

# Bioecology of russet mites in tomatoes and their control

*Abdusalim Yusupov*<sup>1,\*</sup>, *Dilnoza Nuralieva*<sup>1</sup> and *Asamiddin Kholliiev*<sup>1</sup>

<sup>1</sup>Tashkent State Agrarian University, 2, University street, Tashkent, 100140, Uzbekistan

**Abstract.** Tomato russet mite develops freely and quickly mainly on tomatoes and potatoes. The next places are occupied by black and red nightshades and eggplant. The mite can press both the upper and lower sides of the plant leaves. First, the lower leaves and branches of the plant begin to be damaged. It gradually spreads upwards. The affected branch becomes smooth with a brown color, yellow spots appear on the leaves, and the general color begins to turn brown. Infected flowers and small fruit buds and leaves dry up and fall off, large fruits have a web-like pattern and crack. In this article, the species composition, distribution, damage to plants and bioecology of the pest are covered in this article. The development characteristics of the russet mite by plant are presented, in which tomato, potato, and eggplant plants are the most common tomato russet mite in the analysis based on the table. In addition, the results of the research on the effect of the tomato russet mite on productivity in different growth periods are highlighted.

**Keywords.** Tomato, plant, pest, russet mite, productivity, insect, harmfulness, efficiency.

## 1 Introduction

Tomatoes are the most widely consumed vegetable among the population on a global scale [1]. Tomatoes account for half of the total vegetable area and 55% of the annual production. Tomato contains the most necessary nutrients, salts and vitamins for humans. According to researchers, tomatoes contain the following substances: water-93-92% and dry matter-6.58%, of which protein - 0.61%, carbohydrates - 3.99%, fat - 0.9%, vitamin C - 3.5 mg, vitamin A - 0.2-2 mg, and vitamin B (thiamine) - 1.6-6 mg [1, 2].

Today, agriculture in the world is aimed at improving the living conditions of the population in the conditions of the market economy, producing clean products for the population, increasing the demand for export and import, and protecting the environment. In particular, bringing a sufficient amount of agricultural products per capita to the ranks of highly developed countries in terms of production and consumption is an important urgent issue in front of the agrarian policy being carried out in Uzbekistan [3].

Since vegetables are considered to be incomparable food products that improve human health, work capacity, and prolong life, Uzbekistan is paying great attention to increasing their cultivation [4]. In Uzbekistan, tomato is considered one of the main vegetable crops

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\* Corresponding author: [a.yusupov@tdau.uz](mailto:a.yusupov@tdau.uz)

and occupies a special place in the cultivation of vegetable crops, because it is consumed directly [5].

It is urgent to further strengthen food security in Uzbekistan, expand the production of ecologically clean products, significantly increase the export potential of the agricultural sector, and reduce the areas planted with cotton and grain [6]. In addition, a number of tasks have been assigned to freed lands to create and introduce varieties of vegetable and potato crops that are resistant to diseases and pests, adapted to local soil-climate and ecological condition [7]. Tomato fruits are valued for their high taste and nutritional qualities, they are one of the important sources of biologically active substances and antioxidants that protect the human body from oxidation during mental stress and prevent aging processes [8].

The demand of the people of Uzbekistan for vegetable products and their growing needs are increasing the importance of open fields and greenhouses in the cultivation of vegetable crops rich in vitamins throughout the year. This, in turn, requires specialists in this field to select seeds of new high-yielding varieties resistant to various diseases, insects and extreme conditions, as well as cultivation technology and control of diseases and pests.

## 2 Materials and methods

Assessment of the russet mite pest in the tomato plant was carried out based on the methodological manuals [9]. Pest control and agrototoxicological studies were carried out according to "Methodological instructions for testing insecticides, acaricides, biologically active substances and fungicides" published under the editorship of Khojaev [6]. Determination of biological effectiveness of drugs was determined based on Abbot's formula. The results obtained from the research were analyzed and mathematically and statistically processed based on the Dospekhov method [8-10].

Tomato russet mite (*Aculops lycopersici* Masee), a four-legged mite belonging to the *Acariformes* family of the *Eriophyidae* family, tomato russet mite is a very small arthropod that cannot be seen with the naked eye. Its nymph is 100 µm (micron), and the mature breed is 135-160 µm. The color changes from clear to yellowish. The body is elongated, cylindrical, the back end ends with narrow hairs, and consists of 2 pairs of legs.

Tomato russet mite can also develop throughout the year. In this case, it will continue its development from crops in open ground to greenhouses in autumn. Most of them overwinter where they developed in the summer. In this case, it hibernates in the upper layer of the earth, in the state of nymphs. The most optimal conditions for the pest are air temperature of 25-30°C and humidity of 30-40%. Under these conditions, one stage of mite development is completed in 7 days. In one season, the mite can give 15 to 25 stages, 10-15 of which pass in June-August.

The quality and appearance of such fruit is lost, it begins to partially rot. A severely infested plant will die 100%. Especially in July-August, tomatoes and evening potatoes suffer a lot. The branches of potatoes become smooth and turn brown, the leaves (starting from the bottom) dry up, turn yellow and wither prematurely and do not yield. In the fruits of damaged plants (tomatoes, potatoes), quality indicators change: acidity increases by 32-35%; sugar content calculated as dry matter decreases by 45-72%, ascorbic acid by 41-61.8%, carotene by 12-70%, and dry protein by 52-39%.

In the fight against the russet mite, it is important to implement several methods together. These are agrotechnical and chemical methods aimed at drastically reducing the number of parasites and others. Selection of varieties resistant to powdery mildew of the tomato plant leads to saving the crop and reducing the costs of plant protection. This makes it possible to grow products without chemicals and to be effective in biological methods. Choosing resistant varieties will reduce the amount of chemical treatments. Their use ensures that the number of pests is kept at a level that does not cause harm [4].

It has been found that russet mites can cause severe damage to vegetable crops and cause plant death if timely control measures are not taken [1]. According to information, when conducting research on the bioecology of sucking pests in agricultural crops, it was found that their development characteristics are inextricably linked with the soil and plants during the growing season and winter. Therefore, when the agrotechnical activities carried out in the field are organized in the required terms, a negative environment for pests is created and a certain part is observed to die [2, 3].

### 3 Results and discussion

Studying the characteristics of bioecological development of mites provides an opportunity to develop scientifically based methods of plant protection. Research related to the biology of the russet mite has been conducted by experts.

The tomato plant is the main host plant of the russet mite and thrives on this plant. Russet mite infects many plant species in all life stages (except eggs) except tomato. Special experiments were conducted in order to determine whether the russet mite infects different plants at different levels (Table 1).

In this case, plants belonging to different families were artificially damaged and their damage was recorded in the experimental notebook every 5 days. The obtained experimental results are presented in Table 1. In some plants in the observations, the development of this pest was slow and began to move to different parts of the plant in search of food along the stem rather than on the leaf of the plant.

Severe damage to stems and leaves of tomato (*Lycopersicum esculentum* Mill) plant was observed. The russet mite moved up the plant until it killed the plant. In potato (*Solanum tuberosum* L), the stems became pale bronze, unevenly curled, the leaves dried up and the plant died like a tomato. *Solanum nigrum* L. was found to be more effective against the damage of the russet mite.

**Table 1.** Plant species affected by the russet mite (Field experiments, 2021-2022).

Latin name of the plant	English name	Damaging degree
<i>Lycopersicum esculentum</i> Mill.	Tomato	+++
<i>Solanum tuberosum</i> L.	Potato	+++
<i>Solanum dulcamara</i> L.	Bittersweet	++
<i>Solanum nigrum</i> L.	Black nightshade	+++
<i>Solanum melongena</i> L.	Eggplant	+++
<i>Capsicum annum</i> L.	Bell pepper	++
<i>Solanaceae</i>	Nightshade	++
<i>Note:</i> + - weak development in the plant; ++ - average development in the plant; and, +++ - strong development in the plant		

Russet mite is strongly developed on *Lycopersicum esculentum* Mill, *Solanum melongena* L, and *Solanum nigrum* L, and these plants are considered as host plants for the pest. Because it maintains very large populations of the russet mite, and as a result of its damage, the leaves of this plant turn yellow, and tomato fruits crack and die.

Moderate russet mite development and feeding were observed on *Solanum dulcamara* L and *Capsicum annum* L plants. Russet, in studying the damage of the mite, recommended 3 different concepts related to the damage of the pest in the tomato plant:

- 1- Plant damage;
- 2- Damaged plant type;
- 3- crop loss.

Plant damage by pests is determined by the biological characteristics of insects, and the damage they cause depends on the damage and number of pests. Damage to vegetative organs does not affect the yield. However, damage to generative organs significantly affects productivity. The stronger and stronger the plant is, the less it is affected by pests, or if the plant is not satisfied with micro and macro elements that are not well developed, the more it is observed that it is affected by pests.

According to the results of the conducted research, the kura russet mite is a (oligophagous) mite that damages crops belonging to the *Solanaceae* family, and when planting tomatoes, it was observed that the pest settles in clusters on the top and back of the leaf, as well as on the fruits. It also damages the plant stem. The affected stem appears covered with a shiny, brownish layer. One of the main symptoms that appear as a result of the damage is the formation of yellow-yellow spots on the leaf and a shiny reddish-brown layer on the stem (Figure 1).



**Figure 1.** Damage of tomato crop by russet mite.

A heavily infected plant lags behind in development and in most cases dies. 70-80% of the crop can be completely lost in the area affected by the russet mite. This situation is clearly visible in tomatoes planted in the open field and in greenhouse conditions, because the pest develops well in greenhouses and in open field under favorable conditions.

Timing of russet mite control measures is more complex. First, since this pest is very small (100-160  $\mu\text{m}$ ), it cannot be seen with the naked eye when it gets on the plant, even if it is present in large numbers. Secondly, it is natural that the dew-like, reddish-brown layer, which appears as a result of its feeding, can be mistaken for the symptoms of diseases in tomatoes.

Therefore, it is necessary to regularly monitor the planted tomato seedlings from the beginning of the stage of pruning until they are harvested. It is necessary to use a mirror (loupe) that magnifies at least 20-30 times. In order to determine the presence or absence of the russet mite, i.e., the quantity, samples of the leaves that the pest has fallen on the plant body are taken, the amount of the mite is accurately calculated under binoculars, and control measures are determined based on this.

Entomological traps of different shapes and sizes were used to study the damage caused by different phytophages. The plant was grown in specially made sadoks, covered with gauze or small mesh nets to prevent it from being infected by another pest, and the damage caused by the pest was studied in this plant.

Before starting the lysimeter experiments, a laboratory experiment was conducted. For this, the plant was transplanted into a pot and artificially infected. Observations showed that signs of damage began to appear soon after exposure. The stems turned silver, the leaves were first covered with yellow shiny spots, and later the whole leaf turned yellow and dried up. As a result, they were delayed in development and died completely 18 days after infection. It was found out from the experiments that if a tomato plant is damaged by the russet mite during germination or seedling, the plant will die completely.

In 2022, we studied the damage of tomatoes by russet mite in different periods and the effect on the yield of the plant in the "Innovative Developments and Consulting Center in Agriculture" SUE training area of the Tashkent State Agrarian University on a 10-acre plot of land, in the "Mustakillik-28" tomato variety. Magnifiers with a magnification of 20 times were used to observe the development of the mite.

During the observation, it was observed that the mites living on the leaves and crops of the tomato plant formed very large colonies on the back and front of the leaf. One of the main symptoms of tomato russet mite infestation is the formation of yellow spots on the leaves and a shiny reddish-brown layer on the stem. Uneven spots appeared on the damaged stem.

Experiments on damage caused by russet mite to tomato productivity were carried out in 3 replications. Observation and calculations were carried out according to the method of Khodjaev [6].

In the research, tomatoes were artificially infested with the russet mite in the periods of budding, flowering, fruiting and ripening, and continuous counting was carried out. In this case, it was found that the amount of lost yield is 2-3 times higher in plants damaged in the initial period of vegetation compared to those damaged in the last periods of plant development (Table 2).

**Table 2.** Effect of russet mite on productivity during different growth periods of tomato (variety - "Mustakillik-28", "Innovative development and consulting center in agriculture" SUE training field of Tashkent State Agrarian University, 2022).

Plant development phases	Average yield from 1 bush tomato, g		Yield loss relative to control, g
	Control	Experiment	
Spouting	3.755	1.950	1.805
Flowering	3.755	2.180	1.575
Blooming	3.755	2.600	1.155
Ripening	3.755	3.110	0.645

The results of the research are presented in the table. In this case, it was observed that the amount of yield of one damaged plant during the pruning period was reduced to 1,805 g compared to the control. Therefore, if the plant is damaged in the flowering stage, 1.575 g of the yield from each tomato plant will be lost. At the stage of fruiting, it was determined that one third of the crop will die, that is, the yield will decrease by 1.155 g. And finally, when the fruit is infected with the russet mite, an average of 645 g of yield per bush was observed.

## 4 Conclusions

According to the results of the conducted scientific research, the tolerance characteristics of 5 varieties of tomatoes to the russet mite were studied and the difference between them was determined. In the conducted experiment, it was noted that the amount of yield lost as a result of pest damage in the tolerant variety "Temno-krasniy 2077" was 16.9-26.3% less than in other varieties.

Therefore, it was determined as a result of the experiments that if tomato russet mite is damaged in the initial phase of the growth period, the yield loss is greater, and if it is damaged in the later phases (fruiting and fruit ripening), the yield loss is less.

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