Evaluation of certain pesticides and their alternatives against the black vine thrips, *Retithrips syriacus* (Mayet) (Thysanoptera: Thripidae) infesting grapevine

DOI: https://doi.org/10.36811/ijpsh.2020.110022

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Received Date: Jan 28, 2020 / Accepted Date: Feb 07, 2020 / Published Date: Feb 10, 2020

Abstract

The black vine thrips, *Retithrips syriacus* Mayet (Thysanoptera: Thripidae) is considered as pest. Adults and nymphs of this pest cause a serious damage to grapevine leaves. The experiments were carried out to evaluate the toxicity of seven pesticides on nymphs and adults of GVT on Flame seedless and Superior commercial vineyard varieties under laboratory and field conditions during 2016/2017 season. Data clearly indicate that the order of efficiency of the tested compounds were the same at both LC$_{50}$ and LC$_{90}$ levels. The tested insecticides could be descendingly arranged as follows: Radient, Pleo, Movento, Nanoparticles Zinc oxide, Marshal, KZ oil and Garlic extract. The corresponding LC$_{50}$ values were 0.1, 0.24, 0.9, 0.92, 1.33, 1.45 and 1.5 ppm, while the LC$_{90}$ values were 0.87, 1.07, 5.48, 10.92, 8.67, 6.42 and 11.26 ppm, respectively. On the other hand, $\chi^2$ values were 5.77, 2.93, 3.95, 3.08, 6.54, 2.87 and 1.51 respectively. Radient had the steepest toxicity line and Garlic extract had the flattest, however Pleo, Movento, Nanoparticles Zinc oxide, Marshal and KZ oil lie in between. This reflects the superiority of Radient and inferiority of Garlic extract. Radient was the most toxic compound, whereas Garlic extract was the least toxic one. the initial reduction of KZ oil (71.83, 72.80, 71.50 and 70.95) in both varieties and all of them are above 70% reduction. From these results, it should be suggested using of some effective alternatives such as KZ oil for controlling black vine thrips in compatible program with chemical insecticides instead of conventional individuals' insecticides.

Keywords: Insecticides; *Retithrips syriacus*; Thrips; Grapevine

Cite this article as: Refat OH Allam, Amr MMM Badawy, Moustafa MS Bakry. 2020. Evaluation of certain pesticides and their alternatives against the black vine thrips, *Retithrips syriacus* (Mayet) (Thysanoptera: Thripidae) infesting grapevine. Int J Plant Sci Hor. 2: 23-31.

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Introduction

The black vine thrips, *Retithrips syriacus* Mayet (Thripidae: Thysanoptera) is distributed in many countries of the world including Egypt [1-3]. *R. syriacus* causes a serious damage to grapevine leaves [3-5]. The pest inhabits under the surface of the leaves causing discoloration and silvery spots, gradually the leaves drop down and the high infestation could harm the newly formed fruits [6]. Because of their high population, low mobility and confined and gregarious feeding, larvae do more than adults [7]. Chemical control is still a major method for controlling insect pest in grape vine, also the vine variety level of insect’s infestation of should be considered. Therefore, the susceptibility of three cultivated varieties to BVT was investigated. There is little information about any chemical control against it. Therefore, conducting more research related to effective insecticides for chemical control of BVT is highly desired. Hence, the efficacy of 7 selected insecticides and their alternatives including Spinetoram, Pyridalyl, carbosulfan, Spirotetratmat, mineral oil, Nanoparticles Zinc oxide and garlic extract. This study was aimed to the screening of the selected insecticides and their alternatives for nymph and adult stages of GVT under laboratory using leaf dip bioassay and under field conditions.

Materials and Methods

Laboratory experiment

Pesticides [Radiant 12% Sc (spinetoram), Pleo 50% EC (Pyridalyl), Marshal 25% wp (carbosulfan), Movento 10% Sc (Spirotetramat), KZ oil 95% EC (mineral oil), Nano-materials (Nanoparticles Zinc oxide), Garlic extract] were evaluated on nymphs and adults of GVT. Triton X100 (purity 100% BDH chem Ltd. Pool England was used and a stock concentration of each tested compound was prepared, and subsequent serial concentrations were made by diluting with water (V/V) or (W/V) as Active Ingredient to give the necessary concentrations inducing (20-80%) mortality for each material. Concentrations of each insecticide were prepared from time to time as needed.

The leaves were dipped in the pesticides prepared concentration for a period of 10 seconds then left for complete dryness on paper towelet. After words the leaves were placed upside down on agar bed in small Petri dishes (12 mm diameter), then ten healthy nymph and adults of GVT were placed on the treated leaves of each Petri dish, while ten leaves dipped in tap water were used as control. Three replicate batches of thrips (i.e. 30 insects) were used per each concentration. Petri dishes containing thrips were carefully closed and kept for a period of 24 hours until mortality count. All Petri-dishes were kept in an incubator, the temperature was 22±2°C and average R.H. was 60±5%.

Thrips insect, which did not respond to a simple touch with a needle, were considered dead. The mortality percentage was estimated and corrected according to Abbott’s formula [8]. All the mortality data were statistically analyzed according to the method adopted by [9]. Regression lines were drawn on probit-log paper and the median lethal concentration LC50 and slope values were determined, by computerized probit analysis program (LdP Line Program). Toxicity index (T.I.): was calculated for each insecticide according to the equation of Sun [10], as follow:

T.I. = (LC50 of the most toxic insecticide / LC50 of other tested insecticide) x 100.

Relative toxicity (R.T.) Folds: These values were measured according to the equation of Metcalf [11], as follow:

R.T. = (LC50 of the lowest toxic insecticide / LC50 of other tested insecticide) x 100.
The field experiments

The field experiments were carried out to evaluate the toxicity of Pesticides [Radiant 12% Sc (spinetoram), Pleo 50% EC (Pyridalyl), Marshal 25% wp (carbosulfan), Movento 10% Sc (Spirotetramat), KZ oil 95% EC (mineral oil), Nano-materials (Nanoparticles Zinc oxide), Garlic extract] on nymphs and adults of GVT on two commercial grapevines varieties (Flame seedless and superior) during 2016/2017 season cultivated at the Experimental Farm, Faculty of Agriculture, South Valley University, Qena, Egypt.

The insecticides were sprayed using knapsack sprayer with one nozzle, as foliar treatment, at a total volume of 200 liter per feddan. The control plots were sprayed with water. Also, care was taken to avoid any drift among the treated plots. To evaluate the effect of pesticides and their alternatives on thrips, samples of 10 leaves were always randomly collected from each replicate using randomized complete block design with three replicates. The samples representing upper, middle, and lower leaves of the chosen trees were randomly picked and preserved in paper bags. All samples were transferred to the laboratory for inspection, by a binocular microscope. Inspection of infestation was carried out just before spraying and 1, 3, 10 and 15 days after spraying. Percent reduction in infestation was calculated using Henderson and Tilton equation [12].

\[
\text{% Reduction Percentage} = 100 \left\{ 1 - \left( \frac{C_b}{C_a} \times \frac{T_b}{T_a} \right) \right\}
\]

Where:
- \(T_a\) = Aveg. % of infestation in treatment plots after spray.
- \(C_b\) = Aveg. % of infestation in check plots before spray.
- \(T_b\) = Aveg. % of infestation in treatment plots before spray.
- \(C_a\) = Aveg. % of infestation in check plots after spray.

Results and Discussion

Table 1: Toxicity of tested compounds against Adult insect of \(R.\ syriacus\).

| Compounds               | \(\chi^2\) | \(LC_{50}\)*ppm | Confidence limits of \(LC_{50}\)*ppm | \(LC_{90}\)*ppm | Slope     | Index (T.I.) | Resistance Ratio (R.R.) |
|-------------------------|-------------|-----------------|-------------------------------------|-----------------|-----------|--------------|-------------------------|
|                         |             |                 | Lower                              | Upper           |           |              |                         |
| Radiant                 | 5.77        | 0.10            | 0.05                               | 0.15            | 0.87      | 1.36±0.26   | 100                     | 0.07                    |
| Pleo                    | 2.93        | 0.24            | 0.18                               | 0.31            | 1.07      | 1.97±0.26   | 42.02                   | 0.16                    |
| Movento                 | 3.95        | 0.90            | 0.67                               | 1.27            | 5.48      | 1.63±0.23   | 11.11                   | 0.60                    |
| Nanoparticles Zinc oxide| 3.08        | 0.92            | 0.63                               | 1.42            | 10.92     | 1.19±0.21   | 10.86                   | 0.61                    |
| Marshal                 | 6.54        | 1.33            | 0.98                               | 1.84            | 8.67      | 1.57±0.23   | 7.51                    | 0.89                    |
| KZ oil                  | 2.87        | 1.45            | 1.12                               | 1.97            | 6.42      | 1.98±0.27   | 6.89                    | 0.97                    |
| Garlic extract          | 1.51        | 1.50            | 1.08                               | 2.30            | 11.26     | 1.46±0.23   | 6.66                    | 1.00                    |

* = ppm based on A:I R.R. =Resistance Ratio compared with Garlic extract

\(\chi^2\) = Chi-square
T.I.= Index compared with Radiant

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DOI: [https://doi.org/10.36811/ijpsh.2020.110022](https://doi.org/10.36811/ijpsh.2020.110022) IJPSH: February-2020: Page No: 23-31

Figure 1: Toxicity of tested compounds against Adult insect of *R. syriacus*.

Data in table 1 and figure 1 showed the relative toxicity of the toxic action of tested compounds against *R. syriacus*. Data clearly indicate that the order of efficiency of the tested compounds were the same at both LC$_{50}$ and LC$_{90}$ levels. The tested insecticides could be descendingly arranged as follows: Radient, Pleo, Movento, Nanoparticles Zinc oxide, Marshal, KZ oil and Garlic extract. The corresponding LC$_{50}$ values were 0.1, 0.24, 0.9, 0.92, 1.33, 1.45 and 1.5 ppm, while the LC$_{90}$ values were 0.87, 1.07, 5.48, 10.92, 8.67, 6.42 and 11.26 ppm, respectively. On the other hand, $\chi^2$ values were 5.77, 2.93, 3.95, 3.08, 6.54, 2.87 and 1.51 respectively.

It is also obvious, as shown in table 1 and figure 1, that Radient had the steepest toxicity line and Garlic extract had the flattest, however Pleo, Movento, Nanoparticles Zinc oxide, Marshal and KZ oil lie in between. This reflects the superiority of Radient and inferiority of Garlic extract. It is clear that Radient was the most toxic compound, whereas Garlic extract was the least toxic one. These results were in agreement with those of [6].

The low susceptibility of Flame to the black vine thrips, *R. syriacus* could be attributed to physical and or biochemical characteristics as was found on other vineyard varieties. The susceptibility of grapevine varieties to thrips infestation should be considered to improve the insect management programs.

On the other hand, Devonshire [13], showed that the tested insecticides were more active than the tested oils (Natural oil and K.Z oil). Also, he recommended that Natural oil was relatively more active than KZ oil. Data in table 2 and figure 2, show that Radient, Pleo, Movento, Nanoparticles Zinc oxide, Marshal, Garlic Ex and KZ oil were 0.07, 0.19, 0.64, 0.79, 0.84, 1.09 and 1.27 as toxic as Radient at the LC$_{50}$ level, respectively on ground of potency levels (Relative activity). Radient, Pleo, Movento, Nanoparticles Zinc oxide, Marshal, Garlic Ex and KZ oil were 0.05, 0.15, 0.50, 0.63, 0.66, 0.86 and 1 folds as effective as...
KZ oil, respectively, at the LC$_{50}$ level, respectively. Mineral oil (KZ oil) has the lowest effective one (LC$_{50}$ value 1.27 ppm). These results agreed with those of [14], showed that the development of resistance has been a serious problem in the control of thrips. Insecticide resistance management (IRM) depends on using different insecticide that have unique mode of action.

The variations in the reduction of the same insecticides on the difference variety could be explained to factors related to the physio-chemical insecticide properties and host plant characterization e.g. leave form, and leaves thickness, moreover the environmental factors effect on host plant and insecticide interactions.

### Table 2: Toxicity of tested compounds against nymph of *R. syriacus*.

| Compounds      | $\chi^2$ | LC$_{50}$ *ppm | Confidence limits of LC$_{50}$ *ppm | LC$_{90}$ *ppm | Slope   | Index (T.I.) | Resistance Ratio (R.R.) |
|----------------|---------|----------------|-------------------------------------|---------------|---------|--------------|------------------------|
| Radient        | 1.01    | 0.07           | 0.01-0.12                           | 0.51          | 1.43±0.38 | 100          | 0.05                   |
| Pleo           | 2.49    | 0.19           | 0.12-0.26                           | 1.43          | 1.45±0.22 | 34.95        | 0.15                   |
| Movento        | 5.93    | 0.64           | 0.48-0.84                           | 3.18          | 1.83±0.24 | 10.22        | 0.50                   |
| Nanoparticles  | 1.30    | 0.79           | 0.57-1.13                           | 6.25          | 1.43±0.22 | 8.15         | 0.63                   |
| Zinc oxide     |         |                |                                     |               |         |              |                        |
| Marshal        | 3.29    | 0.84           | 0.60-1.15                           | 5.86          | 1.52±0.22 | 7.70         | 0.66                   |
| Garlic extract | 0.79    | 1.09           | 0.79-1.61                           | 8.71          | 1.43±0.22 | 5.93         | 0.86                   |
| KZ oil         | 1.91    | 1.27           | 0.97-1.76                           | 6.53          | 1.81±0.25 | 5.11         | 1.00                   |

**Figure 2:** Toxicity of tested compounds against nymph of *R. syriacus*. 

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The effects of Radient, Pleo, Movento, Nanoparticles Zinc oxide, Marshal, KZ oil and Garlic extract against the black vine thrips, *Retithrips syriacus* were evaluated. Data in table 3 showed that reduction percent of infestation by *R. syriacus* due to the application of tested insecticides and their alternatives, indicated that Radient was the most effective insecticides in reducing the infestation. It exhibited that the initial reduction was 82.22%. The present data stated that tested insecticides could be arranged in a descending order according to their potency as follows: Radient > Pleo > Movento > Nanoparticles Zinc oxide > Marshal > Garlic Ex and KZ oil. According to the recommendation of the Egyptian ministry of agriculture for using insecticides and their alternatives in controlling pests, effective materials should give initial effect not less than 70% reduction and residual effect not less than 40% reduction [15].

### Table 3: Effect of certain pesticides on the nymphs stages of the black vine thrips, *R. syriacus* infesting Flame seedless Grapevines during 2017/2018 season.

| Compounds               | Rate / Fed. | Pre-spry count | % Reduction post-treatment (day) | Mean   |
|-------------------------|-------------|----------------|----------------------------------|--------|
|                         |             |                | 1      | 3      | 10     | 15     |        |
| Radient                 | 200 ml.     | 69.33          | 82.22  | 64.53  | 50.23  | 34.68  | 57.91  |
| Pleo                    | 100 ml.     | 64.67          | 77.25  | 55.80  | 41.07  | 30.14  | 51.06  |
| Movento                 | 150 ml.     | 61.33          | 72.15  | 45.41  | 37.73  | 30.47  | 46.44  |
| Nanoparticles Zinc oxide| 50 gm.      | 57.33          | 71.97  | 39.93  | 31.89  | 28.13  | 42.98  |
| Marshal                 | 300 gm.     | 57.67          | 71.70  | 41.86  | 32.57  | 29.90  | 44.01  |
| Garlic extract          | 3 L.        | 57.00          | 70.90  | 40.41  | 30.15  | 28.23  | 42.42  |
| KZ oil                  | 3 L.        | 58.33          | 71.83  | 41.04  | 32.26  | 30.28  | 43.85  |

### Table 4: Effect of certain pesticides on the adult insect of the black vine thrips, *R. syriacus* infesting Flame seedless Grapevines during 2017/2018 season.

| Compounds               | Rate / Fed. | Pre-spry count | % Reduction post-treatment (day) | Mean   |
|-------------------------|-------------|----------------|----------------------------------|--------|
|                         |             |                | 1      | 3      | 10     | 15     |        |
| Radient                 | 200 ml.     | 73.33          | 81.23  | 69.20  | 57.00  | 37.41  | 61.21  |
| Pleo                    | 100 ml.     | 73.33          | 80.50  | 67.80  | 57.53  | 36.35  | 60.55  |
| Movento                 | 150 ml.     | 65.00          | 76.40  | 59.52  | 45.92  | 32.81  | 53.66  |
| Nanoparticles Zinc oxide| 50 gm.      | 59.33          | 71.24  | 54.18  | 38.94  | 25.36  | 47.43  |
| Marshal                 | 300 gm.     | 58.33          | 70.96  | 54.74  | 38.22  | 25.46  | 47.35  |
| Garlic extract          | 3 L.        | 57.33          | 72.53  | 55.95  | 39.56  | 27.09  | 48.78  |
| KZ oil                  | 3 L.        | 55.67          | 72.80  | 57.07  | 40.29  | 27.26  | 49.35  |
Based on this recommendation, the result in tables 3-6 showed that, the recommended rate of Radient are succeeded in controlling of the black vine thrips, *R. syriacus*, since its initial reduced of the infestation were 82.22,81.23,86.7 and 82.89, respectively. Meanwhile, the total mean of reduction after 1, 3, 10 and 15 days were 57.91, 61.21, 59.96 and 52.28, respectively. While the initial reduction of KZ oil were 71.83, 72.80, 71.50 and 70.95, respectively for nymphs and adult of Flame and superior variety.

These results were in agreement with those of [16] showed that the mineral oil gave low reduction 71% comparing with synthetic insecticides, it can be used in thrips control. Insecticides extracted from plants have less negative environmental effects and create comparatively less risk of insecticide resistance than synthetic insecticides; therefore, they can be proposed as a safe tool for management of pests.

Several problems have resulted from the intensive use of conventional pesticides for pest control such as insect resistance; outbreaks of pest population; destruction of non-pest species; environmental pollution and human health hazards. Plant extractions and mineral oils such as KZ oil could be considered promising alternatives to conventional insecticides for use against the black vine thrips and they are currently being marketed for that purpose in liquid-spray and dust forms. These findings are in agreement with those reported by many investigators. Ridgway et al. [17], reported that some mineral oil might play an important role as effective alternatives.

Data represented in tables 3-6 showed the initial reduction of KZ oil (71.83, 72.80, 71.50 and 70.95%) in both varieties and all of them are above 70% reduction. From these results, it should be suggested using of some effective alternatives such as KZ oil in controlling black vine thrips in compatible program with chemical insecticides instead of conventional individuals' insecticides. The initial deposit of Radient was above 81% which indicate that, the conventional insecticides exhibited good potency in reducing infestation by thrips as compared with the oils. However, this is not enough to recommend using these insecticides widely in controlling this pest species. It is better to suggested using KZ oil in controlling the black vine thrips, *R. syriacus* in compatible program with other controlling agents instead of the conventional insecticides.

Data are presented in tables 5,6 indicated that all the used insecticides had affected the insect population. The insecticides could be arranged according to their potency as follow: Radient > Pleo > Movento > Nanoparticles Zinc oxide > Marshal > Garlic Ex and KZ oil. The average percentages reduction of population were 57.91, 51.06, 46.44, 42.98, 44.01, 42.42, 43.85% and 61.21, 60.55, 53.66, 47.43, 47.35, 48.78, 49.35 % of nymphs and adult of Flame and superior variety, respectively. While the average percentages reduction of infestation was 59.96, 51.83, 45.96, 45.40, 44.00, 44.83, 44.13 % and 52.28, 45.81, 39.33, 33.46, 33.44, 34.44, 33.83% of nymphs and adult of superior variety, respectively, at the level of the recommended rate for tested insecticides.

The most effective insecticide was Radient while the K.Z oil was the least effective one. On the other hand, Nanoparticles Zinc oxide and Garlic extract exhibited 71.97 and 71.94% in its initial effects of nymphs and adult insect of flam variety, respectively. While, the mean percent of reduction during 1, 3, 10 and 15 days intervals were 42.98 and 47.43%. Data clearly show that there is a wide range in the response of the insects to the action of the seven tested compounds. It is obvious that, percent reduction of infestation depended on the type of used compounds.
The present study recommends that Radient insecticide was better than Pleo, Movento and Marshal insecticides in control of Black Vine Thrips, Nanoparticles Zinc oxide was better than Marshal insecticide and it should use as alternative candidate Marshal, also, KZ oil is still effective in control of Black Vine Thrips and gave good results. So that, Radient, Nanoparticles Zinc oxide, Garlic extract and KZ oil, should be considered in integrated pest management (IPM) programs of Black Vine Thrips.

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