

# Comparison of Commercially and Locally Produced *Encarsia formosa* Gahan on the Control of Sweetpotato Whitefly on Poinsettias

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**Summary.** A 2-year demonstration study was conducted to compare the effectiveness of two sources of *Encarsia formosa* (EF) on the biological control of the sweetpotato whitefly (SPWF) (*Bemisia tabaci* Gennadius) on poinsettias (*Euphorbia pulcherrima* Wild.). Commercially produced EF were raised on the greenhouse whitefly (GHWF) (*Trialeurodes vaporariorum* Westwood), while the locally produced EF were raised on the SPWF. Results showed that SPWF populations were reduced considerably both years, and maximum nymph parasitism ranged from 60% to >80%. No large differences were observed in the ability of EF to control SPWF populations whether raised on SPWF or GHWF nymphs. This study suggests that there is potential for controlling SPWF populations on poinsettia by EF in conjunction with an integrated pest management (IPM) program.

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Effective biological control of the greenhouse whitefly (GHWF) by the parasitoid *Encarsia formosa* (EF) has been demonstrated by researchers on poinsettia crops in recent years. Poinsettias are an excellent crop for biological control, as the crop typically is grown as a monoculture and there are only two insect pests of significance: the GHWF and the sweetpotato whitefly (SPWF) (Ecke et al., 1990).

McMahon et al. (1992) showed that poinsettia stock plants could produce terminal stem cuttings free of GHWF adults through three biweekly releases of 9.5 EF per plant. Releases were made when the GHWF infestation was small (i.e., two GHWF per plant), which is essential when implementing biological control agents (Albert, 1990). Several investigations with poinsettia Christmas crops also have been successful in controlling the GHWF with EF (Albert, 1990; McMahon et al., 1989; Michael, 1991). Recently, in many parts of the country, the SPWF has become a serious pest of poinsettias. This pest is resistant to many pesticides (Biosclair et al., 1990) and reproduces at a faster rate than the GHWF, representing a serious threat to poinsettia crops. In light of regulations that are removing pesticides from use by growers, and pesticide-resistant strains of whiteflies, other ways of controlling the SPWF must be found.

EF has been shown to seek out and parasitize the larval stages of the SPWF, much as it does the larval stages of the GHWF. However, previous research has shown that EF is not as effective in controlling the SPWF when compared to the GHWF (Kuack, 1992). Recent studies cast doubt on this assertion. Benuzzi et al. (1990) demonstrated with poinsettias that no significant difference occurred in the percentage of parasitism by EF on SPWF and GHWF. Biosclair et al. (1990) stated that EF can control SPWF populations with sufficiently high introduction rates. Furthermore, if the SPWF occurs by itself, parasitism by EF is better than if both species of whitefly are present. Parrella et al. (1991) conducted a study at a commercial greenhouse in which EF was used to control SPWF on poinsettia stock plants. It was shown that EF greatly reduced SPWF populations in comparison to control cages, although low populations of SPWF were present on the terminal stem cuttings. It was

concluded that EF has better potential for the control of SPWF on poinsettia Christmas crops rather than on stock plants, and that EF usage should be part of an integrated pest management (IPM) program. McHugh (1991) states that there is evidence for EF controlling SPWF infestations quite well once EF has adapted to SPWF.

The objective of this study was to investigate the use of EF for the control of SPWF during flowering poinsettia production. Another objective was to compare the effectiveness of commercially produced EF, which were raised on GHWF, with locally produced EF, which were raised on SPWF.

The experiment was conducted during Autumn 1991 and repeated during Autumn 1992 in the same two identical 7 × 7-m greenhouse compartments. Rooted Annette Hegg 'Brilliant Diamond' cuttings (donated by Paul Ecke Ranch, Encinitas, Calif.) were planted in 16.5-cm azalea pots (23 Aug. 1991 and 25 Aug. 1992). Standard production procedures were implemented according to Ecke et al. (1990). A recording thermograph was placed in each compartment.

A randomized block design was used with eight blocks of 16 plants per compartment. Three days after planting, 25% of the plants from each compartment were exposed to SPWF for 48 h to initiate an infestation. Most SPWF adults were brushed off plants prior to placing plants back in the compartments. Two weeks later, an average of 2.3 EF adults per plant (300 EF per compartment) were released from the center of each compartment. Three more biweekly releases of EF were conducted at the same rate (Table 1). Commercially produced EF (Koppert Company, The Netherlands, via Gerhart Biological Systems, N. Ridgeville, Ohio) were released in compartment No. 1, while locally produced EF (raised at the entomology department of the Ohio Agricultural Research and Development Center, Wooster) were released in compartment No. 2 in 1991. In 1992, the compartments were reversed with regard to the two EF types.

Two 5 × 5-cm yellow sticky traps were placed in the center of each block to monitor SPWF and EF populations. One trap was placed vertically just above the plant canopy; the other trap was placed horizontally on the edge of the pot of the same plant. Population counts were made weekly from the

Table 1. Dates for planting, SPWF infestation, EF releases and data collection.

Year	Plant date	SPWF infestation	EF releases				Start of data collection
			1st	2nd	3rd	4th	
1991	23 Aug.	26 Aug.	13 Sept.	20 Sept.	4 Oct.	18 Oct.	2 Oct.
1992	25 Aug.	28 Aug.	10 Sept.	25 Sept.	9 Oct.	21 Oct.	2 Oct.

traps. Each week, 25% (four) plants from each block were chosen at random and inspected for SPWF. The number of SPWF adults and nymphs, parasitized SPWF nymphs, and EF were recorded. In the 1992 experiment, three control cages (1 × 2 × 1 m) were placed in each compartment, each containing

eight poinsettia plants. Cages were constructed of PVC pipe and covered with a 25 thread-per-inch cheesecloth. Cage bottoms were made of a single piece of styrofoam, cut to match the inside cage dimensions. This was done to compare the SPWF population on poinsettias in the absence of EF. A single 5 × 5-cm

yellow sticky trap was placed in the center of each cage. Traps were orientated horizontally in two of the cages, and vertically in the third. Proportionally, the trapping area was the same in the cages and in the compartments.

Yellow sticky trap data show that there was an approximate 200-fold increase in the number of trapped SPWF adults on the yellow sticky traps in the control cages (no EF present) compared to the number of adults trapped in both biological control compartments at the end of the 1992 experiment (Fig. 1). On 24 Sept., similar numbers of SPWF adults were trapped in the control cages and in the biological control compartments. However, by 4 Nov., 20 times as many SPWF adults were being trapped in the control cages. Throughout the last 7 weeks of the experiment, the number of SPWF adults trapped in both biological control compartments gradually decreased from seven to 10 adults per trap to two to three adults per trap. In contrast, the number of SPWF adults trapped in the control cages from both compartments rapidly increased to ≈1000 adults per trap (Fig. 1). The adult SPWF populations in both compartments showed an overall decline during the 1991 and 1992 experiments (Figs. 2 and 3). Between the 2 years, the populations in both compartments ranged from 48 (1.50 adults per plant) to 75 (2.34 adults per plant) on 2 Oct., and decreased to a range of four (0.13 adults per plant) to 32 (1 adult per plant) on 4 Dec. No consistent differences were evident with regard to SPWF population control by local or commercial EF.

The EF population peaked twice during the 1991 and 1992 experiments, with peaks occurring 1 week apart according to the EF source in 1991, but occurring in the same week in 1992 (Figs. 2 and 3). Larger EF populations were established in 1992, with maximum populations ranging from 235 to 290 EF for the two compartments as compared to 1991 population maximums of 61 to 87. Population peaks of EF in both compartments were always followed by declines in adult SPWF populations (Figs. 2 and 3). There was no consistent trend in EF populations by compartment over the 2-year study.

The 1991 parasitized SPWF nymph populations were always considerably larger in the local EF compartment, with a maximum of 2525 (78.91 nymphs per plant) on 20 Nov., compared to a maximum of 700

**1992 TRAPPED WHITEFLY ADULTS  
CONTROLS VS BIOCONTROLS**

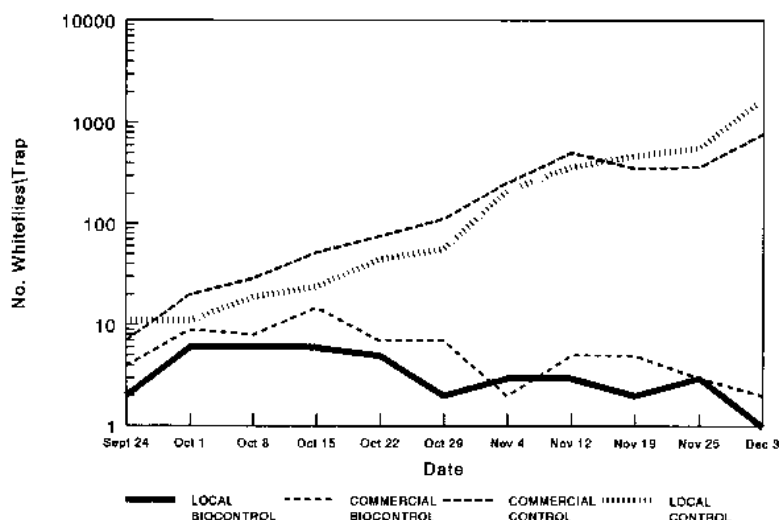


Fig. 1. Results of yellow sticky trapping inside the control cages compared to the trapping results in the commercial and local biocontrol compartments.

**1991 ADULT SWEETPOTATO WHITEFLY  
AND ENCARSIA FORMOSA**

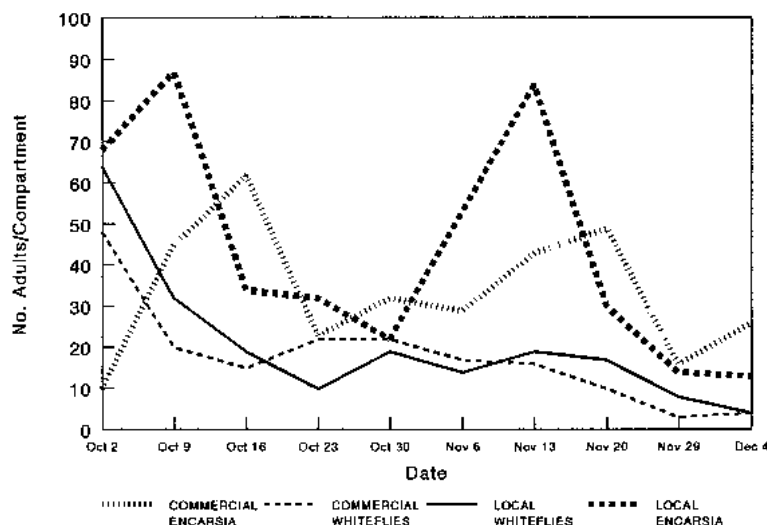


Fig. 2. Number of adult sweetpotato whiteflies and Encarsia formosa observed on sampled plants in local EF and commercial EF compartments, 1991.

(21.88 nymphs per plant) on 6 Nov. in the commercial EF compartment (Fig. 4). In 1992, this difference was reversed, with higher populations of parasitized SPWF nymphs in the commercial EF compartment through 13 Nov. After this date, more parasitized SPWF nymphs were counted in the local EF compartment for the last 3 weeks of the experiment (Fig. 5). Substantial increases in parasitized nymph populations occurred in both compartments in 1991 and 1992 (Figs. 4 and 5).

Nonparasitized (healthy) nymph population peaks were observed both years from 9 to 30 Oct. in the two compartments (Figs. 4 and 5), and the source of EF did not seem to have any effect on population trends. Nonparasitized nymph population peaked at 1000 (31.25 per plant) and 2750 (85.94 per plant) for 1991 and 1992, respectively, in the commercial EF compartment. The nonparasitized nymph population peaked at 1530 (47.81 per plant) and 1800 (56.25 per plant) for 1991 and 1992, respectively, in the local EF compartment. Populations of nonparasitized SPWF nymphs showed an overall net decrease both years in the two compartments from 2 Oct. to 4 Dec., with population fluctuations between these dates (Figs. 4 and 5).

The overall percentage of parasitized SPWF nymphs steadily increased in both compartments throughout the 1991 and 1992 experiments (Fig. 6). On 2 Oct., parasitism ranged from 13% to 38%, and increased to a range of 51% to 82% on 4 Dec. both years (Fig. 6). The percentage of parasitized nymphs was always greater in the local EF compartment in 1991. However, in 1992, there was no consistent pattern in the percentage of parasitized nymphs by EF source.

This 2-year demonstration study showed that it is possible to control SPWF populations successfully by EF on poinsettia crops. Parasitism of SPWF nymphs became evident both years during the first week of data collection, <3 weeks after the first EF release. Data taken from 23 Oct. through 4 Dec. occurred after the fourth and final release of EF. The populations of EF in both compartments increased considerably through 13 Nov., indicating establishment of EF on SPWF-infested plants. The percentage of parasitized SPWF nymphs exceeded 60 both years. This compares favorably with

GHWF nymph parasitism (Benuzzi et al., 1990; McMahon et al., 1989) demonstrated by other researchers.

By the termination of the 1992 experiment, the adult and immature SPWF populations in the control cages in both compartments were such that the plants were literally covered and population counts were impossible. Outside the cages, where EF were present, nymph populations both years were reduced by 50% or more in the two compartments from 2 Oct. to 4 Dec. Final adult populations outside of the cages ranged from 0.13 to one per plant, which could

be eliminated easily by an appropriate aerosol or smoke pesticide application. There was a 200-fold increase in trapped adult SPWF in the control cages compared to traps outside the control cages, further reinforcing the potential of using EF to control SPWF infestations on poinsettia successfully.

The total release rate of 9.2 EF per plant is considerably lower than that implemented by other researchers for both GHWF and SPWF control studies (Parrella et al., 1991; Benuzzi et al., 1990; McMahon et al., 1992). At a cost of \$10.00 per 1000 EF and

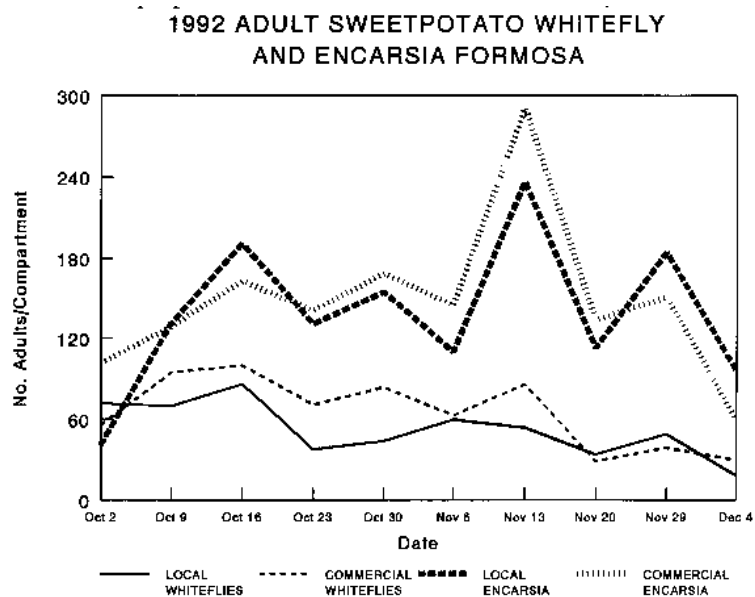


Fig. 3. Number of adult sweetpotato whiteflies and *Encarsia formosa* observed on sampled plants in local EF and commercial EF compartments, 1992.

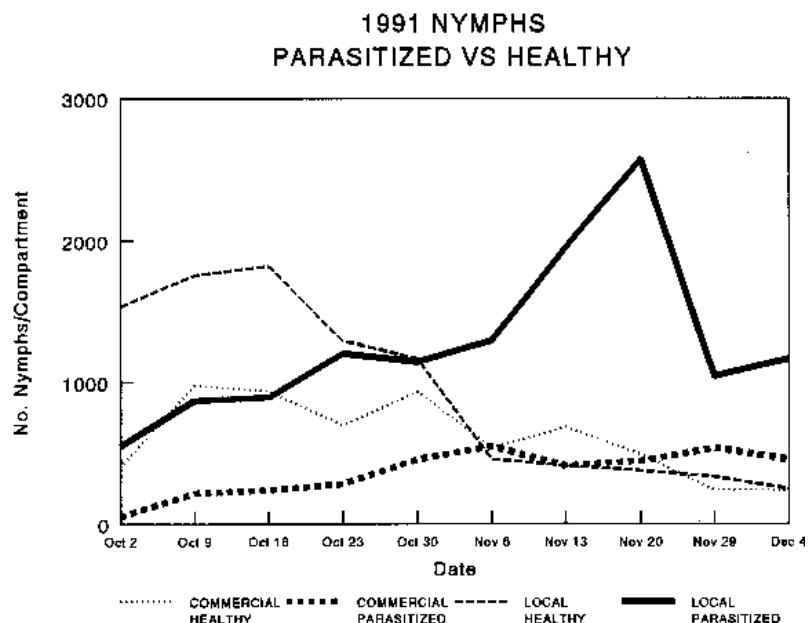


Fig. 4. Number of sweetpotato whitefly nymphs observed on sampled plants in local EF and commercial EF compartments, 1991.

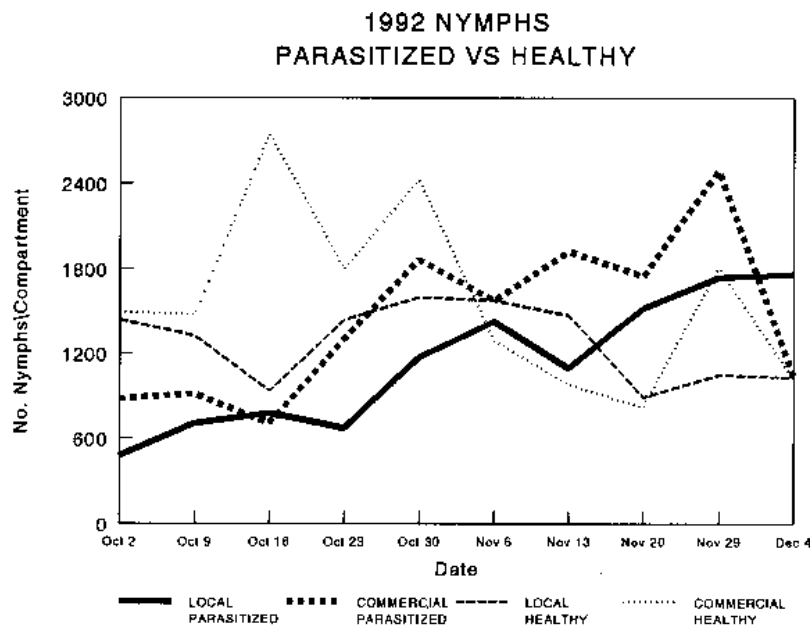


Fig. 5. Number of sweetpotato whitefly nymphs observed on sampled plants in local EF and commercial EF compartments, 1992.

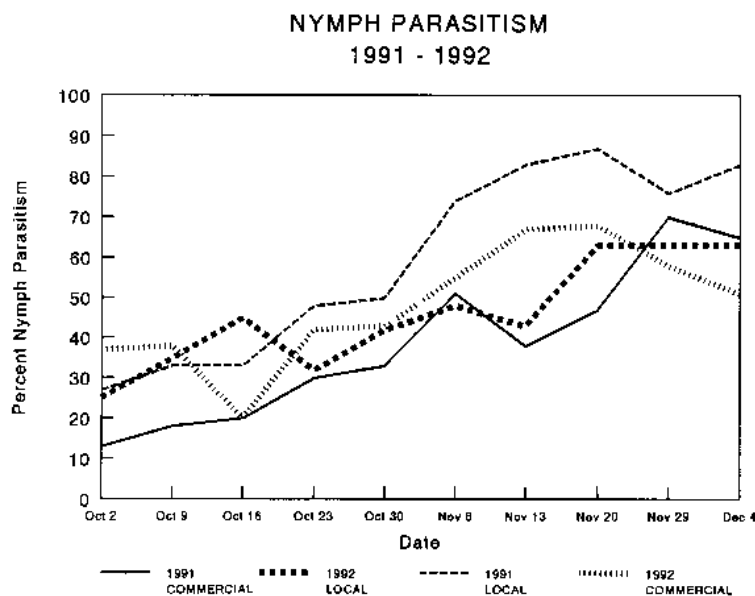


Fig. 6. Percent parasitism of sweetpotato whitefly nymphs on sampled plants in the local EF and commercial EF compartments, 1991 and 1992.

estimating the labor to introduce EF, shipping costs, and other associated costs of an EF control program, the cost per plant was about \$0.17, which is \$0.05 to \$0.09 higher than costs of a conventional pesticide control program (Lindquist, 1993). While this translates to higher costs of implementing an EF control program, benefits include a safer work environment and elimination of pesticide phytotoxicity damage.

This study also showed that EF raised on both whitefly species effectively controlled SPWF populations.

While differences occurred between the two sources of EF in controlling SPWF populations and nymph parasitism, they were not consistent from the 1st to the 2nd year. Benuzzi et al. (1990) concluded that, while EF can be used to control SPWF infestations if used in great enough numbers, EF raised on SPWF nymphs will be less-effective parasites. The results of this study suggest that EF is equally effective in controlling SPWF populations regardless of which type of whitefly is the host for reproducing EF.

It is essential that EF be released

as soon as SPWF populations are detected. In this 2-year study, EF were released when the first SPWF adults were detected on the poinsettias. Two more biweekly releases provided adequate control of the SPWF such that a single appropriate pesticide application just before sale of the plants would eliminate the small SPWF population.

While biological control of SPWF using EF did not result in eradication of SPWF stages, this control method has potential for a poinsettia IPM program. This includes EF releases, greenhouse sanitation, scouting crops for SPWF, monitoring populations by yellow sticky traps and, if needed, environmentally soft pesticides, such as soaps, entomopathogenic fungi, oils, and insect growth regulators. This would result in reduced reliance on conventional pesticides, possible reduction or delay of SPWF resistance to these pesticides due to decreased pesticide use, and allow earlier reentry into treated areas.

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