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SUITABILITY OF *Aphidius absinthii* Marshall AND *Trioxys* (*Binodoxys*) *communis* Gahan (HYMENOPTERA: APHIDIIDAE) FOR THE BIOLOGICAL CONTROL OF *Pentalonia nigronervosa* Coq. (HEMIPTERA: APHIDIDAE) [1]

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ABSTRACT

Two parasitoids collected during a survey were tested for their suitability as control agents against *Pentalonia nigronervosa* Coq. *Aphidius absinthii* Marshall and *Trioxys* (*Binodoxys*) *communis* Gahan successfully parasitized *P. nigronervosa* under laboratory and greenhouse conditions.

Under laboratory conditions, the mean value for parasitization efficiency of *A. absinthii* given a host density of 10 aphids was 1.71 ± 0.95 while that of *T.* (*B.*) *communis* was 2.23 ± 0.08. When the host density was increased to 20 aphids, the mean value for parasitization efficiency increased to 2.19 ± 0.07 for *A. absinthii* and 3.42 ± 0.12 for *T.* (*B.*) *communis*. In the greenhouse, the mean values for parasitization efficiency were lower for both parasitoids.

Parasitization of *P. nigronervosa* occurred, on the average, 9.73 ± 0.33 days after the introduction of both parasitoids in the greenhouse. Under laboratory conditions, parasitization took significantly longer for both parasitoids, 14.14 ± 0.48 days for *A. absinthii* and 14.1 ± 0.48 for *T.* (*B.*) *communis*.

Total developmental periods of the two parasitoids differed under the two experimental conditions. They were longer in the laboratory than in the greenhouse which could be attributed to the limited space and food supply. The parasitoids, having more space and aphids to feed on, developed faster in the greenhouse. However, those in the laboratory lived longer than those reared in the greenhouse.

Key words: Biological control, parasitoids, *Aphidius absinthii*, *Trioxys* (*Binodoxys*) *communis*, *Pentalonia nigronervosa*.

INTRODUCTION

The use of biological control agents, particularly against insect vectors of virus diseases such as the abaca or banana aphid, *Pentalonia nigronervosa* Coquerel, has gained more attention recently because of the increasing problems caused by synthetic pesticides applied in the field to control insect pests.

Aphidophagous insects, particularly parasitoids, have been shown as promising biological control agents against *P. nigronervosa.* For instance, the parasitoids *Aphidius colemani* and *Aphidius* sp. were used in Australia, *Aphidius* sp. in Mauritius, and *Lysiphlebus testaceipes* in Cuba (Waterhouse and Morris 1987). Similarly, in 1986 aphidiid parasitoids *Lysiphlebus fabarum* and *L. testaceipes* were introduced and successfully cultured on *P. nigronervosa*, but no information on their establishment was reported (Waterhouse and Morris 1987). In Tonga, *Aphidius colemani* was used against *P. nigronervosa* (Volk et al. 1990, Wellings et al. 1994).

In the course of two and a half years survey and collection of parasitoids in several places in the Philippines, eleven species were collected from 19 host aphid species. *Trioxys* (*Binodoxys*) *communis* Gahan (Fig. 1) was the most common species, having been encountered 19 times, mostly on *Aphis gossypii* Glover (Fig. 2) and in all the collecting sites. It appeared, therefore, to be the most promising candidate for a suitability test for the control of *P. nigronervosa.* The second parasitoid chosen for the test was *Aphidius absinthii* Marshall (Fig. 3a & b), a species often encountered parasitizing almost entire colonies of *Macrosiphoniella sanborni* Gillette (Fig. 4) on *Chrysanthemum* sp. cultivars. The objective of this study was to determine the potential of the two locally collected parasitoids as biological control agents against the banana aphid based on suitability of the aphid as their host insect, as well as the parasitization capacity and length of developmental period of the parasitoids.

MATERIALS AND METHODS

Mummified *A. gossypii* and *M. sanborni* were collected from various plants and placed individually in plastic containers. The number of days from collection to emergence of parasitoids from the mummified aphids was noted. The parasitoids emerging from the mummified aphids were sexed with the aid of a dissecting microscope and maintained in the laboratory for the suitability tests.

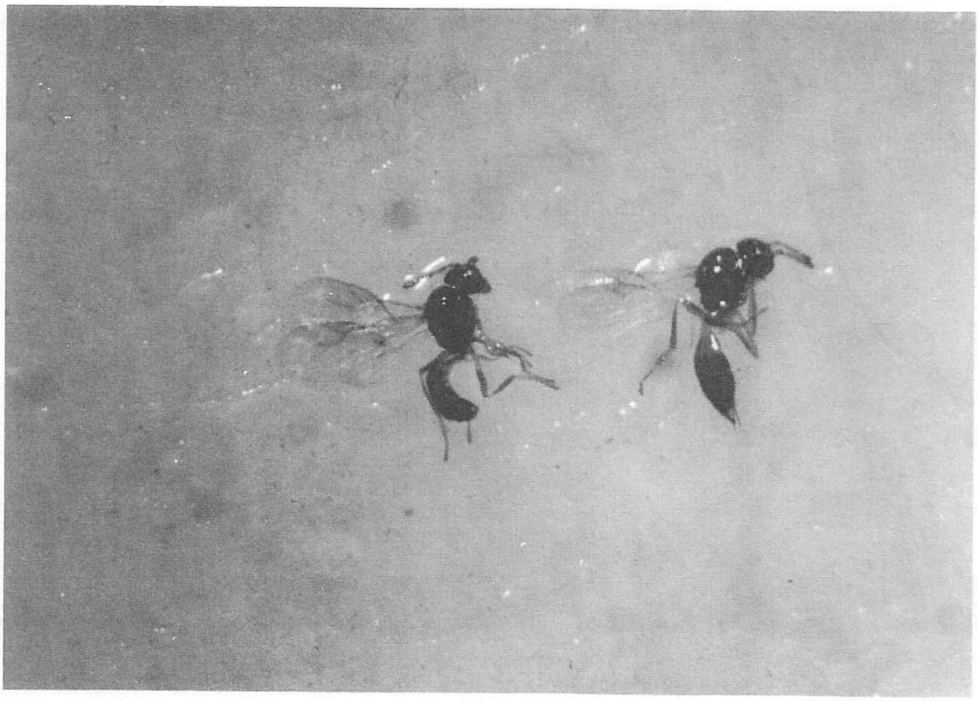

Figure 1. Adult male (left) and female (right) *Trioxys* (*Binodoxys*) *communis* Gahan.

Figure 2. *Aphis gossypii* Glover (with arrows) parasitized with *Trioxys* (*Binodoxys*) *communis* Gahan.

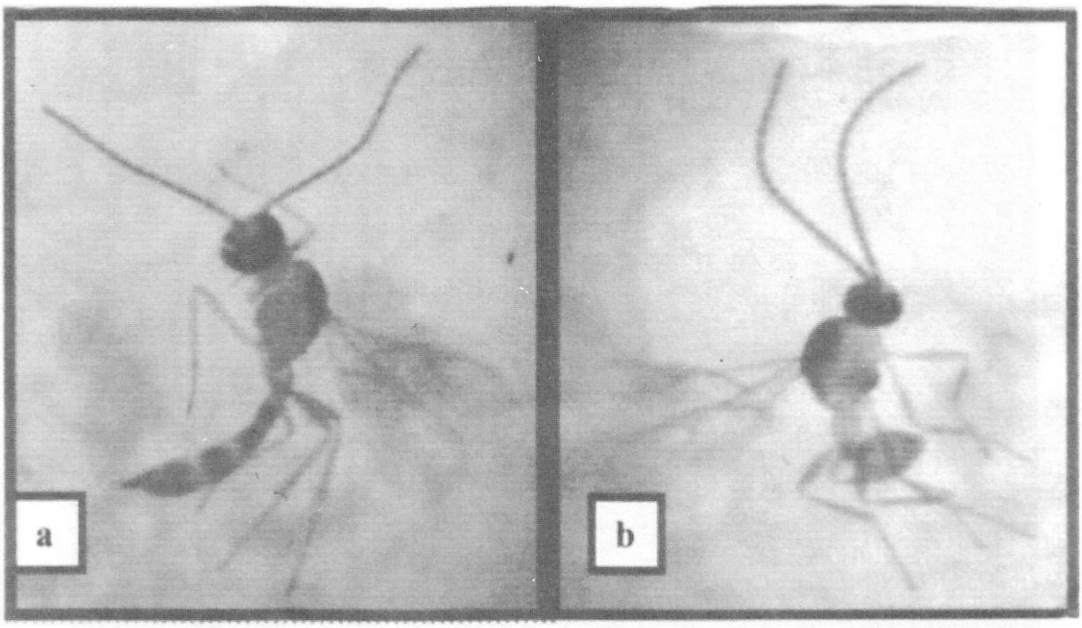

Figure 3. Adult female (a) and adult male (b) *Aphidius absinthii* Marshall.

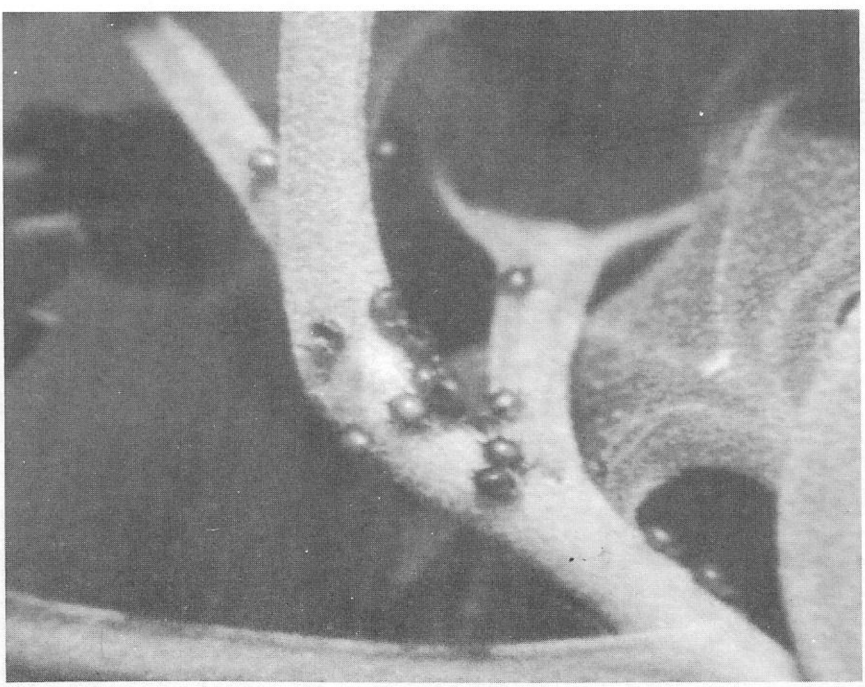

Figure 4. *Macrosiphoniella sanborni* Gillette parasitized by *Aphidius absinthii* Marshall.

Suitability test in the laboratory

Newly emerged male and female pairs of *T.* (*B.*) *communis* and *A. absinthii* were confined in vials for 4 to 5 hours to allow and observe mating. The parasitoids were fed with 1:1 solution of water and pure honey placed on paper strips perforated at the lower half and taped inside the vials. Extreme care was observed not to over wet the paper strips to prevent the parasitoids from getting stuck while feeding. Afterwards mated females of each parasitoid species were confined individually in Petri dishes lined with moist tissue paper and provided abaca leaves containing a specific number of aphids. One set contained 1 female parasitoid and 10 aphids per dish while another set had 1 female parasitoid and 20 aphids per dish. Each set consisted of ten dishes replicated three times. Data on parasitoid developmental period were based on thirty samples using ten and twenty aphid host densities. The following observations were recorded: mating behavior and duration; longevity of the mated female parasitoid; initial movement and response to the presence of the aphid host; oviposition; the process and duration of mummification of the aphid host; and total number of days from oviposition to emergence of parasitoids from mummified aphids. The capacity of the parasitoid was determined based on the number of banana aphids introduced in each Petri dish that got parasitized. Those that became mummified were separated and counted to get the number of parasitized individuals.

Suitability test in the greenhouse

The procedure was similar to that in the laboratory test except that potted abaca seedlings enclosed in Mylar cages (Fig. 5) were used and 20 aphids were introduced per seedling. Three trials for each parasitoid species were conducted and the observations recorded were the same as in the laboratory test.

RESULTS AND DISCUSSION

Mating behavior and duration.

The male and female parasitoids apparently became aware of each other as soon as they were confined together in a vial. The male showed excitement by fanning its wings for a few minutes, then slowly advancing towards the motionless female. As the male approached the female it waved the antennae over, drew them away, then waved them sideways. Soon after, the male held the female's thorax with its legs and started to mate. On the average, the *T* (*B.*) *communis* pair mated for 2 minutes and 30 seconds while the *Aphidius absinthii* pair mated for 1 minute and 7 seconds. After mating the male parasitoids remained motionless for a few minutes, then resumed their normal activity.

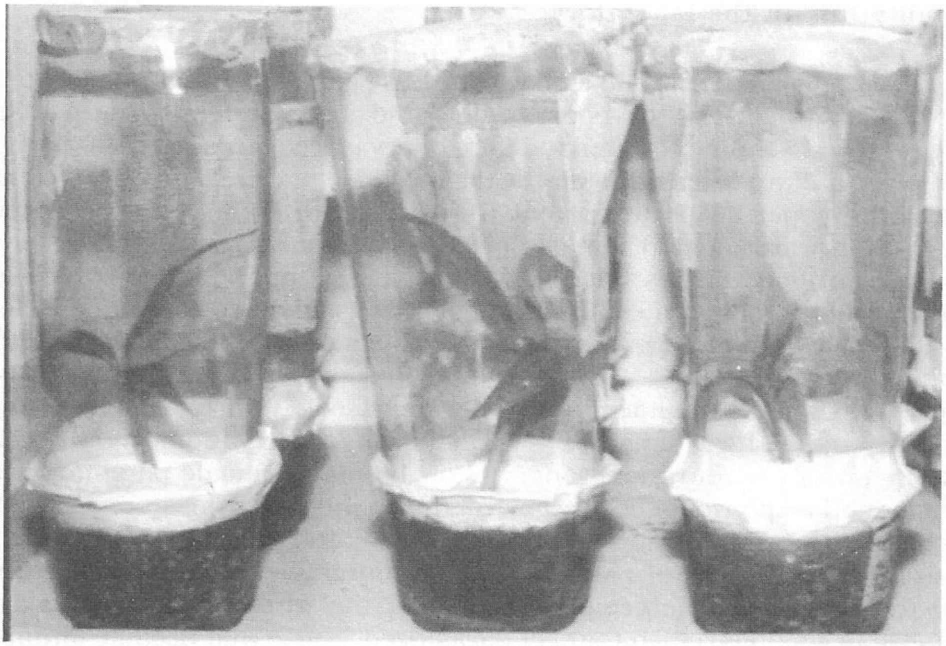

Figure 5. Parasitization set-up in the greenhouse showing Mylar cages enclosing aphid-infested abaca seedlings and released parasitoids.

Searching behavior and oviposition

Like predators, the parasitoids seem to search the vegetation for their host insect at random in a preferred part of the habitat. *T.* (*B.*) *communis*, for instance, reached the aphids at the growing point of the abaca seedling walking around towards no particular direction.

Banana or abaca aphids normally stay concealed under the leaf bases, thus only exposed individuals were attacked by the parasitoids. When females of both parasitoid species encountered their prey, they tapped their antennae over them and then thrust their ovipositors quickly into the aphids' body. When the attempt failed, the parasitoid withdraw its ovipositor, moved around the aphid and tried a different location on the body of the prey. Because the potted abaca seedlings were enclosed in Mylar cages, the aphids tended to crawl away from the plant to the upper part of the cage, so the parasitoids flew upwards and attacked any of the aphids near them.

Behavior of the parasitized aphid

The aphids behaved normally for a few days after the attack of the parasitoid. A week after, however, they appeared agitated and moved away from the unparasitized individuals, settling away from them on any part of the plant cage. This behavior was also observed in the laboratory, the parasitized aphids settling on any part of the excised leaf. The aphids then changed in color from dark brown to translucent light brown. On the second week they became bloated or plump and immobile or fell on the soil after leaving the colony, an indication that the parasitoids succeeded parasitizing them.

Capacity of the parasitoids

Parasitization capacities of the two parasitoids are shown in Table 1. The abaca or banana aphid was parasitized by *T. (B.) communis* and *Aphidius absinthii* under laboratory and greenhouse conditions. In the laboratory, a single *T. (B.) communis* parasitized 1 to 5 banana aphids when provided with 10 aphids in a Petri dish. Higher parasitization capacity ranging from 1 to 13 was noted with 20 banana aphids in a Petri dish. Similarly, *A. absinthii* parasitezed banana aphids at the range of 1 to 5. Under greenhouse condition, both parasitoids parasitized the banana aphids but at a lower rate (1-4). This lesser parasitization capacity may be attributed to the fact that like predators,

Table 1. Parasitization capacity[1] of *Aphidius absinthii* and *Trioxys (Binodoxys) communis* on *Pentalonia nigronervosa*.

Aphid Host Density	Parasitoid	Number of Aphids Parasitized By one parasitoid	
		Range	Mean
		Laboratory	
10	*A. absinthii*	1 – 4	1.71 ± .05
	T.(B.) communis	1 – 5	2.23 ± 0.08
20	*A. absinthii*	1 – 5	2.19 ± 0.07
	T.(B.) communiis	1 – 13	3.42 ± 0.12
		Greenhouse	
30	*A. absinthii*	1 – 4	1.57
	T.(B.) communis	1 – 4	1.63

[1] Based on 30 individuals for each parasitoid.

the parasitoids become aware of the presence of their insect host only when they are close to them (Dixon 1978). The two parasitoids tested in this study have aphid hosts (*A. gossypii* and *M.* sanborni) that are exposed on their host plants and therefore they can easily get close to them. In the case of *P. nigronervosa*, individuals or colonies are usually found concealed in certain portions of the host plant. A parasitoid has to have a good searching or foraging ability to get close to this type of aphid species that usually stays under the leaf bases and even near the roots of its plant host. Apparently, the two parasitoids tested were not able to exploit the concealed aphid colonies as they are used to more exposed colonies on any part of a host plant. Also, host recognition and acceptance is ruled by visual cues, with color being an important short range cue. For instance, color was observed to stimulate the female of *A. ervi* to attack green but not brown aphids (Powell et al. 1998).

Foraging or searching ability is an important factor in the selection of a potential biological control agent. If the parasitoids have limited foraging or searching ability they have to be used in combination with other biological control agents having better potential to control a pest.

Development of the parasitoids *A. absinthii* and *T. (B.) communis* on *P. nigronervosa*

Table 2 shows the development of the two parasitoids under laboratory and greenhouse conditions. Eggs were not seen but must have been laid upon insertion of the ovipositor to the body of the aphid host. Also, the aphids were not dissected to see the stages of development of the parasitoid. The total developmental period of the parasitoids started from the time the eggs were presumed laid up to emergence of adult parasitoids. This also corresponds to the parasitization period of the parasitoids.

It can be noted that the development of the parasitoids differed under the two experimental conditions which can be attributed to space and food supply. The parasitoids had more space and aphids to feed on in the greenhouse. However, the parasitoids tested in the laboratory lived longer than those reared on potted abaca seedlings in the greenhouse.

The tests showed that *P. nigronervosa* is an acceptable and suitable host for the two parasitoids evaluated.

Table 2. Developmental period and longevity of *Aphidius absinthii* and *Trioxys (Binodoxys) communis*.

Aphid Host Parasitoid	Total Developmental Period ((Days)		Longevity (Days)	
	Range	Mean	Range	Mean
10 APHIDS				
A. absinthii	14-21	17.62	2 - 6	3.69
T. (B.) communis	11-20	14.18	2 - 5	2.71
20 APHIDS				
A. absinthii	14-23	18.37	3 - 7	4.69
T. (B.) communis	12-24	17.47	2 - 5	4.69
20 APHIDS				
A. absinthii	10 - 15	12.20	2 - 4	2.26
T. (B.) communis	10 - 13	10.87	1 - 2	1.46

[1] Based on 30 samples with 10 or 20 banana abaca aphids confined with each parasitoid.

SUMMARY AND CONCLUSION

1. *A. absinthii* and *T. (B.) communis* parasitoids that emerged from mummified *A. gossypii* and *M. sanborni* collected from different plant species were tested for suitability as biological control agents for *P. nigronervosa.*

2. A pair of newly emerged male and female parasitoid for mating were confined in vial with paper strips wetted with honey-water solution as food for the insects. On the average, *T. (B.)* communis mated for 2 minutes and 30 seconds and *A. absinthii* for 1 minute and 7 seconds.

3. In the laboratory test, each mated female parasitoid was confined in a Petri dish lined with moist tissue paper and provided 10 or 20 *P. nigronervosa* on a piece of abaca leaf for parasitization. In the greenhouse test abaca seedlings were used, each one infested with 20 aphids enclosed in a Mylar cage, then a mated female parasitoid was released inside.

4. Both species parasitized exposed aphids which the female parasitoid came close to, but not those concealed under the leaf bases. This explains the greater number of aphids parasitized in the laboratory at higher aphid density per Petri dish or in the laboratory compared to the greenhouse test where

the abaca seedlings were used. Normally the aphids stay in the concealed space under the leaf bases or pseudostem of abaca. When confined with 20 aphids, the average number parasitized by *A. absinthii* was 2.19 aphids in the laboratory and 1.57 aphids in the greenhouse, while those of *T.* (*B.*) communis were 3.42 aphids in the laboratory but only 1.63 aphids in the greenhouse.

5. The parasitized aphids settled away from the unparasitized individuals, turned dark brown to transluscent light brown, became bloated or plump and immobile.

6. As a whole, results of the tests showed that *P. nigronervosa* is accepted by the two parasitoids as host insect, thus can kill the aphid. But because of the limited searching ability of the parasitoids, it appears necessary to use them together with other biological control agents to obtain the desired level of control of the banana aphid.

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