ORIGINAL PAPERS

DETERMINATION OF *RHEUM RHAPONTICUM* L. EXTRACTS INSECTICIDAL ACTIVITY FOR *APHIDIDAE* PESTS CONTROLLING

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Key worlds: *R. rhaponticum root extract (R); R. rhaponticum leaf extract (L); R. rhaponticum flowers extract (F), Aphis pomi Degeer, Aphis fabae Scop u Schizaphis graminum (Rondani), insecticidal activity*

INTRODUCTION

The rhubarb root, leaves and inflorescence extracts are a source of various bioactive substances [1]. As part of the chemical raw materials from *Rheum rhaponticum* L (*Polygonaceae*), 3 basic bioactive substances, that are promising for the creation of plant protection products, can be identified - emodin (pesticide, antifidant, bactericide, fungicide), quercetin (antifidant for flying insects, pesticide, bactericide, antiviral, aldose-reductase inhibitor) and oxalic acid (antiseptic, activator). An important natural function of emodin in the mediation of plant-animal interaction is the deterrent factor.

Emodin has a deterrent effect on a large spectrum of invertebrate organisms, inhibits the action of intestinal enzymes (α-amylase and proteinase) of pest insects [2]. In relatively low concentrations, emodin reduces nutrition and extends the development time of the gypsy moth larva and, at high concentrations, causes pronounced mortality. It is known that the action of the complex of rutin and quercetin, inhibits the development and increases the mortality of gypsy moth, and also affects the increase in mortality of a loopworm [3-7].

According to the scientists research, the addition of oxalic acid (0.001-0.003) to insecticides, the Actellic or Fitoverm for the plant protection from *Rhagoletis batava obscuriosa* larvae, caterpillar moth, cabbage whitetail, meadow moth, cabbage, pear and silty aphids, Colorado potato beetle, in 2 times.

The presence of oxalic acid in the working solution creates a stabilizing effect of protection against pests regardless of the weather conditions [8]. On the basis of oxalic acid and oxalates, selective insecticidal plant protection products have already been created in the world. However, the mechanisms of action of all these substances, as insecticides, are still in the process of studying.

The aim of our work was to determine the insecticidal activity of extracts of the *Rheum rhaponticum* root, leaves and inflorescences (R, L, F). The test objects of research were 3 pest species of agricultural crops: *Aphis pomi* Degeer, *Aphis fabae* Scop и *Schizaphis graminum* (Rondani) (Hemiptera: Aphididae).

MATERIALS AND METHODS

The methods for preparing extracts from rhubarb plant raw material were based on the chemical properties of emodin and quercetin, which coincide in solubility in ethanol, and water-soluble oxalic acid. Analysis of bioactive substances in extracts from *R. rhaponticum* roots (R) and leaves (L) was carried out using the following methods: liquid chromatography (HPLC) and spectrophotometry [9].

The total amount of flavonoids from the rhubarb root and leaves extracts was determined with the help of aluminum chloride, using quercetin, as a standard.

Extract of standard solutions of quercetin (0.2 g) with 20-120 mg / l concentration, was mixed with 5% $NaNO_2$ solution (0.3 ml). After 5 minutes, 10% $AlCl_3$ solution (0.3 ml) was added and this mixture was left for 6 minutes for incubation. Then, a solution of 1M NaOH (2 ml) was added. These solutions are well mixed and measure the degree of absorption with a spectrophotometer at a wavelength of 510 nm.

Research of the extracts R, L and F biological effectiveness, as a means of plant protection from pests, were conducted against several aphid's species in laboratory conditions.

On the leaves of sorrel, apple and wheat (in Petri dishes), treated with working solutions, samples of *Aphis pomi, Aphis fabae* and *Schizaphis graminum* were placed in 4-fold replication for each variant. The following variants composition was used: V1 - 5% R; V2 -5% L; V3 -5% F. Control samples were treated with a 1% aqueous - ethanol solution. As a biological standard, 1% solution of ecologically safe insecticide Pelecol was used. Dead insects were counted (Fig.1, a, b).

a)

b)

Fig. 1. Effect of treatment with *R. rhaponticum* extracts for control of aphids: a) condition of aphids before treatment with extracts; b) aphids that died after treatment

RESULTS AND DISCUSSIONS

To obtain extracts from the *R. rhaponticum* root, inflorescences and leaves, the dried, ground raw material was mixed with the solvent at a ratio of 1:10 and extracted in a water bath. As a solvent, 60% ethyl alcohol was used. The extracts obtained were evaporated and, then, the dry residue was dissolved in a 20% aqueous ethanol solution (emulsifiable concentrate), which was used, subsequently, for the preparation of working solutions.

Detection of anthracene derivatives (phenols) was carried out by HPLC at an analytical wavelength λ max of 437 nm, using emodin, as a standard. The study showed that the dominant component of the *R. rhaponticum* root extract is emodin.

Quantitative analysis of flavonoids in rhubarb roots and leaves extracts, carried out using a spectrophotometer, is reflected in the calibration graph. The amount of flavonoids in the root extract was 202.46 mg / 100 g, in the leaf extract - 86.45 mg / 100 g (Fig. 2).

From the data obtained, we can conclude that the rhubarb root contains 2 times more flavonoids than in the leaves. In view of the fact that flavonoids and phenols have antiseptic and fungicidal properties, rhubarb roots and leaves extracts can be considered a promising and available source of bioactive substances for plant protection.

As a result of conducted experiments for the control of *Aphididae* family pests, we found out that on the first day after treatment, all mobile aphids (winged and wingless) try to leave the treated leaves in all experimental variants.

This suggests that the substrate (leaves) became unattractive for them. Some of the pests died. The value of the extract R insecticidal activity was higher than the standard values in the apple aphid (54.1%) variant. The insecticidal activity of extract L exceeded the standard values for all species of aphids: *Aphis pomi* (52.5%), *Schizaphis graminum* (61.5%) and *Aphis fabae* (59.4%). Insecticidal activity of extract F was at the level of the standard for cereal (56.6%) and apple (53.9%) aphids. Bean aphid (34.9%) was the least sensitive to this extract (Fig. 3).

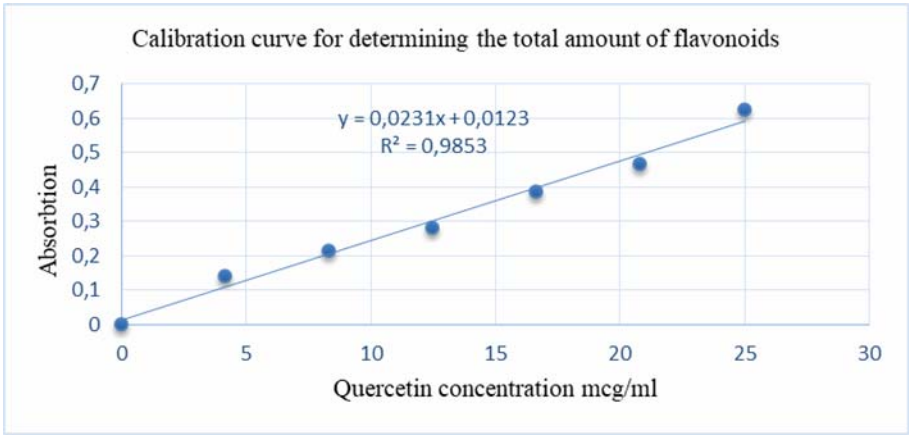

Fig. 2. Calibration curve for determining the total amount of flavonoids in rhubarb root and leaves extracts

According to the final diagram, it can be noted that the greatest insecticidal activity showed leaf extract (57.8%), having exceeded the value of the standard, which can be explained by the presence of the insecticide quercetin and oxalic acid. The availability and profitability of the extract makes it promising for the plant protection products development.

The effect of the extract from the inflorescences was somewhat weaker (48.5%). Its activity is explained by the fact of quercetin high quantity (up to 13.5%) accumulation in the inflorescence. Since the extract does not contain phenols and acids, in sufficient quantity, it is less insecticidal and very quickly decomposes at room temperature. Insufficient raw material base and instability of the extract from the inflorescences make its application in plant protection not technological. The least biological effectiveness in the control of aphids was found in the root extract (44.5%). The applied concentration (5%) could not sufficiently protect from insects, although it showed antifidant effect (Fig.4).

The extract from the root insecticidal activity was 44.5%. The applied concentration (5%) could not provide sufficient protection of plants against insects, although it showed antifidant effect.

In conclusion, it should be noted that the biological effectiveness of extract L for control of all experimental aphid species was highest (57.8%). Insecticidal properties, availability, profitability (created from the production of rhubarb stalks) and the environmental friendliness of this type of extract is the most promising in use for plant protection.

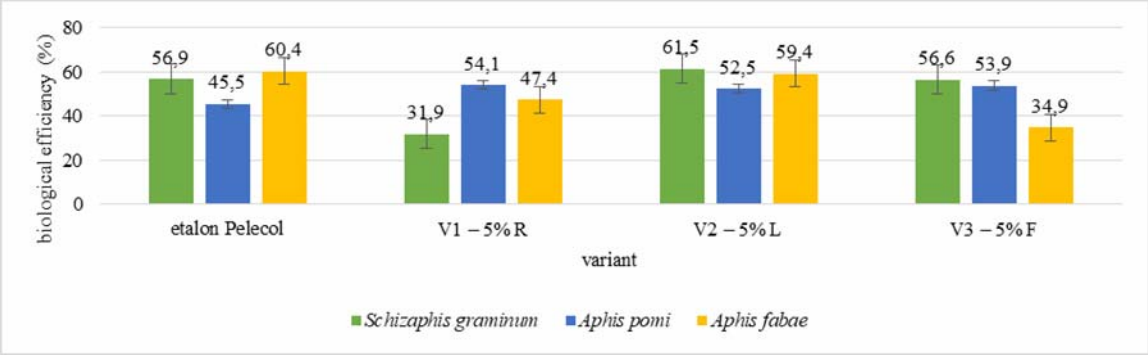

Fig. 3. Biological efficiency (%) of *Rheum* extracts (R; L; F) in the control of various aphid species (*Aphis pomi*, *Schizaphis graminum* и *Aphis fabae*)

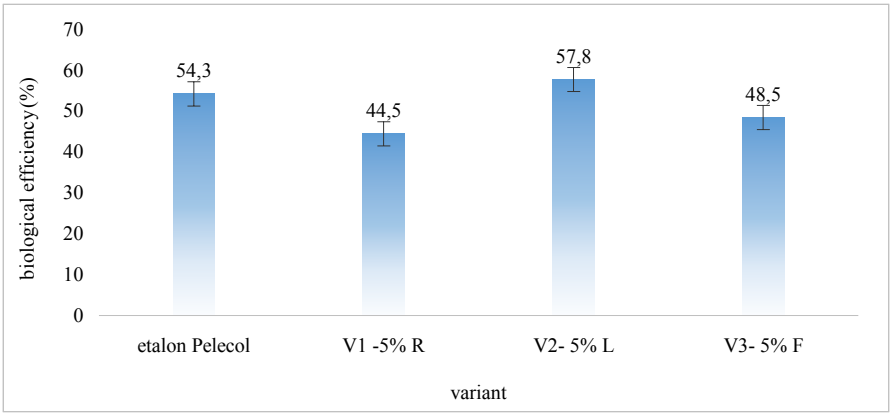

Fig. 4. The average of *Rheum* extracts (R; L; F) biological efficacy in control of aphids

CONCLUSIONS

In order to obtain a spectrum of bioactive substances, a scheme for *R. rhaponticum* roots and leaves extracting was developed and the composition of the extracts was studied. The presence of active substances with a deterrent and insecticidal effect (emodin, quercetin, oxalic acid) has been proven in *Rheum rhaponticum* extracts.

The action of *R. rhaponticum* extracts on the *Aphididae* family pests was determined. Insecticidal activity of rhubarb leaves extract against aphids (57.8%) allows using it in environmental protection of plants in combination with insecticides, in order to reduce the number of chemical treatments.

ABSTRACT

The rhubarb root, leaves and inflorescence extracts are a source of various bioactive substances. As part of the chemical raw materials from *Rheum rhaponticum*, 3 basic bioactive substances, that are promising for the creation of plant protection products, can be identified - emodin (pesticide, antifidant, bactericide, fungicide), quercetin (antifidant for flying insects, pesticide, bactericide, antiviral, aldose-reductase inhibitor) and oxalic acid (antiseptic, activator). The action of *R. rhaponticum* extracts on the *Aphididae* family pests was determined. Insecticidal activity of rhubarb leaves extract against aphids (57.8%) allows using it in environmental protection of plants in combination with insecticides, in order to reduce the number of chemical treatments.

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