Mass Rearing of Pseudophilothrips ichini (Thysanoptera: Phlaeothripidae), an Approved Biological Control Agent for Brazilian Peppertree, Schinus terebinthifolius (Sapindales: Anacardiaceae)

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MASS REARING OF *PSEUDOPHILOTHRIPS ICHINI* (THYSANOPTERA: PHLAEOTHRIPIDAE), AN APPROVED BIOLOGICAL CONTROL AGENT FOR BRAZILIAN PEPPERTREE, *SCHINUS TEREBINTHIFOLIUS* (SAPINDALES: ANACARDIACEAE)

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Brazilian peppertree, *Schinus terebinthifolius* Raddi, native to Argentina, Brazil, and Paraguay (Barkley 1944), is a non-native invasive weed in Florida (Langeland & Burks 2008), California (Randall 2000), Hawaii (Hight et al. 2003), and Texas (Gonzalez & Christoffersen 2006). This woody ornamental most likely was introduced into Florida before 1900 (Morton 1978; Mack 1991). It eventually escaped cultivation and is a serious problem in disturbed sites (e.g., fallow farmlands, ditch banks), natural communities such as pinelands, hardwood hammocks and mangrove forests, and the Everglades National Park (Toops 1979; Ewel et al. 1982).

During the mid-1980s, Brazilian peppertree was targeted for classical biological control in Florida (Bennett et al. 1990; Habeck 1995). The long-term goal of this project is to introduce a complex of specialist natural enemies into Florida that are capable of selectively attacking and reducing the invasiveness of Brazilian peppertree. Surveys for natural enemies within the areas of natural distribution of Brazilian peppertree have been conducted, and biological and host range studies have been completed for several candidate biological control agents (Cuda et al. 2006). In May 2007, the federal interagency Technical Advisory Group for the Introduction of Biological Control Agents of Weeds (TAG) recommended the release from quarantine of the stem-attacking thrips *Pseudophilothrips ichini* (Hood).

The life cycle and impact of *P. ichini* on Brazilian peppertree were investigated in Brazil (Garcia 1977; Furmann et al. 2005). Adults are black and winged (Fig. 1), 3-6 mm in length, and females have a high reproductive rate (~220 eggs); the males are produced by parthenogenesis (arrhenotoky). The adults overwinter on Brazilian peppertree, and in early spring (September), females start laying eggs singly or in small groups on the leaflet pedicels and blades, or on the new tender shoot growth. The wingless larvae, which usually are found clustered around the stem of a tender shoot (Fig. 1), are red or orange in color. Garcia (1977) observed that complete development (egg to egg stage) required 76 d at 18°C, and 38 d at 24°C.

Both larval and adult stages are capable of damaging the plant. Larvae feed by piercing tender shoots and sucking the plant juices, which eventually kills the apical meristems. Adults usually are more randomly distributed, and feed on the flowers, causing them to abort. A replicated field impact study conducted in Brazil showed that *P. ichini* is capable of reducing the vigor and growth rate of young plants (Furmann et al. 2005).

In anticipation of field release, a standard protocol was developed for mass rearing *P. ichini* in the laboratory. A reliable method for mass-producing the thrips will ensure that a sufficient number of healthy insects will be available for releasing at several sites in peninsular Florida to increase the likelihood of establishment of this Brazilian peppertree biological control agent.

Potted Brazilian peppertrees (118) and California peppertrees, *Schinus molle* L. (325) were exposed to adult thrips in the Entomology and Nematology Department's quarantine laboratory. The adults, which were either collected in Brazil under permit or reared from larvae collected in Brazil, underwent a generation in the maximum security room at the Florida DACS/DPI quarantine facility (FBCL) before they were transferred to new plants. Plants used for rearing purposes were grown individually in 3.8-L (1 gal) pots and covered with acrylic cylinders (14 cm diam. × 45 cm ht) with 6 holes covered with Nitex® screen for ventilation. The environmental conditions were recorded inside one of the cylinders with a wireless sensor (Thermo-Hygro, Fisher Scientific®, Pittsburgh, PA) from Jun 2002 through Oct 2004. The average temperature and relative humidity (mean ± SEM) were 25.0 ± 0.8°C and 69.0 ± 2.5%, respectively.

Using a small camelhair brush, we transferred a maximum of 100 adult thrips from the initial colony to fresh, potted plants (approximately 20-25 cm ht) through small holes in the acrylic cylinder cages. Previous observations showed that adult populations higher than 100 per plant were capable of killing the potted plants (J. P. Cuda, unpubl. data). Rubber stoppers were placed in the holes to prevent the

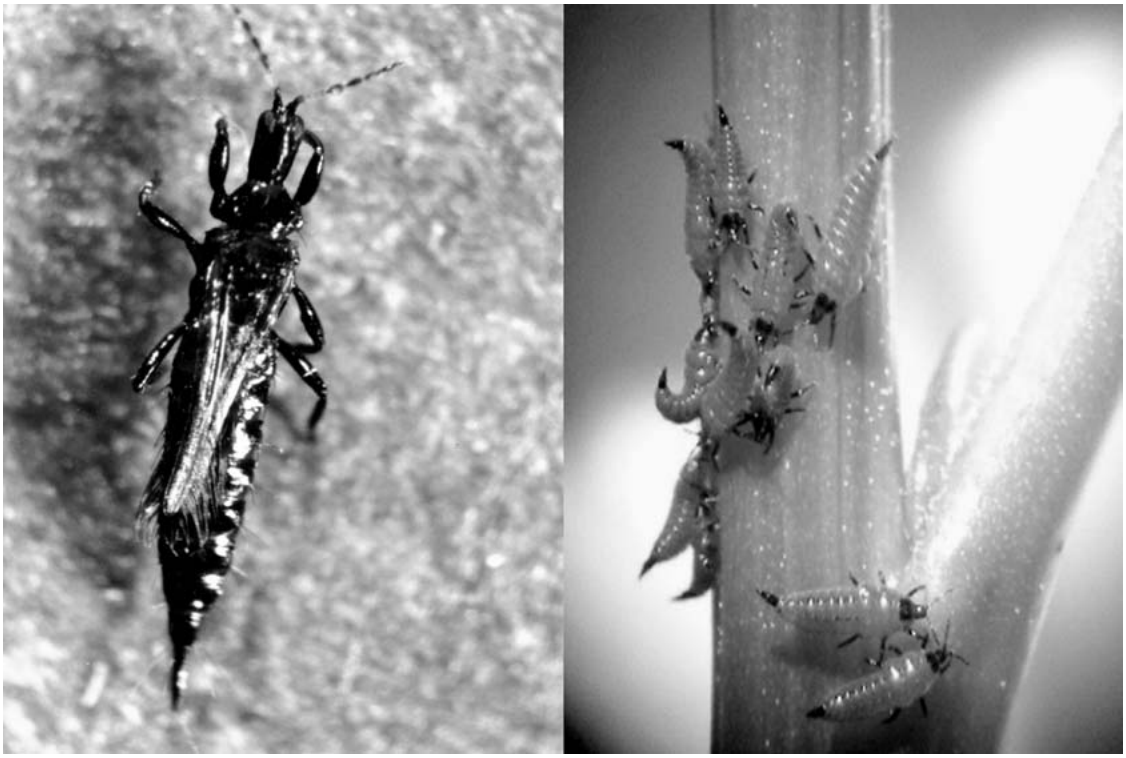

Fig. 1. Adult female (left) and cluster of larvae of *P. ichini* on stem of Brazilian peppertree, *Schinus terebinthifolius* (Photo credits: Marcelo Vitorino and Veronica Manrique).

thrips from escaping. Each cage was labeled with a colony number, the host plant species, and the date. Approximately 20 to 25 d after the parental adults were placed on the plant, a new generation of thrips larvae was produced. Developing larvae were collected by cutting a shoot tip with scissors and carefully transferring the thrips-infested shoot into a 50-dram clear plastic snap cap vial with holes punched in the lid with a teasing needle for ventilation; the holes were sealed with a piece of Kimwipe® sandwiched between the lid and the vial. A freshly cut young shoot of the same host plant species (~8.5 to 9 cm long) was placed inside the vial as a food source. Before using the new shoot tip, we sprayed it with a 10% bleach solution in order to kill bacteria and fungi, and then thoroughly rinsed it with tap water. A piece of standard filter paper (9 cm diam.) moistened with a few drops of tap water was placed in the vial to maintain humidity. A maximum of 80 larvae was placed inside each vial. The snap cap vials were transferred to larger, round, clear plastic containers (26 cm diam × 9 cm ht) and placed inside a growth chamber set at 23.0°C and a 16:8 (L:D) photoperiod.

The snap cap vials with developing larvae were checked at least 3 times per week for adult emergence. Fresh shoot tips were added to the vials, as needed, until the larvae pupated. Newly emerged adults were then transferred to a fresh, potted plant (100 thrips per plant) of the same species again for mating and oviposition. The numbers of adults that emerged from this technique were recorded and pooled to obtain a monthly total.

From Jun 2002 to Oct 2004, an average of 1,110.5 ± 169.9 (mean ± SEM) adult thrips was produced per month in the Entomology and Nematology Department's quarantine laboratory (Fig. 2). A maximum of 3,153 adults was collected during the month of Oct 2003. The adults produced were used in supplemental host range tests requested by the TAG.

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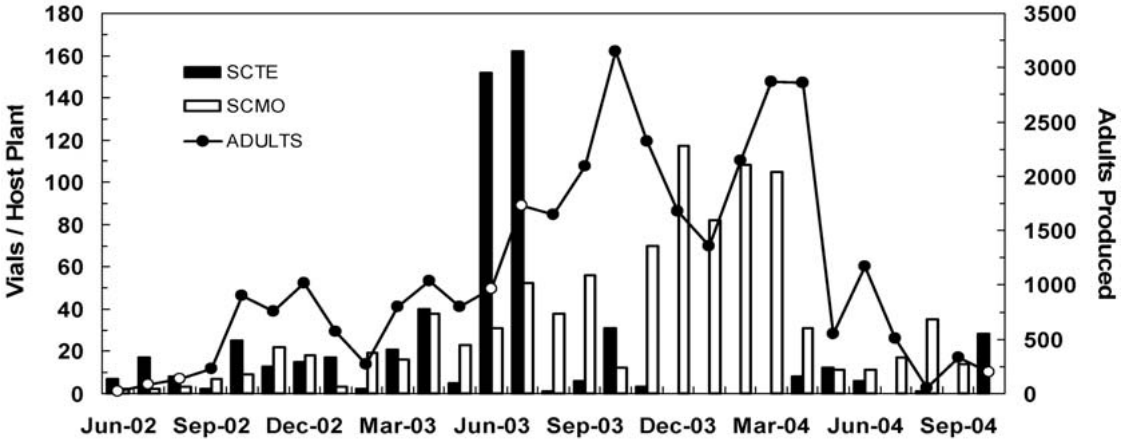

Fig. 2. Total number of vials per host plant and *P. ichini* adults produced monthly in the UF/IFAS Entomology and Nematology Department quarantine laboratory, Jun 2002-Oct 2004. SCTE = *Schinus terebinthifolius*, SCMO = *S. molle*.

Summary

A technique for rearing large numbers of the thrips *P. ichini*, an approved biological control agent for Brazilian peppertree, was developed. This rearing method facilitated laboratory host range testing that was required for obtaining approval for field release in Florida. The procedure will be used for mass rearing the insect to provide sufficient numbers of insects for the initial field releases at several Florida locations.

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