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Insecticidal activity of some botanical products against green peach aphid (*Myzus persicae* Sulzer) and thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Perg.) in greenhouse pepper production

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Abstract

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Global trends for ecological agriculture require looking for an alternative to conventional production. In recent years, crop protection has relied to a great extent on synthetic chemical pesticides, but their availability is now declining as a result of new legislation requirements and the development of resistance in pest populations. Synthetic chemical insecticides pose risks to the environment and to consumers of produce. Biopesticides are products for control of pests based on microorganisms or natural products. Botanical insecticides, which are of plant origin belong to biopesticides. They have a proven potential to control pests and are used all over the world. Studies were carried out in the greenhouses of the Maritsa Vegetable Crops Research Institute-Plovdiv to determine the biological activity of some botanical plant protection products, as well as a combination of them, to control the green peach aphid (*Myzus persicae* Sulzer) and thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande) on pepper variety Piruet F_1 in greenhouses. The bioproducts Krisant EC (a. i. pyrethrin) and Neem Azal T/S (a. i. azadirachtin) were tested. The products Krisant EC 75 ml/da and the combination Krisant EC 75 ml/da+Neem Azal T/S 0.3% show very good effectiveness over 80% against sucking pests aphids and thrips.

Keywords: pepper; pests; greenhouse; phytopesticides; effectiveness

Introduction

The reduced use of pesticides is a priority task in the cultivation of pepper in greenhouses, which aims to reduce the risks of their negative impact on human health and the environment. Modern trends for organic farming require the need to look for alternative methods of pest control. In recent years, efforts have been directed towards the use of natural plant protection products such as phytopesticides. Botanical insecticides are a small part of the total volume of pesticides. Nevertheless, they remain important in pest control in vegetable crops (Khursheed et al., 2022; Ayilara et al., 2023). Phytopesticides sometimes provide effective control of pests that have become resistant to other insecticides. Many plants have insecticidal properties due to the natural alkaloids, esters, glycosides, etc. found in them (Regnault-Roger & Philogène, 2008). Botanical insecticides have a number of advantages that make them preferred in modern agriculture. They are not a threat to the environment and human health. Such are pyrethrins based on chrysanthemum extract (*Chrysanthemum cinerariaefolium* Vis.) (Asteraceae). The insecticidal action of pyrethrins is characterized by rapid action, hyperactivity and convulsions in most insects. These symptoms result from

the neurotoxic action of pyrethrins, which block sodium channels (Isman, 2006; Jababu et al., 2016).

For many years, pyrethrum has been safely and effectively used as a pesticide around the world. The flowers of this plant, which contain a mixture of pleasant-smelling esters called pyrethrins, have extremely unusual insecticidal properties. Unique in their ability to repel most insect pests while not posing a threat to the environment, pyrethrins have been the subject of great interest to many scientists (Casida & Quistad, 1995).

Standardized plant protection products based on plant extracts are commercially available. Preparations with the active substance azadirachtin, extracted from the seeds and vegetative mass of the neem tree (*Azadirachta indica* A. Juss) (Meliaceae), belong to this group. They are limonoids in chemical composition and have a specific antifeedant and deterrent effect – suppression and cessation of feeding, reduction of molting, deformations in pupae and imaginal adults, reduction of female fertility (Kleeberg, 2001; Isman, 2006; Hiiesaar et al., 2009).

Botanicals are encouraging. They only affect the target pests, they are effective in very small quantities, they break down quickly and provide a safe living environment and they do not leave food residues. When incorporated into integrated pest management programs, botanical pesticides can significantly reduce the use of conventional pesticides or be used in rotation or in combination with other insecticides, provide an opportunity to reduce the total amount of chemical insecticides applied, and possibly delay the development of resistance in pest populations (Khater, 2012).

The aim of the study was to determine the biological activity of the botanical products Krisant EC 75 ml/da and Neem Azal T/S 0.3% against peach aphid (*Myzus persicae* Sulzer) and thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande) during cultivation of pepper in greenhouses.

Material and Methods

The studies were conducted during the period of 2022–2023 in greenhouses of the Maritsa Vegetable Crops Research Institute – Plovdiv.

Test plants

Pepper variety Piruet F_1 – early variety for greenhouse production. The fruits have a regular conical shape. Their characteristic initial color is light green. After ripening, they turn orange. Total area of the plots – 300 m^2. Scheme of the experiment – 50 + 105 + 105 + 50/30 cm.

Test pests

- Green peach aphid (*Myzus persicae* Sulzer)

Plants in the greenhouse with a natural infestation of aphids are sprayed with the appropriate concentration of insecticide. The number of live and dead individuals before spraying and at intervals after it 1, 3, 5, 7, 10 and 14 days was recorded. Effectiveness (%) was calculated using the Henderson-Tilton (1955) formula.

- Thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande)

In naturally infested pepper crops, pest mobile forms of pre-marked 4 plants or 4 flowers are listed for repetition. The number of live individuals before spraying and at intervals after it 1, 3, 5, 7, 10 and 14 days was recorded. Effectiveness was calculated using the Henderson-Tilton (1955) formula.

Test plant protection products

- Krisant EC 75 ml/da (a. i. pyrethrin);
- Neem Azal T/S 0.3% (a. i. azadirachtin);
- Deca EC 30–50 ml/da (a. i. deltamethrin) (standard).

The results are processed mathematically. A comparative analysis of the obtained results was made using the method of Duncan's multiple range test (1955).

Results and Discussion

Aphids are one of the most common pests of pepper growing in greenhouses. In addition to direct damage, they are vectors of virus diseases, which lead to an increased risk of losses. The control against these pests is difficult due to the great reproductive potential and the emergence of resistance in populations to commonly used chemical insecticides. Trials to determine the effectiveness of some botanicals against peach aphid in greenhouse pepper were conducted. The best biological activity was reported against *Myzus persicae* Sulzer for pepper of the combination Krisant EC 75 ml/da+Neem Azal T/S 0.3% – 85.20% 5th day after treatment, exceeding to the reported for the standard Deca EC 50 ml/da – 81.66% 3rd day after the treatment. The independent treatment with Krisant EC 75 ml/da, an effectiveness of 82.07% was reported on the 3rd day after the treatment. The effectiveness reported for the product Neem Azal 0.3% is satisfactory – 75.83% 5th day after treatment, relatively lower than that reported for the other variants (Table 1 and Figure 1). Singh & Joshi (2020) evaluated Azadirachtin 1% for the management of the green peach aphid, *M. persicae* on capsicum under protected conditions. They established that Azadirachtin 1% at 4 and 5 ml/l caused 71.2 and 74.7% population reduction for aphid after 3rd spray, and were effective in reducing aphid populations

on capsicum recommending its organic production under protected cultivation and could be a part of integrated pest management program. The results of conducted studies indicate that tested neem-based products are very effective and suppress aphid populations and colonization is reduced by 50-75%. Various neem products caused a significant reduction in green peach aphid numbers 7 days after treatment (Shannag et al., 2014). Previous research has shown

Table 1. Effectiveness of some botanical plant protection products against green peach aphid (*Myzus persicae*Sulzer) in pepper variety Piruet F_1 grown in greenhouses

Variant	E (%)	Effectiveness (%) / Days after treatment					
		1	3	5	7	10	14
Krisant EC 75 ml/da	MIN	62.95	79.79	79.12	41.94	35.48	39.39
	MAX	76.85	84.62	87.10	76.19	68.00	68.49
	Average	69.12 ab	82.07a	82.00 a	62.32 bc	58.96 c	54.27 c
	SD	5.75	1.98	3.64	14.49	15.67	12.09
Neem Azal T/S 0.3%	MIN	19.36	60.78	66.88	66.88	53.63	41.84
	MAX	77.03	77.03	80.17	80.39	75.76	69.70
	Average	50.55 c	68.89 ab	75.83 a	75.34 a	67.7 ab	57.99 bc
	SD	24.45	7.92	6.04	5.95	9.71	13.89
Krisant EC 75 ml/da + Neem Azal T/S 0.3%	MIN	55.88	80.42	80.84	65.02	59.64	57.47
	MAX	84.57	87.04	94.41	86.01	79.49	71.41
	Average	72.44 bc	84.16 a	85.20 a	75.60 ab	69.73 bc	64.24 c
	SD	12.39	3.18	6.34	9.79	8.11	7.10
Deca EC 50 ml/da (standard)	MIN	54.18	75.52	63.05	34.31	34.31	30.58
	MAX	75.07	88.67	84.14	77.34	69.23	68.16
	Average	65.11 bc	81.66 a	73.81 ab	62.69 bc	58.03 c	50.95 c
	SD	9.57	6.26	8.64	19.75	16.31	17.09

a, b, c … – Duncan's multiple range test ($p < 0.05$)

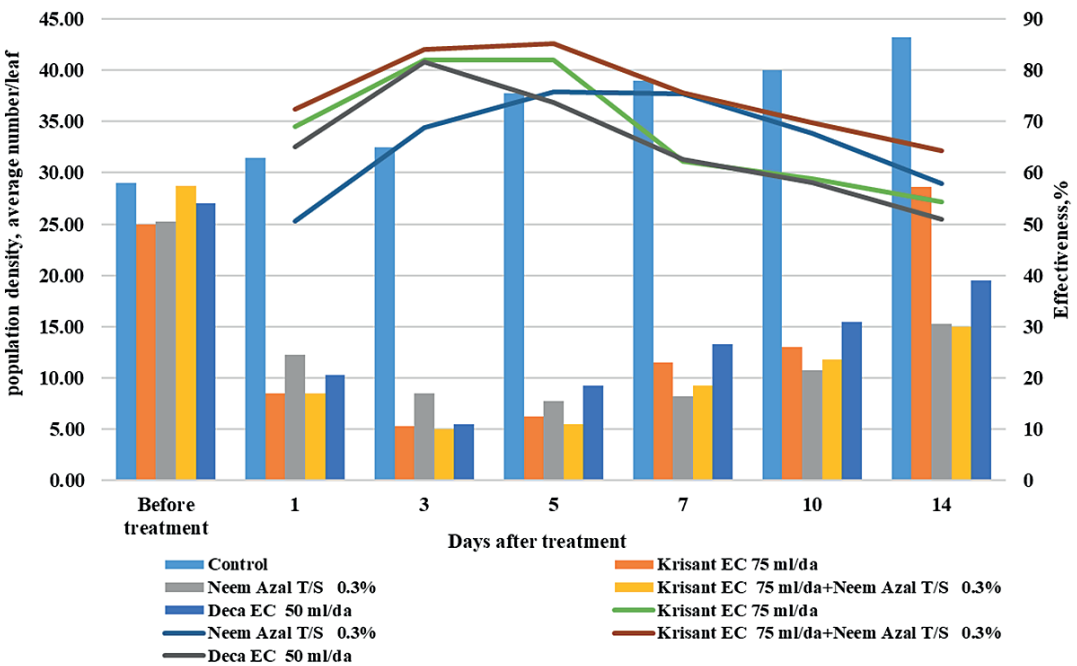

Fig. 1. Status of the green peach aphid (*Myzus persicae* Sulzer) population in Piruet F_1 pepper variety after treatment with botanical plant protection products

that neem-based products can control a number of other plant aphid species (Ahmed et al., 2007; Bartelsmeier et al., 2022). The extract neem reduced longevity of adults and nymphs, adult fecundity, and molting of nymphs. Application of the extract had little impact on the survival of adult parasitoids and developing parasitoids within aphids because parasite emergences were similar between treated and untreated parasitized aphids. These results indicate that neem extract may be compatible with integrated pest management programs (Tang et al., 2002). Studies have shown that pyrethrins can be useful in the management of aphids (Kraiss & Cullen, 2008). Pyrethrin insecticides degrade rapidly in sunlight. Pyrethrins are suitable alternatives that can be used to reduce the risk of exposure to synthetic pesticide residues (Antonious, 2004).

In recent years, there has been an increase in the population density of thrips in pepper cultivation in greenhouses. The indirect damage caused by these pests as vector of the virus disease *Tomato spotted wilt virus* (TSWV) is significantly large, leading to a drastic reduction in yield and deterioration in the quality of production. In the tests conducted against thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande) in the pepper variety Piruet F_1, the best effectiveness was again reported for the variant Krisant EC 75 ml/da + Neem Azal T/S 0.3% – 86.06% 3rd day after the treatment, exceeding that reported for the standard Deca EC 30 ml/da – 79.29%. The independent treatment with the products Krisant EC 75 ml/da and Neem Azal T/S 0.3% shows a lower value of the reported effectiveness, respectively 82.57% 3rd day after the treatment and 74.40% 5th day after the treatment (Table 2 and Figure 2). After two consecutive applications at a 7-day interval, neem oil was found to effectively reduce thrips populations compared to an untreated plot (Aliakbarpour et al., 2011). Pyrethrins are active ingredients extracted from pyrethrum flowers and are widely used botanical insecticides. They are a significant deterrent to western flower thrips (*Frankliniella occidentalis* Pergande) (Yang et al., 2012).

Our results confirm the established data of Dively et al. (2020) on the broad spectrum of action against various pests of products from the botanical insecticide group. Their studies included both the active substances pyrethrum and azadirachtin and the combination between them, showing good insecticidal activity.

Table 2. Effectiveness of some botanical plant protection products against thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande) in pepper variety Piruet F_1 grown in greenhouses

Variant	E (%)	Effectiveness (%) / Days after treatment					
		1	3	5	7	10	14
Krisant EC 75 ml/da	MIN	50.00	67.19	58.33	59.18	42.86	16.67
	MAX	100.00	100.00	100.00	100.00	65.28	60.23
	Average	72.17 ab	82.57 a	79.74 a	73.13 ab	58.38 bc	47.57 c
	SD	21.41	14.47	18.70	18.81	10.50	20.67
Neem Azal T/S 0.3%	MIN	33.33	61.90	61.90	61.90	61.11	16.67
	MAX	62.50	67.19	85.71	85.71	72.22	68.18
	Average	47.17 c	64.56 ab	74.40 a	74.40 a	66.31 ab	51.84 ab
	SD	12.29	2.75	10.32	10.32	5.63	23.70
Krisant EC 75 ml/da + Neem Azal T/S 0.3%	MIN	62.50	76.19	68.75	59.18	57.14	33.33
	MAX	80.95	100.00	100.00	91.36	82.72	78.79
	Average	71.58 bc	86.06 a	84.92 a	77.67 ab	73.26 bc	61.07 c
	SD	8.48	10.39	13.65	13.44	11.68	20.76
Deca EC 30 ml/da (standard)	MIN	66.67	60.00	61.90	42.86	4.76	16.67
	MAX	80.95	100.00	91.36	79.59	78.57	71.43
	Average	75.95 a	79.29 a	74.88 a	66.41 ab	48.30 c	44.65 c
	SD	6.52	16.47	13.29	16.92	32.25	22.77

a. b. c … – Duncan's multiple range test ($p < 0.05$)

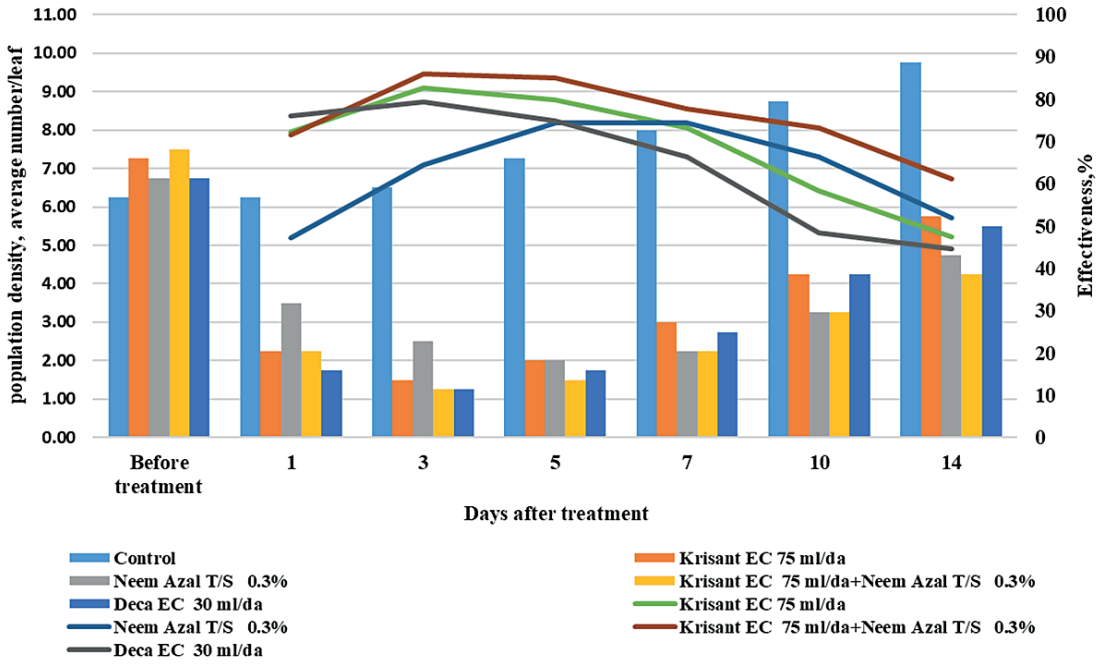

Fig. 2. Status of the thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande) population in Piruet F_1 pepper variety after treatment with botanical plant protection products

The use of synthetic chemical insecticides to control pests is very common because of their rapid effect in reducing pest populations. The use of pesticides shows various harmful effects on humans as well as on the environment (Donkor et al., 2016). Chemical insecticides have adverse effects on the structure, functioning and equilibrium of agroecosystems and human health. Overreliance and frequent application of synthetic chemical insecticides can cause resistance in pests, resurgence, outbreaks of secondary pests, phytotoxicity, residual toxicity in the food and harm to non-target or beneficial organisms (Wiktelius et al., 1999; Antonious, 2004).

The use of phytopesticides is an alternative to conventional chemical insecticides for pest control in greenhouse pepper production. The botanical products Krisant EC 75 ml/da and Neem Azal T/S 0.3%, as well as the combination between them, can be successfully used in integrated and biological systems for the production of pepper in greenhouses.

Conclusions

The best biological activity was reported against green peach aphid (*Myzus persicae* Sulzer) and thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande) in pepper grown in greenhouses of the combination of plant protection products Krisant EC 75 ml/da+Neem Azal T/S 0.3% E > 85%.

The botanical product Krisant EC 75 ml/da shows good effectiveness > 80% against green peach aphid (*Myzus persicae* Sulzer) and thrips (*Thrips tabaci* Lindeman, *Frankliniella occidentalis* Pergande), and for the bioproduct Neem Azal T/S 0.3% satisfactory effectiveness >70% against the same pests has been established.

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References

Ahmed, A. A. I., Gesraha, M. A. & Zebitz, C. P. W. (2007). Bioactivity of two neem products on Aphis fabae. *Journal of Applied Sciences Research*, *3*(5), 392-398.

Aliakbarpour, H., Che Salmah, M. R. & Dzolkhifli, O. (2011). Efficacy of neem oil against thrips (Thysanoptera) on mango panicles and its compatibility with mango pollinators. *Journal of Pests Science*, *84*, 503–512.

Antonious, G. F. (2004). Residues and half-lives of pyrethrins on

field-grown pepper and tomato. *Journal of Environmental Science and Health*, *39*(4), 491-503.

Ayilara, M. S., Adeleke, B. S., Akinola, S. A., Fayose, C. A., Adeyemi, U. T., Gbadegesin, L. A., Omole, R. K., Johnson, R. M., Uthman, Q. O. & Babalola, O. O. (2023). Biopesticides as a promising alternative to synthetic pesticides: A case for microbial pesticides, phytopesticides, and nanobiopesticides. *Frontiers in Microbiology, 14*, 1040901. doi: 10.3389/fmicb.2023.1040901

Bartelsmeier, I., Kilian, M. & Dicke, M. (2022). Effects of NeemAzal-T/S on different developmental stages of rose aphid, Macrosiphum rosae. *Entomologia Experimentalis et Applicata*, *170*(3)*,* 245–259.

Casida, J. E. & Quistad, G. B. (1995). Pyrethrum flowers: production, chemistry, toxicology and uses. *Oxford University Press*, Oxford, 356.

Dively, G. P., Patton, T., Barranco, L. & Kulhanek, K. (2020). Comparative efficacy of common active ingredients in organic insecticides against difficult to control insect pests. *Insects*, *11*(9), 614. doi: 10.3390/insects11090614.

Donkor, A., Fosu, P. O., Dubey, B., Kingsford-Adaboh, R., Ziwu, C. & Asante, I. (2016). Pesticide residues in fruits and vegetables in Ghana: a review. *Environmental Science and Pollution Research*, *23*, 8966–18987.

Duncan, D. (1955). Multiple range and multiple F-test. *Biometrics, 11*(1), 1-42.

Henderson, C. F. & Tilton, E. W. (1955). Tests with acaricides against the brow wheat mite. *J. Econ. Entomol., 48*(2), 157-161.

Hiiesaar, K., Švilponis, E., Metspalu, L., Jõgar, K., Mänd, M., Luik, A. & Karise, R. (2009). Influence of Neem-Azal T/S on feeding activity of Colorado potato beetles (*Leptinotarsa decemlineata* Say). *Agronomy Research, 7*(Special issue I), 251–256.

Isman, M. B. (2006). Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. *Annu. Rev. Entomol., 51*(1), 45–66.

Jababu, N., Kopta, T. & Pokluda, R. (2016). Insecticidal activity of neem, pyrethtrum and quassia extracts and their mixtures against diamondback moth larvae (*Plutella xylostella* L.). MendelNet, *Proceedings of International PhD Students Conference*, Brno, Czech Republic, Mendel University, 84-89.

Khater, H. F. (2012). Prospects of botanical biopesticides in insect pest management. *Pharmacologia*, *3*(12), 641-656.

Khursheed, A., Rather, M. A., Jain, V., Wani, A. R., Rasool, S., Nazir, R., Malik, N. A. & Majid, S. A. (2022). Plant based natural products as potential ecofriendly and safer biopesticides: A comprehensive overview of their advantages over conventional pesticides, limitations and regulatory aspects. *Microbial Pathogenesis, 173*, 105854. https://doi.org/10.1016/j.micpath.2022.105854

Kleeberg, H. (2001). NeemAzal: Properties of a commercial neemseed-extract practice oriented results on use and production of plant extracts and pheromones in integrated and biological pest control. *Procc. of the 6th Workshop*, Cairo-Egypt, 10-11.

Kraiss, H. & Cullen, E. M. (2008). Efficacy and non target effects of reduced-risk insecticides on *Aphis glycines* (Hemiptera : Aphididae) and its biological control agent *Harmonia axyridis* (Coleoptera: Coccinellidae). *Journal of Economic Entomology, 101*(2), 391-398.

Regnault-Roger, C. & Philogène, B. J. R. (2008). Past and current prospects for the use of botanicals and plant allelochemicals in integrated pest management. *Pharmaceutical Biology*, *46*(1-2), 41-52.

Shannag, H. S., Capinera, J. L. & Freihat, N. M. (2014). Efficacy of different neem-based biopesticides against green peach aphid, Myzus persicae (Hemiptera:Aphididae). *International Journal of Agricultural Policy and Research*, *2*(2), 061-068.

Singh, H. & Joshi, N. (2020). Management of the aphid, *Myzus persicae* (Sulzer) and the whitefly, *Bemisia tabaci* (Gennadius), using biorational on capsicum under protected cultivation in India. *Egyptian Journal of Biological Pest Control, 30*, 67. https://doi.org/10.1186/s41938-020-00266-5

Tang, Y. Q., Weathersbee, A. A. & Mayer, R. T. (2002). Effect of neem extract on the brown citrus aphid (Homoptera:Aphididae) and its parasitoid Lysiphlebus testaceipes (Hymenoptera: Aphididae). *Environmental Entomology*, *31*(1),172-176.

Wiktelius, S., Chiverton, P. A., Meguenni, H., Bennaceur, M., Ghezal, F., Umeh, E. N., Egwuatu, R. I., Minja, E., Makusi, R., Tukahirwa, E., Tinzaara, W. & Deedat, Y. (1999). Effects of insecticides on non-target organisms in African agroecosystems: a case for establishing regional testing programmes. *Agriculture, Ecosystems and Environment*, *75*(1–2), 121-131.

Yang, T., Stoopen, G., Wiegers, G., Mao, J., Wang, C., Dicke, M. & Jongsma, M. A. (2012). Pyrethrins protect pyrethrum leaves against attack by western flower thrips, *Frankliniella occidentalis. Journal Chemical Ecology*, *38*, 370-377.

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