Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
Impact Factor (RJIF): 5.83
www.entomoljournal.com
JEZS 2026; 14(2): 242-245

Received: 07-02-2026
Accepted: 10-03-2026

Mirella Lo Pinto
Department of Agricultural, Food and Forest Sciences, University of Palermo, Palermo, Italy

Alfonso Agrò
Ex Researcher, Department of Agricultural, Food and Forest Sciences, University of Palermo, Palermo, Italy

Corresponding Author:
Mirella Lo Pinto
Department of Agricultural, Food and Forest Sciences, University of Palermo, Palermo, Italy

A preliminary study on the toxicity of natural pyrethrins against *Aphidius colemani* Viereck (Hymenoptera: Braconidae), a polyphagous parasitoid of aphids

Mirella Lo Pinto and Alfonso Agrò

DOI: https://www.doi.org/10.22271/j.ento.2026.v14.i2c.9741

Abstract
This study represents a preliminary investigation on the toxicity of pure pyrethrins directly used against *Aphidius colemani* Viereck (Hymenoptera: Braconidae), parasitoid of various harmful aphids such as *Aphis gossypii* Glover, *Myzus persicae* (Sulzer) (Homoptera: Aphidiidae) and others. As little is known about the collateral effects of botanical insecticides on *A. colemani*, this study set out to investigate the insecticidal activity of pyrethrins, which were used for the first time against the adults of this parasitoid. Two commercial products were tested in the experiments: product A (pyrethrins 18.5g/l) and product B (pyrethrins 0.047g/l + rapeseed oil 8.25g/l) (5.5µl/ml dose), which are commonly used against pests of cultivated and ornamental plants. We evaluated the mortality of adult parasitoids at 24h, 48h, 72h and 96h after exposure to the treatment, under laboratory conditions. The results highlighted that both products showed adulticidal activity as early as 24 hours after exposure to the treatment, differing significantly from the control.

Keywords: Adult mortality, botanical insecticide, parasitoid

Introduction
Botanical insecticides are key components of integrated pest management (IPM) practices, thanks to their beneficial combination of insecticidal activity and reduced environmental and health risks [1]. However, beneficial organisms, such as natural antagonists-including both predators and parasitoids-pollinators and soil invertebrates, are also affected by these substances [2]. Compounds authorised for organic production that have lethal and sublethal effects on beneficial insects have been documented in the literature [3, 4] and many of these concern parasitoid species [5-7] in relation to their longevity, survival, fecundity, fertility, hatching rate and sex ratio [8]. In particular, extracts from numerous plants [9-13] have been studied for their lethal effects on parasitoids, but few studies are carried out on the activity of pyrethrins on these beneficial species [14, 15]. Natural pyrethrins are mainly extracted from plants of the Asteraceae family, such as *Chrysanthemum* (*Tanacetum*) *cinerariaefolium*. They remain among the most important botanical biopesticides globally and are frequently used as safe, low-persistence insecticides in agricultural practices for the control of various pests domestic, horticultural and agricultural pests [16], however, also exhibit broad-spectrum activity against beneficial arthropods, such as parasitoids [17]. The aim of this work was to provide preliminary insights into the effects of pyrethrins on *Aphidius colemani* Viereck (Hymenoptera: Braconidae), parasitoid of harmful aphids, such as *Aphis gossypii* Glover, *Myzus persicae* (Sulzer) (Homoptera: Aphidiidae) and other, both in open fields and in commercial greenhouse crop production [18]. In particular, we want evaluated the insecticidal activity of pyrethrins, used for the first time against adults of *A. colemani*, by assessing the mortality of the parasitoid up to 4 days after exposure to the treatment under laboratory conditions.

Materials and Methods
Products
In the experiments we used two botanical insecticides based on pure pyrethrins extracted from

pyrethrum (500g/Kg) both commonly used against various pests: product A (Biopiren Biogard) containing 18.5g/l pyrethrins, diluted in 150ml water per 100l, and product B (Solabiol SBM) containing 0.047g/l pyrethrins + 8.25g/l rapeseed oil. To assess insecticidal activity, the products were administered by inhalation at a dose of 5.5µl/ml against parasitoid adults.

Insects

Aphidius colemani were supplied by BIOPLANET SRL (Cesena, Italy) in AphidiPAK500 packs containing 500 aphid mummies of mixed ages (adult aphids parasitised by parasitoid larvae). The pack was placed in a dedicated emergence chamber (a Plexiglas cage, dimensions 50x30x30cm) to collect the adult wasps as they emerged, and kept in laboratory (25±5 °C, 50-70% RH, photoperiod 16:8 hours light:dark). The newly emerged adults were transferred to each test container using a vacuum aspirator.

Bioassays

The experiments were conducted in the laboratory (previously mentioned conditions) using glass jars (600ml) fitted with a disc of absorbent paper (Whatman No. 1) sprayed with 1ml of a solution of the product in distilled water containing 2% Tween® 20 (Sigma-Aldrich) using a micropipette and attached to the screw cap of the glass jars, then left to dry (approximately 1 hour) before introduction to the adults. A dose of 5.5µl/ml was used for both products. The control was treated with the same volume of distilled water and Tween® 20 alone. Twenty-four adults (males and females) were introduced into each glass jar and maintained under the laboratory conditions mentioned above. The wasps were fed with honey and water (1:3 v/v solution) of on a cotton wool pad placed in the top of the jars. Six replicates were performed for each treatment and control. The effects of the treatment were assessed at 24, 48, 72 and 96 hours by counting the number of dead adults in each glass jar.

Statistical analysis

The percentage mortality of adults was calculated for each treatment. Two-way analysis of variance (ANOVA) was performed on the data. Duncan's Multiple Range Test was applied to detect significant differences in mortality between treatments at the 0.05 percent level. All statistical analysis were performed using the Statistica 7.0 software package for Windows [19]. Abbott's formula [20] was used to correct the bioassay data for the control response.

Results

Experiments on the insecticidal effects of pyrethrins against *A. colemani* highlighted their adulticidal activity by inhalation as early as 24 hours after exposure to treatments with both products, product A (pyrethrins 18.5g/l) and product B (pyrethrins 0.047g/l + rapeseed oil 8.25g/l). The mortality rate increased over the subsequent observation period, ranged from 36.96% at 24h to 100% at 96h for product A and from 10.53% to 64.91% for product B over the same observation period. In the control group, mortality was not detected until 48 hours after the start of the test, rising to 8.33% and 25% at 72h and 96h respectively (Fig. 1). Statistical analysis (two-way ANOVA) revealed significant differences between the treatments and the control ($F=469.7$, $df=2$, $p<0.0001$). Significant differences were also found between the observation time intervals for each treatment (product A and product B) and the control ($F=125.5$, $df=3$, $p<0.0001$). Post hoc analysis (Duncan's Multiple Range Test) showed that no difference was detected between 72h and 96h for product A and between 48h and 72h for product B, whilst in the control group the differences were consistently non-significant, except between 72h and 96h.

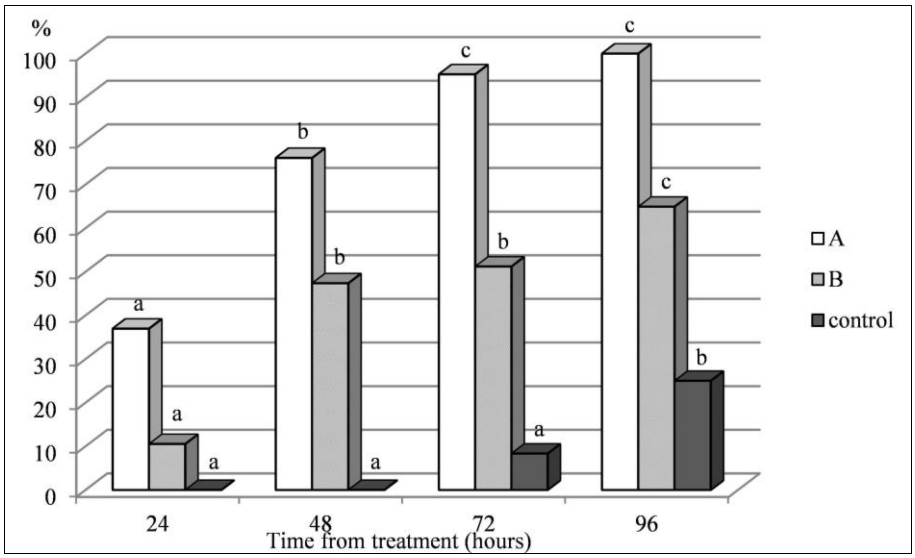

Fig 1: Mortality (%) of adult *Aphidius colemani* due to inhalation toxicity following administration of two products (5.5µl/ml dose), A (pyrethrins 18.6 g/l) and B (pyrethrins 0.047 g/l + rapeseed oil 8.25 g/l), compared to that of the control group (distilled water + 2% Tween). Same letters above the bars indicate not significant differences ($P<0.05$) among the observation time intervals

Discussion

Overall, numerous studies have investigated the side effects of various plant extracts and botanical insecticides on parasitoid insects. However, the research on the effects of biopesticides on *A. colemani*, in particular in relation to pyrethrins, are limited. This work represents a preliminary study on the toxicity of pure pyrethrins (extracted from pyrethrum, 500g/Kg) directly used by inhalation against *A. colemani* and tested for the first time on adults of this parasitoid. The experiments showed that both commercial formulates, pyrethrins alone (product A) and pyrethrins + rapeseed oil (product B), caused a certain mortality rate

depending on the duration of exposure to treatments. Mortality increased with exposure time from 24 to 96 hours after treatment, differing significantly from the control group. The formulation containing only pyrethrins (product A) compared with the formulation containing pyrethrins and oil (product B), showed a greater effect on mortality, probably due to the higher concentration of pyrethrin in product A. In contrast, the only study on the toxicity of pyrethrins (at concentration of 0.64g/l) on *A. colemani*, which assessed the emergence rate of the parasitoid from aphid mummies (*M. persicae*), reported no lethal effects, likely due to some degree of protection provided by the mummy to the parasitoid [13]. However, in agreement with our results, effects of pyrethrins on adult mortality have been observed in other species of parasitoids as *Encarsia* sp, *Aleurodiphilus* sp, (Hymenoptera: Aphelinidae) [14], *Trissolcus japonicus* (Ashmead) [15], *Telenomus podisi* (Ashmead) (Hymenoptera: Scelionidae) [21], *Anastatus reduvii* (Howard) (Hymenoptera: Eupelmidae), *Chelonus oculator* Panzer [22], *Aphidius rhopalosiphi* De Stefani Perez (Hymenoptera: Braconidae) [23] and *Tamarixia radiata* (Waterston) (Hymenoptera: Eulophidae) [24]. The susceptibility of adult *A. colemani* to the plant extracts is reported also in the literature for other botanical insecticides. For example, the use of an insecticidal soap caused 100% adult mortality 24h after treatment (concentration 17.5g/l) [25]. A study on residual toxicity tests, revealed that the highest concentrations of EO of aromatic plants (Myrtaceae), were slightly toxic, causing less than 20% mortality observed after 48h of exposure [10]. Other authors [26] reported the toxicity of aqueous extracts from *Melia azedarach* seeds and *Nerium oleander* leaves on *A. colemani* females, showing a maximum mortality rate of 43% and 50%, respectively, 96 hours later. Considering other biological parameters of *A. colemani*, a reduction in the parasitism rate and in the biological efficiency was observed when the hosts (*A. gossypii* and *Aphis fabae)* were treated with Spinosad and *Beta vulgaris* EO [27].

Conclusion

In conclusion, this work has improved our understanding of the side effects of botanical insecticides -which are commonly used to control agricultural pests-on non-target organisms. The pyrethrins, used for the first time against adult *A. colemani* showed mortality as early as 24 hours after treatment, subsequently increasing up to 96 hours. However, further investigations are necessary to assess the lethal and sublethal effects of pyrethrins on other biological parameters of this parasitoid (development, emergence rate, oviposition, etc.), in order to develop biological control programmes compatibility with other management practices.

Declaration of Interest

Authors declare no conflicts of interests.

References

1. Isman MB. Botanical insecticides, deterrents, and repellents in modern agriculture. Annu Rev Entomol. 2006;51:45-66.
2. Giunti G, Benelli G, Palmeri V, Laudani F, Ricupero M, Ricciardi R, *et al*. Non-target effects of essential oil-based biopesticides for crop protection: impact on natural enemies, pollinators, and soil invertebrates. Biol Control. 2022;176:105071.
3. Biondi A, Desneux N, Siscaro G, Zappalà L. Using organic-certified rather than synthetic pesticides may not be safer for biological control agents: selectivity and side effects of 14 pesticides on the predator *Orius laevigatus*. Chemosphere. 2012;87(8):803-812.
4. Desneux N, Decourtye A, Delpuech JM. The sublethal effects of pesticides on beneficial arthropods. Annu Rev Entomol. 2007;52:81-106.
5. Serrão JE, Plata-Rueda A, Martínez LC, Zanuncio JC. Side-effects of pesticides on non-target insects in agriculture: a mini-review. Sci Nat. 2022;109(2):17.
6. Lisi F, Siscaro G, Biondi A, Zappalà L, Ricupero M. Non-target effects of bioinsecticides on natural enemies of arthropod pests. Curr Opin Environ Sci Health. 2025;45:100624.
7. Soares AP, Zocolo GJ, Bueno ADF. The overlooked impact of botanical pesticides on non-target organisms. Plants. 2026;15(6):917.
8. Ogburn EC, Walgenbach JF. Effects of insecticides used in organic agriculture on *Anastatus reduvii* (Hymenoptera: Eupelmidae) and *Telenomus podisi* (Hymenoptera: Scelionidae), egg parasitoids of pestivorous stink bugs. J Econ Entomol. 2019;112(1):108-114.
9. Ahmadpour R, Rafiee-Dastjerdi H, Naseri B, Hassanpour M, Ebadollahi A, Mahdavi V. Lethal and sublethal toxicity of some plant-derived essential oils in ectoparasitoid wasp, *Habrobracon hebetor* Say (Hymenoptera: Braconidae). Int J Trop Insect Sci. 2021;41(1):601-610.
10. Hassan E, Mostafiz MM, Iramu ET, George D, Lee KY. Evaluation of the effect of fungatol and gamma-T-ol on the emergence and adult parasitoid survival of mummies of cotton aphids parasitized by *Aphidius colemani*. Insects. 2022;13(1):38.
11. Bibiano CS, Alves DS, Freire BC, Bertolucci SKV, Carvalho GA. Toxicity of essential oils and pure compounds of Lamiaceae species against *Spodoptera frugiperda* (Lepidoptera: Noctuidae) and their safety for the nontarget organism *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae). Crop Prot. 2022;158:106011.
12. Asadi P, Farasat M, Tadayoni M, Hasanzadeh N, Roshan SA. Insecticidal activity of *Rhamnus persica* Boissier (Rhamnaceae) essential oil on the parasitoid, *Habrobracon hebetor* Say (Hymenoptera: Braconidae), under the laboratory conditions. Int J Trop Insect Sci. 2023;43(2):769-778.
13. Lami F, Burgio G, Magagnoli S, Depalo L, Lanzoni A, Frassineti E, *et al*. The effects of natural insecticides on the green peach aphid *Myzus persicae* (Sulzer) and its natural enemies *Propylea quatuordecimpunctata* (L.) and *Aphidius colemani* Viereck. Insects. 2024;15(7):556.
14. Price JF, Schuster DJ. Effects of natural and synthetic insecticides on sweetpotato whitefly *Bemisia tabaci* (Homoptera: Aleyrodidae) and its hymenopterous parasitoids. Fla Entomol. 1991;74(1):60-68.
15. Ribeiro AV, Holle SG, Hutchison WD, Koch RL. Lethal and sublethal effects of conventional and organic insecticides on the parasitoid *Trissolcus japonicus*, a biological control agent for *Halyomorpha halys*. Front Insect Sci. 2021;1:685755.
16. Jeran N, Grdiša M, Varga F, Šatović Z, Liber Z, Dabić D, *et al*. Pyrethrin from Dalmatian pyrethrum (*Tanacetum cinerariifolium* (Trevir.) Sch. Bip.): biosynthesis,

biological activity, methods of extraction and determination. Phytochem Rev. 2021;20:875-905.
17. Roberts JM, Rusin W, Garcia EV, Tonks AJ, Clunie BJ, Pope TW. Assessment of interactions between pyrethrum extract and oleic acid against *Aphis fabae* scopoli (hemiptera: aphididae) through a modified checkerboard assay approach. 2026. https://ssrn.com/abstract=6086739
18. Benelli G, Messing RH, Wright MG, Giunti G, Kavallieratos NG, Canale A, *et al*. Triggering mating and host-seeking behavior in the aphid parasitoid *Aphidius colemani* (Hymenoptera: Braconidae: Aphidiinae): implications for biological control. J Econ Entomol. 2014;107(6):2005-2022.
19. Statsoft Inc. Statistica (Data Analysis Software System), Version 6. Vigonza (PD): StatSoft Italia Srl; 2001.
20. Abbott WS. A method of computing the effectiveness of an insecticide. J Econ Entomol. 1925;18(2):265-267.
21. Cem Z, Hilal T, Neşet K. Toxicity and repellent effects of some botanical insecticides on the egg-larval parasitoid *Chelonus oculator* Panzer (Hymenoptera: Braconidae). Sci Res Essays. 2014;9(5):106-113.
22. Jansen JP, Defrance T, Warnier AM. Effects of organic-farming-compatible insecticides on four aphid natural enemy species. Pest Manag Sci. 2010;66(6):650-656.
23. Rugno GR, Qureshi JA. Topical and field-tested residual effects of globally used insecticides on the parasitoid *Tamarixia radiata* released against the Asian citrus psyllid, *Diaphorina citri*. Entomol Exp Appl. 2024;172(1):66-74.
24. Tremblay E, Bélanger A, Brosseau M, Boivin G. Toxicity and sublethal effects of an insecticidal soap on *Aphidius colemani* (Hymenoptera: Braconidae). Pest Manag Sci. 2008;64(3):249-254.
25. Kaoutar F, Najiba B, Rabea Z, El Hassane B, Najib G. Evaluation of the impact of five bio-insecticides of plant origin and a chemical insecticide on the survival of imagos of the parasitoid *Aphidius colemani* under laboratory conditions. J Exp Agric Int. 2019;41(6):1-10.
26. El-Hadary WA, Ali MA. Effect of the utilization of the bioinsecticide spinosad on certain piercing sucking insect pests attacking okra plants and effect on *Aphidius colemani* Viereck, in Sohag Governorate. Egypt Acad J Biol Sci A. 2025;18(1):19-28.
27. Rohart A, Ameline A, Tougeron K, Maupas F, Coutte F, Couty A. Study of multitrophic interactions and bioinsecticide efficacy under the influence of global change in beet crops. 8th International Entomophagous Insect Conference. 2025 Jul 1-5.