

# Comparative Bio-efficacy of Different Acaricides on the Population of Two-spotted Spider Mites in Apple Trees

Mohammadi Mohammad Mirwais<sup>1</sup>, Amini Mohammad Yosof<sup>1\*</sup>, Daneshyar Jalil Ahmad<sup>1</sup>, and Amiri Abdul wasi<sup>2</sup>

<sup>1</sup>Department of Plant Protection, Faculty of Agriculture, Herat University, Herat, Afghanistan

<sup>2</sup>Department of Horticulture, Faculty of Agriculture, Herat University, Herat, Afghanistan

\*Corresponding author : [dryosofamini@gmail.com](mailto:dryosofamini@gmail.com)

## ABSTRACT

Plant mites are considered serious pests of fruit trees due to the considerable damage they inflict. In recent years, pesticides have been increasingly used for the control of plant mites. However, the use of pesticides can also have negative effects on the environment, human health, and non-target organisms. In this study, the effects of treatments with Abamectin, Propargite, Dicofol, Deltamethrin, Garlic-soap solution, and Tobacco-pepper solution on apple trees were investigated at the farm of the Faculty of Agriculture, Herat University. The experiment was conducted in a completely randomized block design with three replications, including a control. The percentage of corrected mite mortality was calculated after 3, 7, and 14 days of treatment application. The results indicated significant differences between treatments on all counting dates. The impact of Abamectin treatment resulted in mortalities of 79%, 90% and 94% after 3, 7, and 14 days after spraying, respectively. In the Propargite treatment, mite mortality was 71%, 84% and 90% after 3, 7, and 14 days, showing no significant difference from the treatment Abamectin. The impact of Dicofol treatment resulted in mortalities of 75% after 14 days of spraying. However, Deltamethrin treatments had mortalities of 77% after 14 days, which significantly differed from the first two treatments. Notably, in the natural substance treatments (Garlic soap, Tobacco-pepper), mite mortalities were more than 60% 14 days after spraying, suggesting that low-risk methods can create unfavorable conditions for mites, leading to a substantial reduction in population. Considering the minimal impact of these substances on natural enemies can benefit from these low-risk approaches in integrated pest management. This study was carried out to assess and compare the impacts of chemical and organic pesticides in managing the infestation of two-spotted spider mites.

**Keywords:** Acaricide, Apple Tree, Control, Plant Mite

## INTRODUCTION

Plant insects and mites constitute one of the significant factors causing damage to crops (Khanjani & Iraninezhad, 2006). The two-spotted spider mite is considered one of the significant pests affecting apple fruit, and it is found in almost all regions worldwide, infesting over 150 species of economic plants (Mirzaeia et al., 2020). The increasing significance of the two-spotted spider mite (*Tetranychus urticae* Koch) in recent years may be attributed to its polyphagous nature and its ability to develop resistance to pesticides (Warabieda, 2015). Since other control methods, such as the use of resistant varieties, cultural practices, and biological control, have not proven to be sufficiently effective against the mentioned spider mite (Attia et al., 2013), the use of chemical substances in integrated pest management programs for this mite is deemed necessary (Mirzaeia et al., 2020). Due to the recent resurgence of mites, chemical control is rapidly expanding, but the environmental impact of chemical pesticides on humans and beneficial organisms raises concerns (Yu, 2008).

According to the International Institute of Entomology in 1996 and NAPPO 2014, the two-spotted spider mite has been observed in various regions of Afghanistan. In recent years, the presence of this mite in some provinces including Kabul, Herat, Mazar-e-Sharif, Jalalabad, Kandahar, and some other areas of Afghanistan during the summer season is an irrefutable phenomenon (Amini, 2009). Controlling of this mite is mostly carried out through chemical methods. However, due to the lack of proper precautions in control measures, leads to environmental pollution and other side effects in nature (Doğu & Zobar, 2014). A study in Iran in 2002 revealed that the acaricide Fenazaquin had a better effect on the European red mite compared to the registered acaricides Propargite and Cyhexatin in apple orchards. Additionally, Fenazaquin showed greater persistence on the red mite than the other two acaricides, with reported mortality rates approaching one hundred percent (Arbabi et al., 2002). Research conducted by Michelle et al. in 2010 indicates that water spray with a soap solution leads to a reduction in the population of certain pests, including plant mites. According to Gowda et al. (2007), chemical control is preferably used as a last resort in an integrated pest management program and is only applied when economic damage has occurred. The chemicals used should preferably have minimal negative effects on humans, the environment, and natural enemies within the agricultural system. The primary aim of this study is to assess the impact of different chemical and natural acaricides in managing the

population of two-spotted spider mites on apple trees. Furthermore, exploring the contribution of natural substances in preventing the mentioned mite damage and replacing them with unsafe chemical pesticides may be regarded as secondary objectives of the current research.

## MATERIALS AND METHODS

**Study area:** The research was conducted during 2018 and 2019 at the Agriculture Faculty Farm of Herat University. The evaluation of various chemical pesticides on apple trees took place in 2019 at the Agriculture Faculty Farm.

**Investigation of the Effect of Acaricides and Natural Substances:** To investigate the effect of several acaricides against mites in apple trees, the experiment was designed in completely randomized blocks with seven treatments and three replications. The studied treatments included four acaricides: Abamectin; 1 ml/lit, Propargite; 1.5 ml/lit, Dicofol; 2 ml/lit, Deltamethrin; 2 ml/lit, along with two natural substances (Garlic-soap solution; 1 lit/10lit of water and Tobacco-pepper solution; 1 lit/10lit of water). Additionally, a control was included for comparison of mite populations on apple trees. Trees under the experiment were selected during March and April, with five meters between each experimental tree and the adjacent one. Regular, continuous, and weekly observations and data collection were conducted to determine the field's mite infestation level. In each observation, ten leaves were randomly selected from the upper, middle, and lower parts of each tree. The samples were placed inside labeled plastic bags and transferred to the laboratory and to prevent sample loss and mite displacement, stored in a refrigerator. The count of adult mites, nymphs, larvae, and plant mite eggs was carried out separately using a stereo binocular microscope. Sampling intervals were one day before spraying, three, seven, and fourteen days after the application. When the mite population in the field reached a noticeable level, simultaneous acaricide spraying was performed using advanced sprayers available in the laboratory of the Agriculture Faculty at Herat University.

**Preparation of Garlic-soap Solution:** To obtain this solution, a good-sized garlic bulb was crushed, and mixed with five cubic centimeters of dishwashing liquid in one liter of pure water. This solution was stored in 1.5-liter plastic bottles for two days to allow it to ferment. After filtering, the obtained solution was mixed with ten liters of pure water and used to control mites in apple trees.

**Preparation of Tobacco-pepper Solution:** To prepare this solution, initially, a hundred grams of tobacco and a hundred grams of dried pepper were added to one liter of pure water. The obtained materials were kept in 1.5-liter plastic bottles for a day to ferment. The next day, the resulting solution was filtered and used to control mites in apple trees by mixing it with ten liters of pure water.

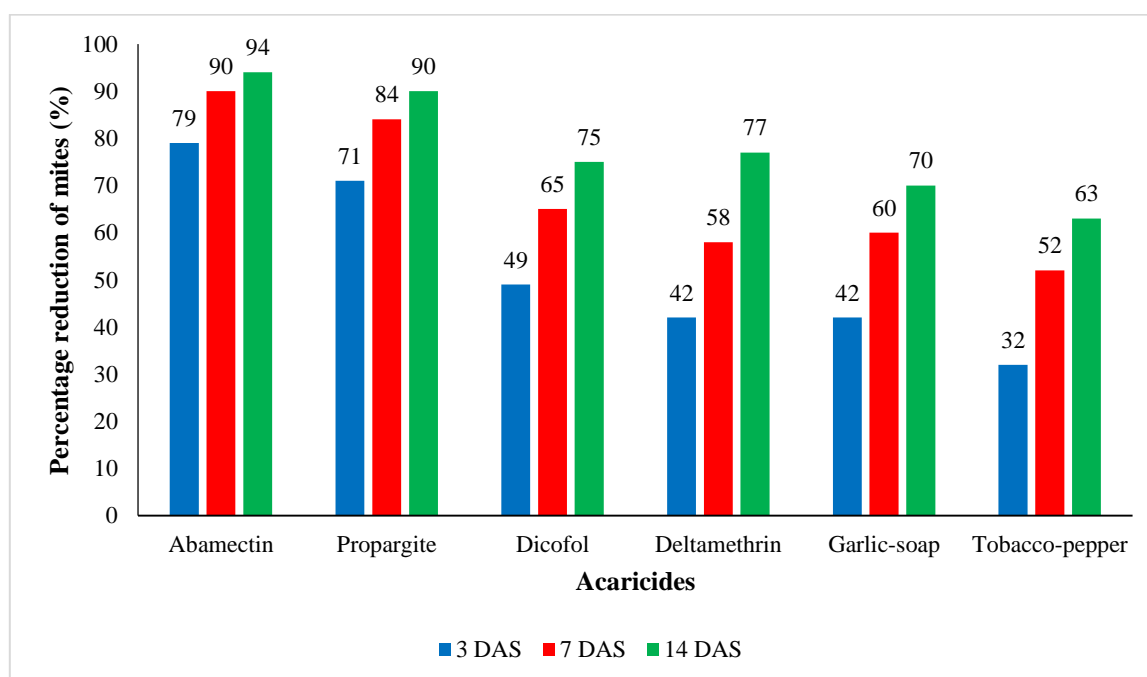
**Statistical Analysis** The results obtained from this research were recorded and analyzed using statistical methods. The data analysis in this study employed SPSS v20.0 software. After analyzing, the data were presented through graphs and tables in the findings section.

## RESULTS

After analyzing the data obtained from the research, it was evident that there is a significant difference in the average number of live mites on the leaves of apple trees after spraying different pesticides. Results indicated the effectiveness of Abamectin and Propargite against apple tree mite populations. Three days after spray, Abamectin showed the best efficacy, with six mites per leaf, followed by Propargite with an average of ten mites per leaf. In the subsequent rankings, Dicofol with thirteen mites per leaf was observed. Among the chemical pesticides, Deltamethrin had the least efficacy, with seventeen mites per leaf. However, Solution 1 (Garlic-soap) exhibited a lower impact with fifteen mites per leaf, and Solution 2 (Tobacco-pepper) showed the least effect with twenty mites per leaf compared to chemical pesticides (Table 1). Seven days later, Abamectin continued to demonstrate the best efficacy with three mites per leaf, followed by Propargite with five mites per leaf, while Deltamethrin had a less pronounced effect with thirteen mites per leaf. On the other hand, Solution 1 and Solution 2 showed similar effects to Deltamethrin, with ten and fourteen mites per leaf, respectively (Figure 1). Fourteen days after the spray, the performance of Abamectin and Propargite was more prominent compared to other pesticides. Only two to three mites per leaf were observed, and Dicofol ranked next with six mites per leaf. Deltamethrin, in contrast, had the least impact, with seven mites per leaf. Solution 1 and Solution 2 showed less efficacy compared to chemical pesticides, yet they managed to significantly reduce the plant mite populations (Table 1).

No	Acaricides	Dosage	Mean number of mites/leaves			
			Pre-treatment	3 DAT	7 DAT	14 DAT
1	Abamectin	1ml/lit	28(1.2)	6(0.6) <sup>a</sup>	2.7(0.3) <sup>a</sup>	1.7(0.3) <sup>a</sup>
2	Propargite	1.5ml/lit	33.7(3.0)	10(0.9) <sup>a</sup>	5.3 (0.3) <sup>a</sup>	3.3(0.3) <sup>a</sup>
3	Dicofol	2ml/lit	26(6.6)	13(2.6) <sup>ab</sup>	9(2.1) <sup>a</sup>	6.3(1.2) <sup>ab</sup>
4	Deltamethrin	2ml/lit	30(6.0)	17.3(2.7) <sup>ab</sup>	12.7(1.5) <sup>ab</sup>	7(0.6) <sup>ab</sup>
5	Garlic-soap	1lit/10 lit	25.7(3.8)	15(1.7) <sup>bc</sup>	10.3(0.3) <sup>ab</sup>	7.7(0.3) <sup>ab</sup>
6	Tobacco-pepper	1lit/10 lit	30(3.6)	20(2.0) <sup>bc</sup>	14(1.9) <sup>bc</sup>	11(2.1) <sup>bc</sup>
7	Control	-----	29(2.6)	36(3.1) <sup>d</sup>	50(1.9) <sup>d</sup>	64(3.5) <sup>d</sup>
F test			NS	*	*	*
SEM±			0.71	0.35	0.32	0.46
CD at P=0.05			-----	(0.25)	(0.30)	(0.22)

DAT: Days After Treatment; \*: Significant at P=0.05; NS: Non-significant; Figures in parentheses are  $\sqrt{x+0.5}$  transformed values: Treatments with same alphabetical superscript within each column are statistically on par.



**Figure 1.** Percentage reduction in the population of apple tree mites

## DISCUSSION

In this study, Propargite and Abamectin showed the best results for reducing the population of plant mites with the lowest dosage. Approximately seventy percent reduction in mites was observed three days after spraying, and more than ninety percent reduction was achieved fourteen days later. In a study conducted by Karabhantanal et al. (2012), the results of using six treatments in controlling *Tetranychus urticae* were demonstrated. Among the pesticides used in the study, Abamectin and Propargite, with doses of 0.5 and 1.5 ml/lit respectively, showed the most significant efficacy (90.8% and 85.4%) in reducing mite populations. This indicates agreement with the findings of the present study. Similar research conducted by Lagziri and Amrani (2009) demonstrated that considering the high efficacy of both examined compounds, Abamectin had a higher killing effect on mite populations compared to Propargite. This study also investigated the impact of Abamectin on tree mites, revealing that a concentration of 2 ml/lit led to the death of approximately fifty percent of the mites. Additionally, another study by Jinhe et al. (2006), revealed that a simple water spray without any chemical substances significantly reduced the mite population in apple trees compared to the control. Furthermore, Brunner et al. (2001) reported that soap solutions (dishwashing liquid) were less toxic to natural enemies than chemical pesticides. Soaps were found to be suitable for pest control and

significantly reduced their populations. Similarly, in the present study, the use of solutions containing Garlic-soap or Tobacco-pepper resulted in a significant reduction in mite populations in fruit trees.

## CONCLUSION

In relation to the impact of various chemical pesticides and natural substances, it is noteworthy that the most significant effect was observed with the pesticide Abamectin at a concentration of 1 ml/lit and Propargite at 1.5 ml/lit. Natural substances such as Garlic-soap and Tobacco-pepper had a lower impact compared to the chemical pesticides used in the research, but due to their positive reaction in terms of reducing the frequency of pesticide applications, along with their positive environmental aspects, can potentially delay the development of resistance to these compounds.

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