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ИНСЕКТИЦИДНО ДЕЙСТВИЕ НА СИЛВЕТ L-77 СПРЯМО НЯКОИ ВИДОВЕ ЛИСТНИ ВЪШКИ
INSECTICIDAL ACTION OF SILWET L-77 TOWARDS SOME APHID SPECIES

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Abstract

The insecticidal action of Silwet L-77, a common organosilicone surfactant and wetting agent for plant protection products, on the base of trisiloxane ethoxylate, was observed at concentrations 0.011 – 0.012% (v/v), towards three aphid species: *Aphis nerii* Boyer de Fonscolombe, *Macrosiphum rosae* (L.) and *Aphis pomi* (de Geer). Our results indicate that Silwet L-77 has good potential for controlling tested aphid species alone, in spite of being a typical agricultural adjuvant used for lowering of the surface tension, respectively to improving wetting abilities of the pesticide spraying solutions.

Keywords: Silwet L-77, surfactant, *Aphis nerii* Boyer de Fonscolombe, *Macrosiphum rosae* (L.), *Aphis pomi* (de Geer), aphicidal.

INTRODUCTION

Aphids are one of the most economically important pests attacking crop plants and can cause significant damage and economic losses. They can be serious plant pests and may stunt plant growth, produce plant galls, transmit plant virus diseases, and cause the deformation of leaves, buds, and flowers (https://www.britannica.com/animal/aphid).

The oleander aphid, *Aphis nerii* Boyer de Fonscolombe is a common pest of several important ornamental plants in the families of *Apocynaceae* and *Asclepiadaceae*, the principal host plant is an oleander *Nerium oleander* L. The oleander is a widely grown ornamental plant in parks, in gardens, indoors, along roadsides, and as a windbreak especially in tropical and subtropical regions (Farrar, 1998).

The rose aphid *Macrosiphum rosae* (L.) originates from Europe and feeds mostly on rosaceous plants, but it is known to feed on plant species in other families. The economic impact of *Macrosiphum rosae* (L.) is primarily due to feeding damage on cultivated roses (Wöhrmann et al., 1991). In Bulgaria, the pest is the most common insect pest of roses (Rosa sp.) – ornamental, those grown for

essential oil production, wild, in greenhouses and in open fields (Grigorov, 1980). *Aphis pomi* (de Geer), commonly known as the apple aphid or the green apple aphid is widespread in Europe, western Asia as far east as India and Pakistan, North Africa and North America with apple (*Malus domestica*), as its primary host, but the aphid can also infest many other plants from the family Rosaceae: pear (*Pyrus communis*), quince (*Cydonia oblonga*), rose (Rosa sp.) (Alford, 2014).

Agricultural adjuvants are substances that, once added to a pesticide spray tank, modify a pesticide's performance and the physical properties of the spray mixture (Stevens, 1993). Adjuvants are usually much cheaper than pesticides and can decrease the effective pesticide dosage as much as 10 folds. They strongly affect the interactions between pest, pesticide, and crop (Green and Green, 1993).

Some agricultural adjuvant increase pesticide efficacy (Sharma, Singh, 2001) and modify environmental fate (Weinberger, Greenhalgh, 1984). Results of previous studies have indicated that some of these products are toxic to certain species on their own or they increase the toxicity of pesticides (Sharma, Singh, 2001; Henry et al., 1994; Liu and Stansly, 2000; Mangan and Moreno, 2001).

Insecticidal effect of surfactants have been known for many years (Cory and Langford, 1935; Dozier, 1937), however, surfactants have seldom been put to practical use, perhaps because of their lower efficacy compared with general synthetic insecticides. Recently high aphicidal effect of non-ionic surfactants was observed under laboratory conditions and a close correlation between aphicidal effect and the surface tension was revealed. Despite of being registered as agricultural spray adjuvant in numerous recent studies Silwet L-77 showed good aphicidal effect to some aphid species (Imai et al.,1994, 1995; Wood et al., 1997), against silverleaf whitefly *Bemisia argentifolii* (Liu and Stansly, 2000) and against several arthropod pests of table grape (Tipping et al., 2003).

Silwet L-77 is a popular non-ionic surfactant for lowering of the surface tension, respectively to improving wetting abilities of the pesticide spraying solutions. The product is based on a trisiloxane ethoxylate (https://www.momentive.com/en-us/products/tds/silwet-l-77-ag-spray-adjuvant/).

The purpose of the article is to determine the insecticidal action of Silwet L-77 towards three aphid species: *Aphis nerii* Boyer de Fonscolombe, *Macrosiphum rosae* (L.) and *Aphis pomi* (de Geer).

MATERIALS AND METHODS

Natural colonies of nymphs and wingless adults of testes aphid species were used. The individuals were placed on the layer of filter paper soaked with Silwet L-77, in 10 cm high plastic caps (5 cm diameter of the bottom). Each variant was implemented with three replicates with 10 aphids in each repetition. The variants were treated with tested concentrations of product and the control was treated with water. As standard variant was used Karate Zeon® on the base of lambda-cyhalothrin produced by Syngenta at 0.03% (v/v) concentration. The number of surviving individuals was recorded on the 24 hours after the treatment. The efficacy was estimated according to Henderson and Tilton formula (Henderson and Tilton, 1955). Ten different concentrations were tested to be determined LC_{05} (NOEL),

LC_{25} (LOAEL) LC_{50} and LC_{90}. The received data from conducted tests were statistically manipulated with R language for statistical computing (R Development Core Team, 2011) and *drc* R language package (Ritz and Streibig, 2005).

RESULTS AND DISCUSSION

Silwet L-77 gives an aqueous surface tension of 20.5 mN/m and its physical properties are listed in table 1.

Table 1. Physical properties of Silwet L-77

Surface Tension (0.1%, mN/m)	20.5
Cloud Point (0.1 wt%), °C	<10
Viscosity, cPs @ 25°C	20
Specific Gravity @ 25/25°C	1.007
Flash Point, °C	116

(https://www.momentive.com/en-us/products/tds/silwet-l-77-ag-spray-adjuvant/).

The figure below show the Dose – Response Modeling for tested products. The received toxicological data are:

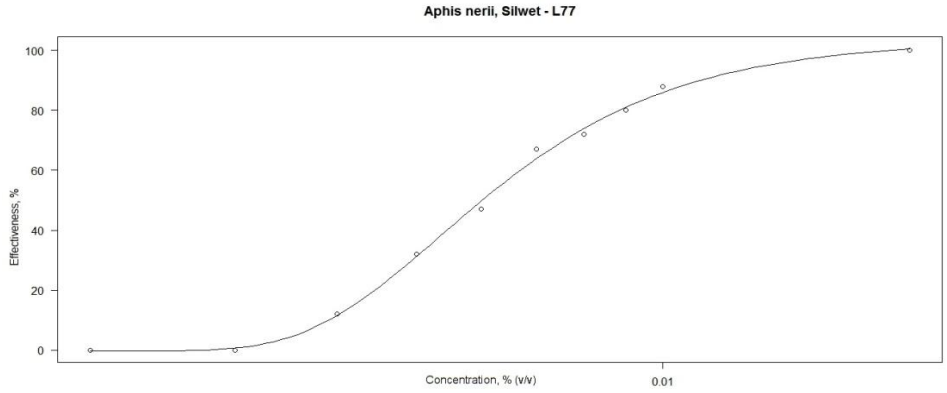

Fig. 1. *The Effectiveness of Silwet - L77 towards Aphis nerii*

The toxicological indexes are:

- *NOAEL* (LD_{05}) = 0.0035 % (v/v)
- *LOAEL* (LD_{25}) = 0.0047 % (v/v)
- LD_{50} = 0.006 % (v/v)
- LD_{90} = 0.012 % (v/v)
- *AIC* = 48.53

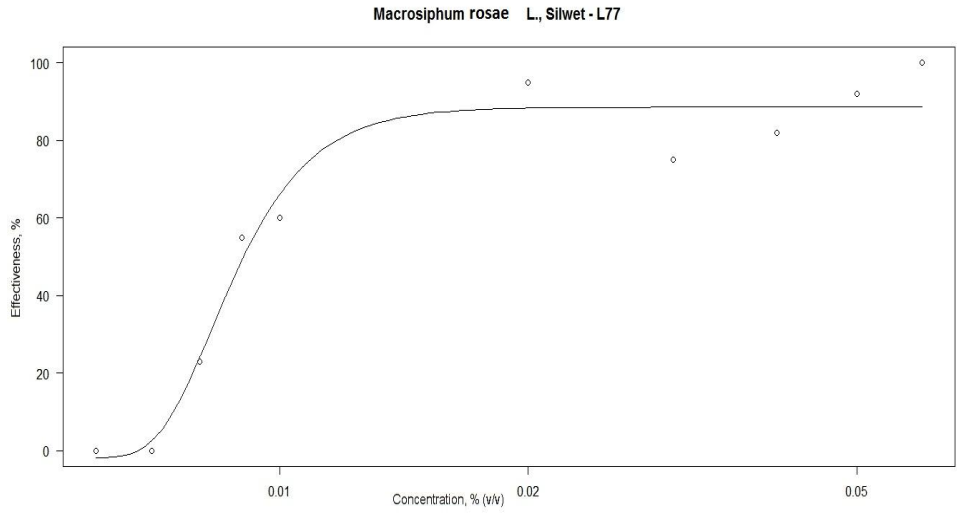

Fig. 2. *The Effectiveness of Silwet – L77* towards *Macrosiphum rosae* L.

The toxicological indexes are:

- *NOAEL* (LD_{05}) = 0.007 % (v/v)
- *LOAEL* (LD_{25}) = 0.0078 % (v/v)
- LD_{50} = 0.0087% (v/v)
- LD_{90} = 0.011 % (v/v)
- *AIC* = 77.43

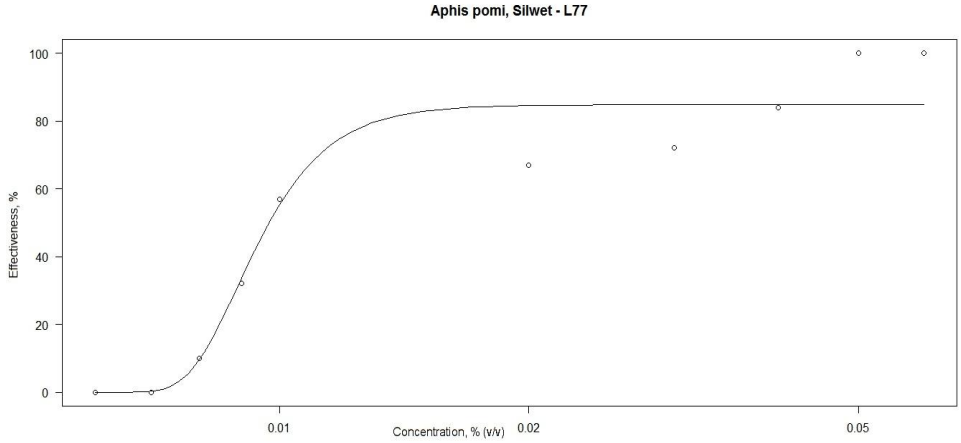

Fig. 3. *The Effectiveness of Silwet* – L77 towards *Aphis pomi*

The toxicological indexes are:

- *NOAEL* (LD_{05}) = 0.0076 % (v/v)
- *LOAEL* (LD_{25}) = 0.0085 % (v/v)
- LD_{50} = 0.0093% (v/v)
- LD_{90} = 0.012 % (v/v)
- *AIC* = 81.82

From the presented Dose – Response models and toxicological indexes is obvious that the effectiveness of the Silwet L-77 towards tested aphid species is almost alike with minor differences (Fig 4).

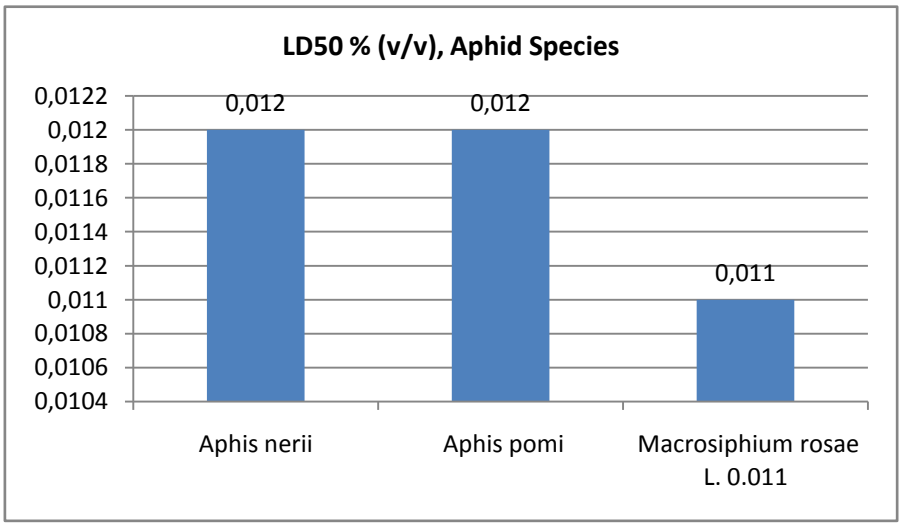

Fig. 4. *The Effectiveness of Silwet - L77 towards tested aphid species*

The conducted ANOVA analysis by R language (Teetor, 2011) show that there are no significant differences between variants (*p>0.05*).

CONCLUSIONS

1. The recommended concentration of uses of Silwet L-77 is between 0.025% and 0.1% (v/v) in order to be achieved the lowering of the surface tension, respectively the improving of wetting abilities of the pesticide spraying solution in sufficient degree.

2. The present study shows that even in lower concentrations (0.011–0.012% v/v), the surfactant can manifest the insecticidal effect according to the tested aphid species, alone without the addition of any insecticides.

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