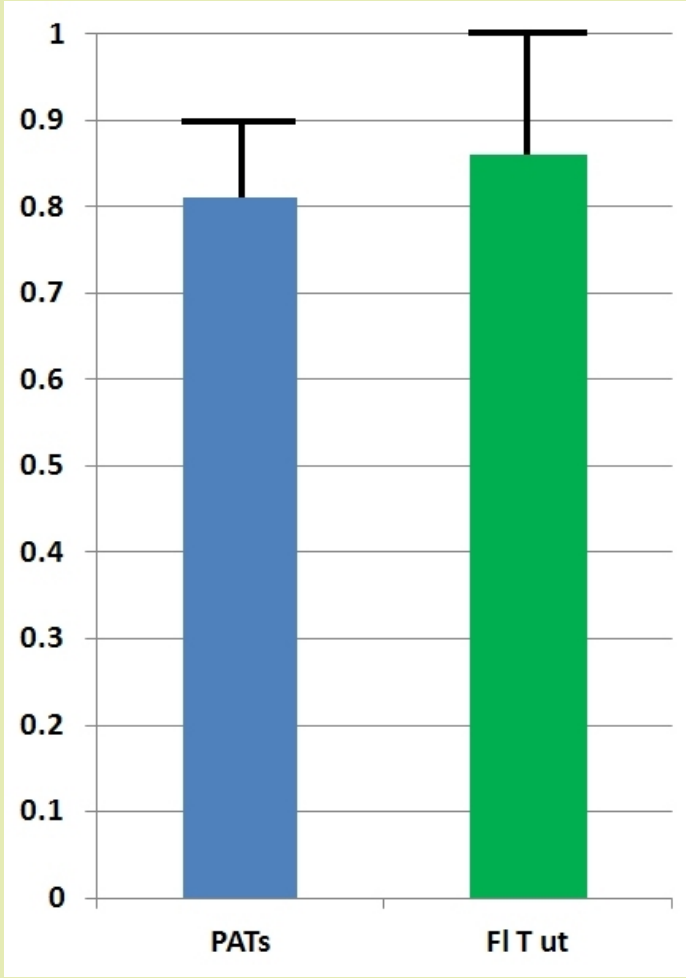
***P*-value = 0.000**

Proportion of larvae that pupated



***P*-value = 0.031**

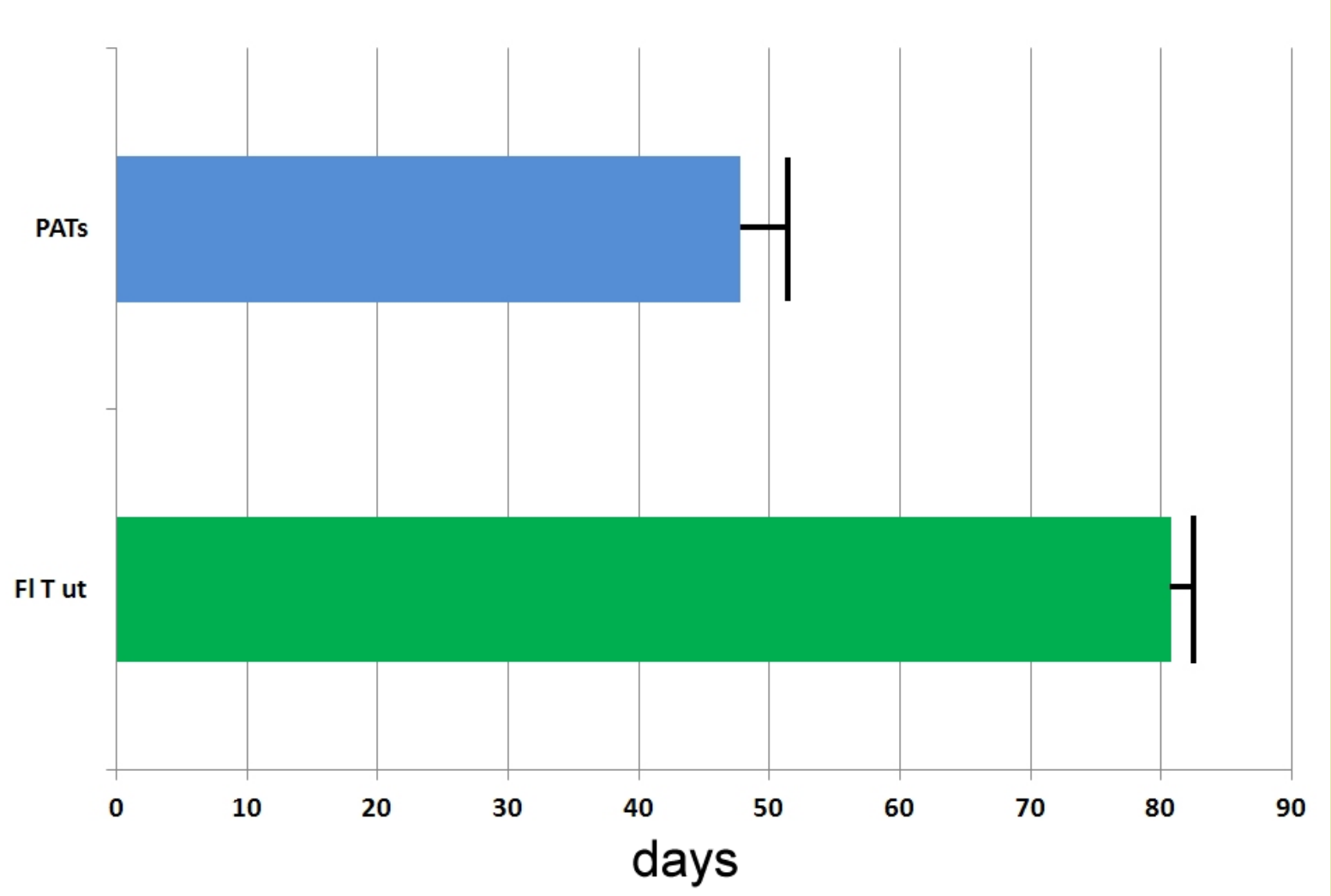
Proportion of pupae that emerged as adults



***P*-value = 0.785**

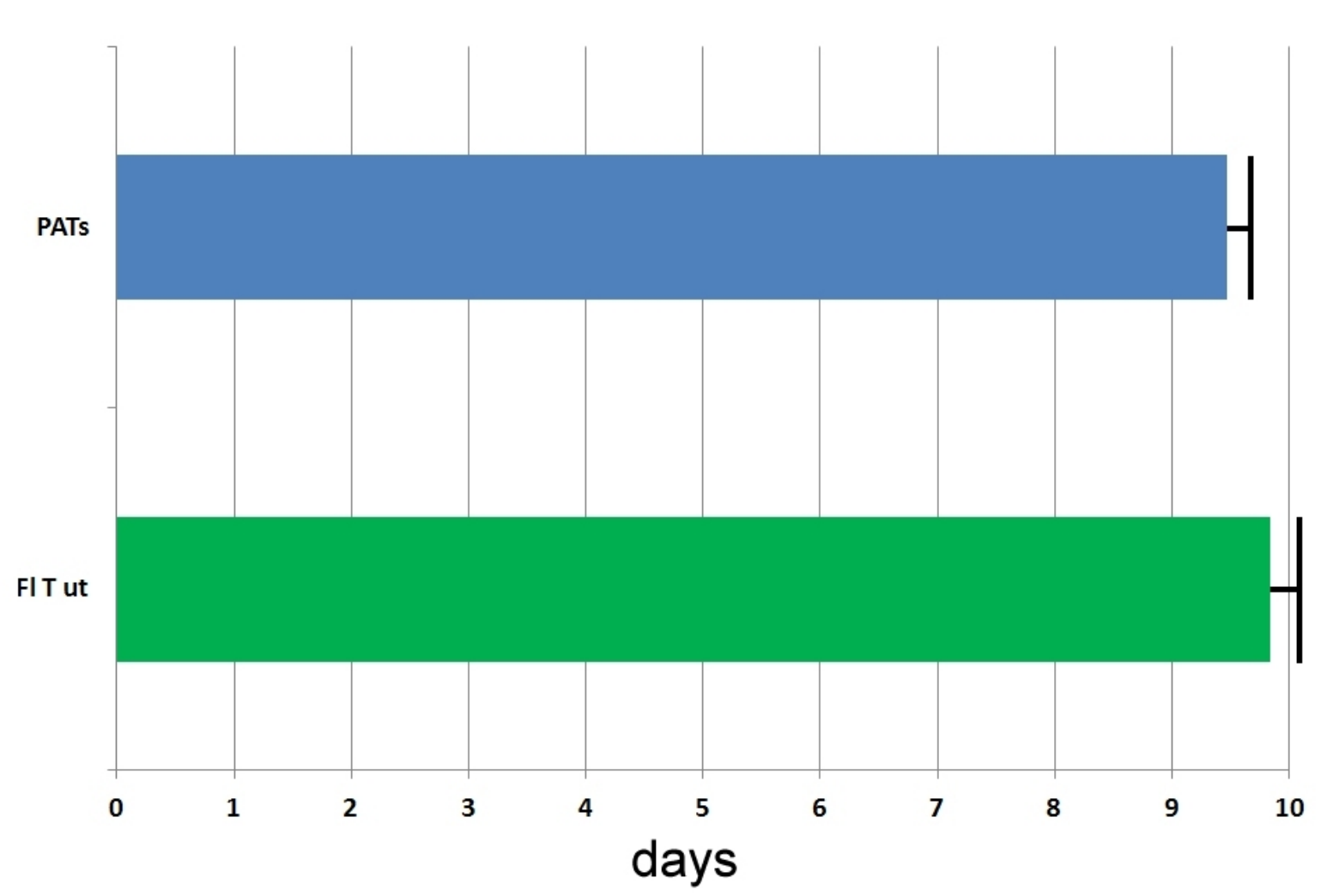
Larvae fed *T. utriculata* C Am and *T. fasciculata* leaves lived for several months, but grew very little and never matured beyond 3rd instar.

Development time from egg to pupa



***P*-value = 0.000**

Development time from pupa to adult



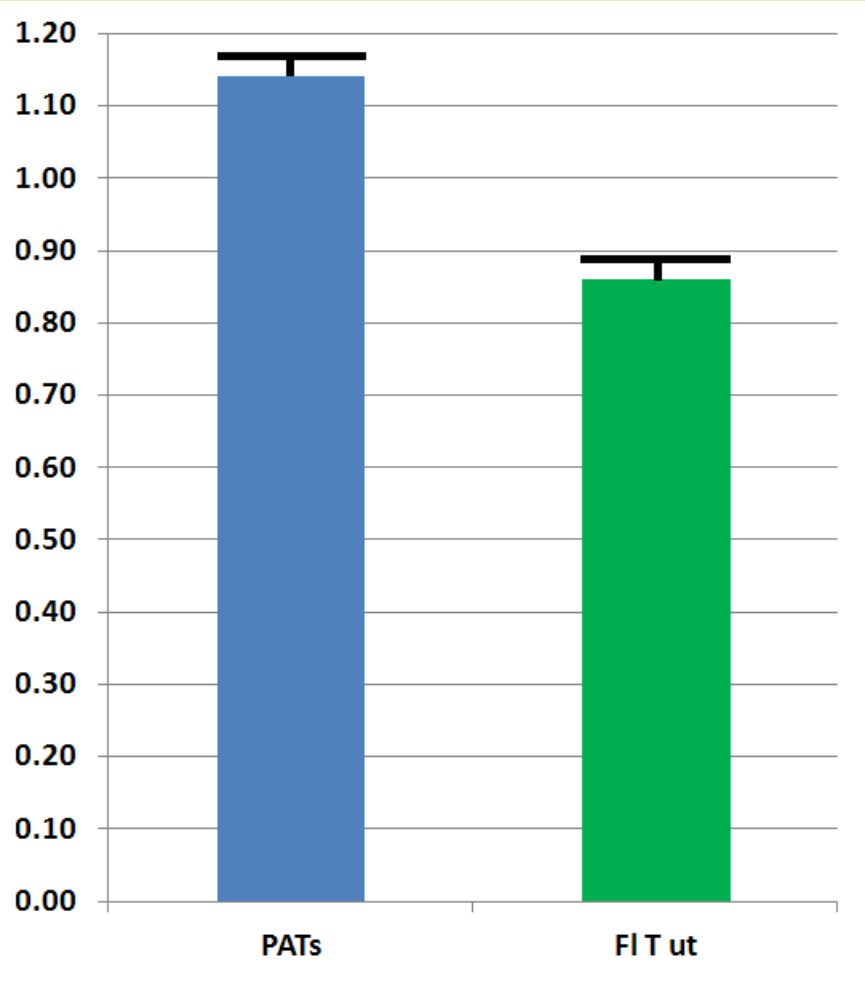
***P*-value = 0.474**

Weevil adult length and width

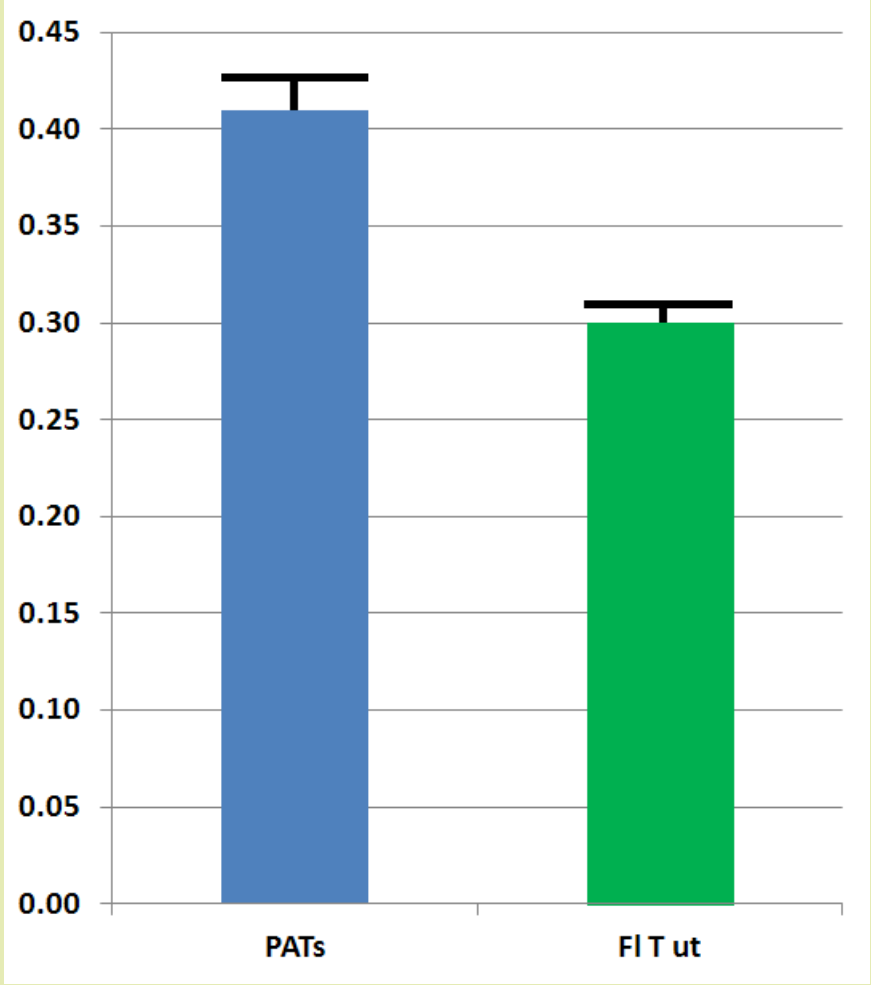
Adult weevil length was measured from the dorsal, posterior edge of the rostrum to the tip of the abdomen.

Adult weevil width was measured across the widest part of the elytra.

Adult size



M. callizona length, cm



M. Callizona width, cm

Summary

Characteristic	Similar	Different	Eating	Not eating
Oviposition rate		**X**	**X***	
Proportion of egg hatch	**X**			**X**
Proportion of larvae to pupate**		**X**	**X**	
Proportion of pupae to adult	**X**			**X**
Development time, egg to pupa		**X**	**X**	
Development time, pupa to adult	**X**			**X**
Adult size		**X**	**X**	

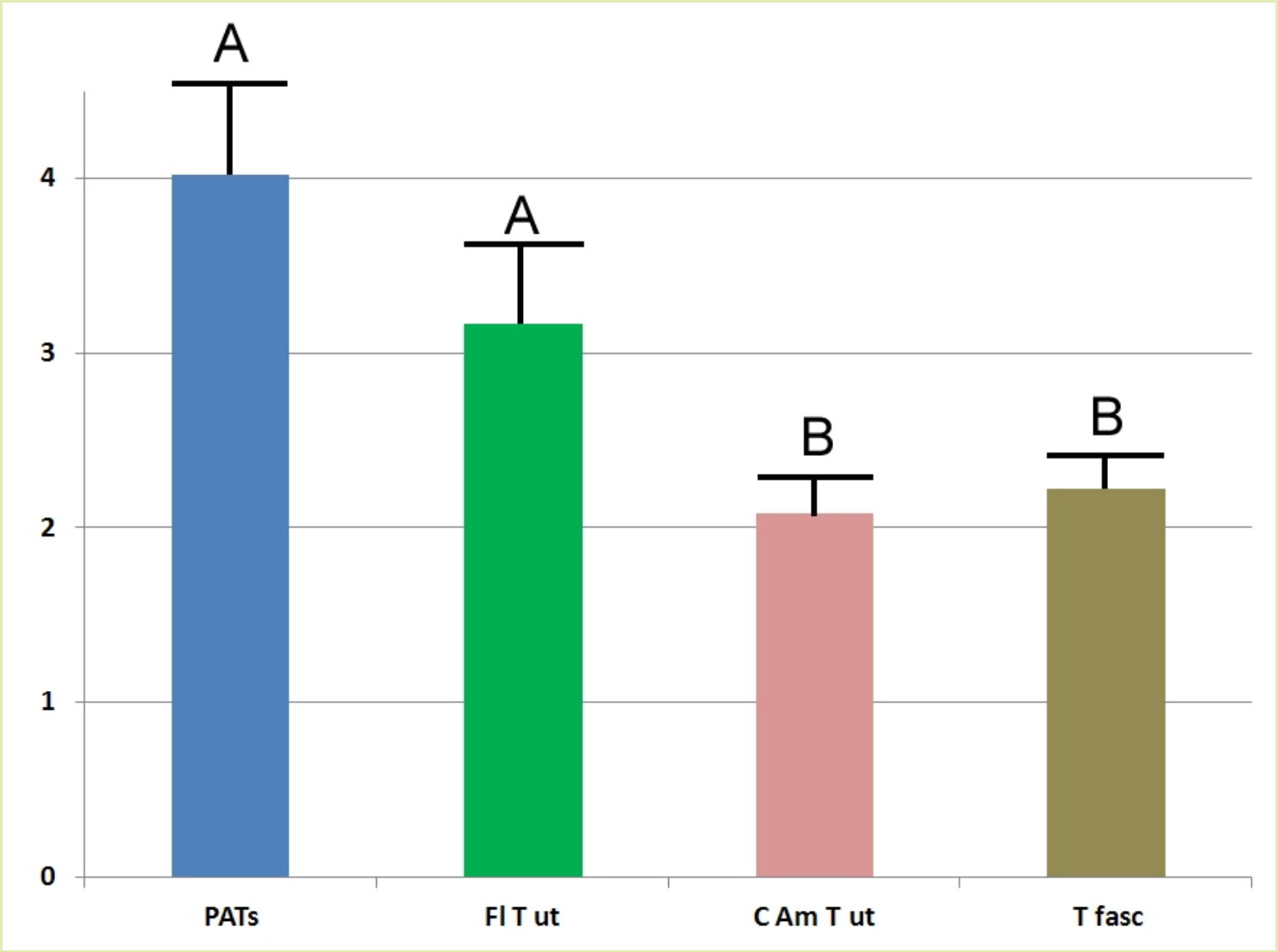
*Adult assessment of host substrate.

**Weevils growing on Central American *T. utriculata* and *T. fasciculata* leaves never grew past 3rd instar.

BRIX analysis

The four host bromeliad types were tested for total soluble solids, a rough indication of sugars found in the leaves and stems, using a hand-held refractometer.

BRIX analysis



Host plant effect on weevil growth and development: Using whole plants

Many thanks to our supporters…

South Florida Water Management District

Florida Council of Bromeliad Societies, Inc.

Department of Environmental Protection
Florida Park Service

University of Florida

References:

Cave RD. 1997. *Admontia* sp., a potential biological control agent of *Metamasius callizona*. J Brom Soc 47:244-249.

Cave RD, Duetting PS, Creel OR, Branch CL. 2006. Biology of *Metamasius mosieri* (Coleoptera: Dryopthoridae), with a description of larval and pupal stages. Ann Entomol Soc Am. 99(6):1146-1153.

Cooper TM. 2008. Seasonality and abundance of *Metamasius callizona* (Coleoptera: Dryopthoridae), an invasive insect herbivore, on two species of *Tillandsia* (Bromeliaceae) in Florida. J Nat Hist. 42(41-44):2721-2734.

Ferriter A. 2006. Distribution of Mexican bromeliad weevil in south and central Florida. Fig. 9-3 In: 2006 South Florida Environmental Report. Florida Department of Environmental Protection (DEP) and South Florida Water Management District (SFWMD).

Frank JH. 1996. Bromeliad biota: A list of weevils known to eat bromeliads [online]. Gainesvill (FL): University of Florida [cited 2009 Mar 22]. Available from: http://BromeliadBiota.ifas.ufl.edu/wvbrom3.htm. (June 2006).
Frank JH. 1999. Bromeliad-eating weevils. Selbyana. 20(1):40-48.

Frank JF, Curtis GA. 1981. Bionomics of the bromeliad-inhabiting mosquito *Wyeomyia vanduzeei* and its nursery plant *Tillandsia utriculata*. Fla Entomol. 54:491-506.

Frank JH, Thomas MC. 1994. *Metamasius callizona* (Chevrolat) (Coleoptera: Curculionidae), an immigrant pest, destroys bromeliads in Florida. Can Entomol 126:673-682.

Frank JH, Cave RD. 2005. *Metamasius callizona* is destroying Florida's native bromeliads. In: Second International Symposium on Biological Control of Arthropods; 2005 Sep12-16; Davos, Switzerland: USDA Forest Service Publication FHTET-2005-08. Vol 1. P 91-101.

Gavilánez Margarita Susana García. 2005. Fecundidad de cf. *Lixophaga* (Diptera: Tachinidae) y parasitismo artificial de *Metamasius quadrilineatus* (Coleoptera: Dryophthoridae) como forma alterna para su producciòn masiva. Thesis. Zamorano, Honduras.

Salas J, Frank JH. 2001. Development of *Metamasius callizona* (Coleoptera: Curculionidae) on pineapple stems. Florida Entomol 84:123-126.

Wood DM, Cave RD. 2006. Description of a new genus and species of weevil parasitoid from Honduras (Diptera: Tachinidae). Florida Entomol 89:239-244.

http://www.entnemdept.ufl.edu/frank/SaveBromeliads

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