Pest Management in Horticultural Ecosystems
Vol. 27, No.1 pp 1-3 (2021)
DOI Number: 10.5958/0974-4541.2021.00001.1

Paraffin wax enhances aphicidal action of vegetable oils

DONYO GANCHEV*

Agricultural University of Plovdiv, Mendeleev Avenue 12, town of Plovdiv, Bulgaria

***E-mail:** donyo@abv.bg

ABSTRACT: The paper presents a study about aphicidal activity of mixtures composted from emulsified vegetable oils and ceresin (kind of paraffin wax) widely used in numerous medicinal and especially cosmetic products. The results show that the addition of ceresin to the oils can greatly increase the effectiveness of the mixtures towards different aphid species. This approach can be cheap, easy to be perform and effective way to grow the place of such kind naturally friendly plant protection products among the pesticides.

Keywords: aphids, ceresin, insecticide, vegetable oil, paraffin wax

INTRODUCTION

During recent years, vegetable oils have gained popularity as a cheap, relatively effective, eco friendly and easy to be produced and applied plant protection products (Marie *et, al.,* 2009). Oils were among the first chemicals used to control various pests on plants (Liu and Stansly, 2000). In 2016, European Union even approved sunflower oil as a basic substance against tomato powdery mildew (European Commission, 2016; Marchand *et al.,* 2018). The use of vegetable oils as pesticides and biocides gained popularity in other areas except agriculture (Ogban, 2019) The vegetable oils as natural pesticides have several advantages like being economical, no residues, zero resistance risk, safer to non target organisms, very low pre harvest intervals (Van Huis, 1991; Nikpay, 2007; Nile *et al.,* 2019). However increased risk of phytotoxicity (Cranshawand Baxendale, 2005) and the insufficient effectiveness of vegetable oils is major drawback in their use as plant protection products. In this study, a research to increase the aphicidal activity of vegetable oils by addition of paraffin wax (ceresin) is made. Paraffin wax is a cheap, versatile and popular petrol derived product used mainly for candle production (Sanderson *et al.,* 1988). However, paraffin wax has numerous applications including in pen's ink, lubricants, cosmetic and pharmaceutical products, polish products, paints and others (Mózes, 1983). Ceresin is a specific kind of paraffin wax derived from ozokerite by a purifying process and this is the best possible petroleum alternative of beeswax which makes ceresin extremely applicable in the numerous cosmetic and pharmaceutical products. According to the Safety Data Sheet, of the substance, it is completely harmless for humans and work with it does not require taking specific safety measurements (Termo Fisher Scientific, 2021).

MATERIALS AND METHODS

Four different vegetable oils *viz.*, rapeseed oil, sunflower oil, soy oil and palm oil were used in this study. Oils were emulsified with Sinterol PZ emulsifier produced by Chimatech, Bulgaria especially created and used for vegetable oils and plant protection products (Chimatech, 2019). The standard *in vivo* trials with different widely spread in Bulgaria and Europe were performed (IRAC Susceptibility Test Methods Series, 2009). The insecticidal trials were conducted with four different aphid species viz., *Aphis gossypii* on cucumbers, *A. pomi* on apples, *Macrosiphum rosae* on oil-yielding roses and *A. nerii* on buddleia plants (butterfly bush). The collected pests were placed plastic pot lids ventilated with gauze covered ventilation holes with a diameter too small for the aphids to escape. Aphids were collected from untreated host plants leaves. Every test variant (test solution in different concentration) consisted from 4 replicates. Leaf disks were dipped in the test liquid for 10 seconds with gentle agitation and place to surface-dry on paper towelling (abaxial surface facing skywards) to air dry. Once the insecticide deposit was dry, individual leaf discs were placed into each pot. A small drop of distilled water was placed on the surface of the agar prior to laying the leaf on the surface may help to stick the leaf to the agar surface. The mortality rate was calculated by the formulae of Henderson and Tilton (Henderson and Tilton, 1955). The mathematical manipulation of data was done by R language for statistical computing (R Core Team, 2020). Additional in vivo trials for phytotoxic activity were conducted with various cultural and non cultural plants (European Commission, 2002) treated in different BBCH stages. Especially attention was paid to oil – yielding roses due to the fact, this plants are one of the Bulgarian national symbols.

RESULTS AND DISCUSSION

The first goal of this study was to establish the maximal concentration possible of ceresin in the vegetable oils. The oils and paraffin wax were heated to 80°C and after melting, the liquid ceresin was mixed with vegetable oils. After cooling of mixtures the observations about aggregate state and texture were made. The tests show that the biggest possible concentration of ceresin in the plant oils was 3 % (m/v). Over this concentration mixtures became too viscous and emulsifying was impossible. There were no differences between different plant oils in this aspect. Also the addition of 3 % (m/v) ceresin to the oils do not affect the concentration of emulsifier in them i.e. the addition of ceresin does not require additional amounts of emulsifier. The content of emulsifier in the enhanced and non-enhanced vegetable oils was 15 % (m/v). The density of the mixtures from vegetable oils, ceresin and emulsifiers is shown on the chart below (Fig.1)

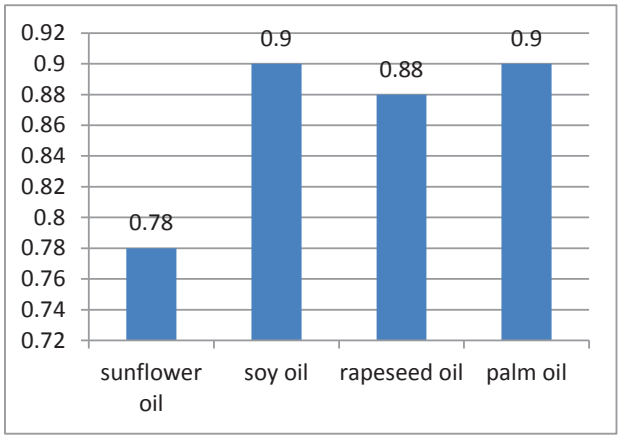

Fig. 1. Density of mixtures of vegetable oils and ceresin plus emulsifier (g / cm^3)

The Figure 1 shows that all mixtures have a density below 1 g / cm^3 and the differences between separate oils are minimal. Density of the 1 % (v/v) water solutions of created mixtures (used distilled water) was also measured at 25°C. The results show that all solutions have 1 gram / cm^3 density. The distilled water have 0.99 gram / cm^3. During *in vivo* trials, observations for acute phytotoxic manifestations (necrosis, chlorosis, deformations) onto treated plants were made regularity. The results show firstly, that there was no difference in the effectiveness between separate oils (without or with ceresin) toward aphid species and between separate aphid species towards different vegetable oil mixtures ($p > 0.05$)

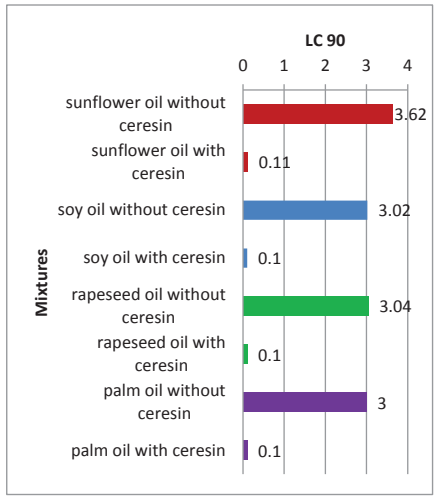

Fig. 2. Lethal concentration 90 % (LC90) of the tested vegetable oils mixtures towards aphid species

All tests reveal that all vegetable oils without ceresin can effectively kill aphid species at approximately 3.0 % (v/v) concentration (sunflower oil has the lowest effectiveness of all). The addition of ceresin to the mixture greatly increases the insecticidal action of oils and they can achieve the same effect at 0.1 % (v/v) concentration (Fig. 2).

Fig. 3. *Macrosiphum rosae* on rose plants control variant

Fig. 4. *Macrosiphum rosae* on rose plants treated with palm oil mixed with 3 % ceresin at 0.1 % (v/v)

There were no phytotoxic manifestations onto treated plants at 0.1 % and double increased concentrations towards vegetable oils enhanced with ceresin – Figure 5. However the plants sprayed with oils without ceresin at 3.0 – 3.62 % concentrations show slightly acute phytotoxic symptoms (1-8 %) as leaves deformations and necrosis, except oil-yielding roses

Fig 5. Cucumbers variety "Gergana", BBCH = 71 treated with palm oil mixed with 3 % ceresin at 1.0 % (v/v)

Based on the results obtained, it can be concluded that the addition of paraffin to the oils had increased their efficacy against aphids and hence could be a cheap, easy to perform and effective way of plant protection.

REFERENCES

Abbott, W. S. 1925. Abbott's formula. J. Econ. Entomol, 18, 267-268.

Cranshaw, W. S. and Baxendale, B. 2005. Insect control: horticultural oils (Doctoral dissertation, Colorado State University. Libraries).

Chimatech,. 2019. SinterolRZ.from: https://www.chimatech.bg/en/product_category/other-products/emulsifiers/sinterol-rz

European Commission, Health and Food Safety Directorate – General.2016. Basic Substance, Sunflower Oil. SANTE/10875/2016

European Commission, Health and Food Safety Directorate – General. 2002. Guidance Document on Terrestrial Ecotoxicology Under Council Directive 91/414/EEC. SANCO/10329/2002 rev 2 final

Henderson, C. F. and Tilton, E. W. 1955. Tests with acaricides against the brow wheat mite, *Journal of Economic Entomology*, **48**:157–161.

IRAC Susceptibility Test Methods Series.2009.Method No: 001

Liu, T. X. and Stansly, P. A. 2000. Insecticidal activity of surfactants and oils against silverleaf whitefly (*Bemisia argentifolii*) nymphs (Homoptera: Aleyrodidae) on collards and tomato. *Pest Management Science* (formerly Pesticide Science), **56** (10): 861-866.

Marie, S. S., Amr, E. M. and Salem, N. Y. 2009. Effect of some plant oils on biological, physiological and biochemical aspects of *Spodoptera littoralis* (Boisd.). *Research Journal of Agriculture and Biological Sciences*, **5** (1): 103-107.

Marchand, P. A., Dimier-Vallet, C. and Vidal, R. 2018. Biorational substitution of piperonyl butoxide in organic production: effectiveness of vegetable oils as synergists for pyrethrums. *Environmental Science and Pollution Research*, **25** (30): 29936-29942.

Mózes, G. (Ed.). 1983. Paraffin products. Elsevier.

Nikpay, A. 2007. Insecticidal efficacy of three vegetable oils as post-harvest grain protectants of stored wheat against *Rhyzopertha dominica* (F.)(Coleoptera: Bostrychidae). *Insect science*, **14** (2): 145-150.

Nile, A. S., Kwon, Y. D. and Nile, S. H. 2019, Horticultural oils: possible alternatives to chemical pesticides and insecticides. *Environmental Science and Pollution Research*, **26** (21): 21127-21139.

Ogban, E. I., 2019. Insecticidal value of four vegetable oils against *Dermestes maculatus* Degeer on smoked African mud cat fish, *Clarias gariepinus*. *Journal of Entomology and Zoology Studies*, **7**(3): 563-568.

R Core Team, 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Sanderson, C., Emmanuel, J., Emmanual, J. and Campbell, P. 1988. A historical review of paraffin and its development as an embedding medium. *Journal of Histotechnology*, **11** (1): 61-63.

Termo fisher Scientific.2021. Wax ceresin. Safety Data Sheet.

Van Huis, A. 1991. Biological methods of bruchid control in the tropics: a review. *International Journal of Tropical Insect Science*, **12** (1): 87-102.

MS Recieved -26 March 2021
MS Accepted 20 April 2021