Efficiency evaluation of alcohol extract of *Eriobotrya japonica* on some biological aspects of *Bemisia tabaci* (Gennadius, 1889) and *Aphis gossypii* (Glover, 1877)

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**Abstract.** The whitefly *Bemisia tabaci* (Gennadius, 1889) and the cotton aphids *Aphis gossypii* are serious pests that are causing damage to the Broccoli (*Brassica oleracea*) crop; therefore, this research was conducted to study the effect of the alcohol extract of loquat *Eriobotrya japonica* at three concentrations 5%, 10% and 15% on the population density of these two pests in a field in Baghdad/Iraq. The total phenol compounds have been detected. The results revealed that the alcohol extract of loquat had an efficient reduction against the whitefly and aphid pests. All the loquat alcohol extract concentrations had the same effects in the reduction of aphid and whitefly density.

1. **Introduction**

Broccoli (*Brassica oleracea* L.) is an edible green plant. China and India combined produce about three-quarters of the world's broccoli in 2017 [1]. Broccoli is rich in essential nutrients and vitamins (C, B, and K), thus many studies have shown that broccoli is rich source of antioxidants and it plays an important role as in the inhibition of chronic diseases, such as cardiovascular and carcinogenic pathologies, and breast and prostate cancers [2][3]. As many crops, broccoli is attacked by many pests, many studies on broccoli have been conducted to control pests attacking it, the continuous uses of chemical pesticides causing environmental and health problems, therefore plant extracts can be a very good source alternative to chemical pesticides to control insect pests, because of their eco-friendly, safe and well-suited properties [4]. *Eriobotrya japonica* is one of medicine plant that contain organic compounds including, carotene, pro-saponins, and flavonoids [5][6].

Several studies showed that many secondary plant compounds have been known to affect insects’ biology [7][8][9][10]. Therefore, the purpose of this study was to evaluate the total phenol compounds in the ethanol extract of *Eriobotrya japonica* and their effects on Broccoli (*Brassica oleracea*) pests under consideration in this study.

2. **Materials and methods**

2.1. **Description of the study area**

The field experiment was implemented in the vegetables field of the University of Baghdad, College of Science for Women for the agricultural season of 2019/2020.

2.2. **Preparation of the Loquat extract**

Loquat fruits were collected from a local field in Baghdad on April 2019 classified and authenticated by the Iraq National Herbarium; the fruit was washed and stored at 4°C. All chemical materials and solvents used in this study were purchased from Merck (Darmstadt, Germany) (St. Louis, USA). Fifty grams of fruits were freed from seeds, crushed by blender, filtrated and evaporated; the residues obtained were stored in a dark bottle in refrigerator for further use.

2.3. **Determination of total amount of Phenolic compounds in Loquat (Eriobotrya japonica).**
Extraction of phenols was performed using a High-Performance Liquid Chromatography (HPLC) device to estimate the total content of phenols in the fruit of loquat (*Eriobotrya japonica*), as it was a modern method that is efficient, effective and accurate [11].

2.4. **Field layout and experimental design**

*Brassica oleracea* was sown on 6x3 meter plots during early season of 2019 - 2020 early season. The plots were grouped into five replications of 3 treatments arranged, according to the split-plot design in randomized complete block design (RCBD).

The treatments were carried out by applying the following concentration 5%, 10% and 15% of *Eriobotrya japonica* extracts at the following stages of growth of the plant: Mid-vegetative stage (V) and Mid-fruiting stage (FR). An unsprayed plot was included as the control (CT).

2.5. **Insects sampling**

The collecting of insect species commenced at 70 % emergence stage and proceeded weekly up to the time of fruit maturity. Population density of whitefly *Bemisia tabaci* and cotton aphids *Aphis gossypii* were assessed using three randomly selected leaves. Each plot had a plethora of collected data used to express the mean population for it. That being said, the pre-treatment calculations were held a day before the treatments, whereas the post-treatment calculations were undertaken a day after the treatment [12].

2.6. **Statistical analysis**

The results were statistically analyzed according to these two designs using the statistical analysis system-SAS (2012) program, by means of the analysis of variance and the least significant difference (L.S.D.) at a probability level of 0.05 to compare the results.

3. **Results**

3.1. **Total phenol compounds in loquat (*Eriobotrya japonica*).**

*Eriobotrya japonica* contains important secondary chemical compounds, including phenols, which have attractive and repelling effects, as well as hindering effects on the growth. The total amount of phenolic compounds was determined in the ethanol extract of loquat (*Eriobotrya japonica*) and it was 13.58 mg Gallic / gm. Several studies were conducted to estimate the phenolic content, and the estimation of the content had varied concentration levels. The genetic and environmental factors as well as post-harvest processing conditions upon which the phenolic concentration of loquat (*Eriobotrya japonica*) fruit depend on [13].

The results showed that the effect of alcohol extract at different concentrations of loquat (*Eriobotrya japonica*) applied at two stages (vegetative and fruiting) of growth of Broccoli (*Brassicci oleracec*) on the abundance of major pest arthropods (*Bemisia tabaci* and *Aphis gossypii*) was significantly (**p** < 0.05) lower in plots sprayed throughout the crop growth period and highest in the control plots. When we sprayed alcohol extract of loquat (*Eriobotrya japonica*) in the mid-vegetative stage of crop growth period, table 1 showed that the mean number of *Bemisia tabaci* (29) was significantly highest in the control plot, while the treated plot with 5% concentration decreased to 17 and then significantly decreased (5, 3) at 10% and 15% concentrations respectively. In addition, table 1 also showed that the mean number *Aphis gossypii* was (14) significantly higher in control plot than treated plots with no significant differences among them. The same concept occurred when we applied the plant extract in the mid-fruited stage of crop growth period. Tables 1 and 2 showed that there were no significant differences in the reduction of the pests’ density with increasing concentrations of the loquat extract, while the control plots consistently had the highest density of pests and it differed significantly (**p** < 0.05) compared to the tested plots. It is noticed
from the results that we do not need to increase the loquat extract concentrations, because it had the same effect at all concentration levels and was highly effective in controlling whitefly and aphids’ populations. A previous study showed that the active secondary compounds may have a role in the cells of the lining of the insects’ gut died [14]. A mixture of Neem and wild garlic was more effective in reducing population densities of whitefly and aphid in comparison with plant extract applied alone [15]. The present study agreed with the previous study on Neem extract that reduced both the population densities of whitefly and aphid on cabbage [16].

**Table 1:** Effect of 5, 10, 15 % concentration of alcohol extract of loquat (*Eriobotrya japonica*) applications at Mid-vegetative stage of growth on the population density of whitefly (*Bemisia tabaci*) and aphids (*Aphis gossypii*) on Broccoli (*Brassica oleracea*).

| Treatment       | concentration (%) | N   |
|-----------------|-------------------|-----|
|                 | 5                 | 17 ± 0.02 b |
| *Bemisia tabaci*| 10                | 5 ± 0.05 c  |
|                 | 15                | 3 ± 0.06 c  |
| control         |                   | 29 ± 0.03 a |
| *Aphis gossypii*| 5                 | 5.3 ± 0.7 b |
|                 | 10                | 1.8 ± 0.6 b |
|                 | 15                | 2.8 ± 1.2 b |
| control         |                   | 14 ± 2.1 a  |

Means with the same letter are not significantly different at the 0.05 level

**Table 2.** Effect of 5, 10, 15 % concentration of alcohol extract of loquat (*Eriobotrya japonica*) applications at Mid-fruiting stage of growth on abundance (Mean±SE) of whitefly (*Bemisia tabaci*) and aphids (*Aphis gossypii*) on Broccoli (*Brassica oleracea*).

| Treatment       | concentration (%) | N   |
|-----------------|-------------------|-----|
|                 | 5                 | 25 ± 0.25 b |
| *Bemisia tabaci*| 10                | 9.2 ± 0.9 b |
|                 | 15                | 13 ± 0.8 b |
| control         |                   | 35 ± 0.5 a  |
| *Aphis gossypii*| 5                 | 6.6 ± 0.4 b |
|                 | 10                | 1.16 ± 0.4 b |
|                 | 15                | 2.1 ± 0.7 b |
| control         |                   | 17.8 ±2.7 a |

Means with the same letter are not significantly different at the 0.05 level

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