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RESEARCH ARTICLE OPEN ACCESS

Tetranychus ludeni, a "Red Spider Mite" Sucking Pest, Damages Mulberry Leaves

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Abstract:

Mulberry leaves are the primary food for silkworms; they must be fresh, soft, tender, and appropriate for the particular stage of development of the worms. Mulberry leaves, which account for 38.2% of the total success, are the most important element in silkworm farming, even if a variety of other variables might impact its success. How well mulberry is cultivated has a significant impact on the quantity, quality, and price of silk cocoons. About 70% of the silk produced by silkworms comes from mulberry leaves, and mulberry cultivation accounts for about 60% of the expense of creating cocoons. Around 20–25% of all crop losses are attributable to pests and diseases. A significant pest, the Red Spider Mite (Tetranychus ludeni) feeds on the sap of young leaves, causing them to turn brownish-yellow (a condition called cholrosis), which results in leaf drying, decreased nutritional content, and the mulberry tree's inability to carry out photosynthesis. The red spider mite or dark-red spider mite, as this mite is widely known, is a significant threat to mulberry trees (Morus spp.) because it harms the leaves, which results in a decrease in the quantity and quality of leaf output. Although the mite may be found throughout the year, it causes significant infestations in India, particularly from February to June, during hot and dry weather. The biology, meteorology related incidence, kinds and amounts of damage, and techniques for controlling mulberry feeding insects are all covered in this essential subject.

Key words: Mulberry leaves, silkworm, insect pest, red spider mite, polyphagous pest, acaricides, growth characteristics, Tetranychus ludeni.

Introduction:

Because of its evergreen, lush leaves, mulberry is a valuable plant that supports many species by providing food and shelter. It only eats the silkworm Bombyx mori, which is thought to be an important insect for making silk. Mulberry trees (Morus spp.) are the only food source for silkworms. As a result, the silkworm larvae's growth and maturation, as well as the superior quality of the cocoons they create, are both strongly impacted by the quality of the mulberry leaves. However, mulberry farming is frequently plagued by a variety of insect pests, including the Red Spider Mite (Tetranychus ludeni), which may significantly lower the yield and quality of mulberry leaves **(Das Gupta, KP 1961)**. Although mulberry trees are susceptible to a wide variety of insect pests, only a few of them actually cause economic harm to mulberry farming. Because the mulberry tree can flourish year-round, it is the only viable food source for the development of mulberry silkworm larvae, making it even more valuable. Around 8 million people in India work in the agriculture-dependent sericulture business. Mulberry (Morus alba L.) is widely grown on roughly 230,000 hectares and is often used for silk production and silkworm breeding. For 15 to 20 years, it is kept up as a perennial crop.

Silkworm raising and larval development are greatly impacted by the amount and quality of mulberry leaves, which has an impact on silk production and farmer income. Consistent farming methods, such irrigation, fertilization, weeding, and pest and disease management, are crucial for improving the yield and quality of mulberry leaves. Mulberry plants are susceptible to a wide variety of pests, some of which cause significant harm to the leaves' nutritional and chemical composition. Particularly problematic are sucking insects **(Burd JD, Elliot NC 1996)**. This feeding damage has a detrimental impact on the cocoon output and silk quality. Despite the hundreds of pest species that exist on mulberry, the Red Spider Mite (Tetranychus ludeni), mulberry thrips (Pseudodendrothrips mori), and papaya mealybug are the main culprits. Additionally, some insects are still at low economic impact levels and are sometimes thought to be insignificant. However, a number of weather-related variables can cause secondary pests to multiply unexpectedly in tropical regions. Sap-sucking insects have needle-like mouthparts that they use to suck nutrient-rich sap, such chlorophyll, micronutrients, pigments, and bioactive compounds from the stems or leaves **(Chatterjee KK, Sarkar A 1993)**. This feeding results in nutrient loss in leaves and inhibits the development of mulberry. Many of these pests secrete honeydew, which promotes the development of white or black sooty mold, a fungus that infests mulberry crops, covers leaves, and renders the vegetation unappealing during severe pest infestations. In addition to spreading diseases, some species also inject toxins while feeding, resulting in wilting. Scale insects, whiteflies, mealybugs, and thrips are examples of common sap feeders **(Sengupta K, 1990)**. Furthermore, several mite species that are not considered insect pests also consume mulberry sap. The papaya mealybug (Paracoccus marginatus) is a tiny polyphagous bug that infects a variety of host plants, such as tropical fruits, vegetables, mulberry, and decorative plants (Shree MP, et al., 1989). Infestations manifest as cotton-like bunches with lengthy, waxy threads on stems and leaves. The mulberry plant is weakened by the sap high in chlorophyll and bioactive pigments consumed by both the immature and adult forms **(Veeranna G., 1997)**. The afflicted leaves turn yellow, wrinkled, and ultimately die. Red Spider Mites (Tetranychus ludeni) produce honeydew that fosters the development of sooty mold, which reduces the capacity for photosynthesis. In addition, infestations alter the amounts of nutrients, photosynthetic pigments, and biochemical composition in various mulberry cultivars. Due to its susceptibility to a variety of insect pests and diseases, the mulberry tree is prone to a number of illnesses that compromise its quality. According to research, mulberry trees are susceptible to infestation by more than 300 different species of insects and non-insects. As a result, the Red Spider Mite, whose scientific name is a polyphagous pest, is able to infest a variety of crops and plants around the world. With its first notable record as a detrimental pest to mulberry in the nation, it has also been identified in India as a destructive pest to apricot, fig, tomato, plum, apple, wheat, peach, and hibiscus, particularly in wet areas. This scenario is concerning because mites have a big impact on the quality of mulberry leaves and negatively affect the biological and financial features of silkworms that eat them. Although acaricides are often used to control these pests, these man-made insecticides may have detrimental effects on the environment and endanger the health of silkworms. Moreover, these compounds have the potential to induce mite resistance. As a result, a new study was carried out to investigate the population growth rates of pests, such as the Red Spider Mite, and to analyze the impact of meteorological changes during rainy seasons on their growth parameters on mulberry **(Yokoyama T 1963)**. In addition, the goal of this study was to develop a strategy for controlling this mite in mulberry plantations **(Zeya SB, et al 2019)**. The perfect meteorology for raising the population of the red spider mite (Tetranychus ludeni) on mulberry was found to be a sericulture garden with an average and optimal summer temperature of 26±1°C in this study. The developmental time, notably the egg duration, as well as the fertility of the mite are also impacted. Furthermore, the dynamic variables of pest red spider mite

(Tetranychus ludeni) were also shown to be better in summer meteorology at ambient circumstances than in autumn. Ultimately, the understanding of population growth across different meteorology will aid in predicting the pest red spider mite (Tetranychus ludeni) load and implementing preventative and curative management strategies to prevent the mulberry leaf fall and safeguard the silkworm from pesticide exposure. To sum it up, the summer meteorology, which has an average temperature of 261°C, is conducive to the growth of destructive pests on mulberry trees that harm the silkworm's life cycle.

Life Cycle of Red spider mite:

Tiny sucking insects known as spider mites can cause significant harm to both indoor and outdoor gardens. Several species of spider mites (family Tetranychidae) are prevalent in Eastern Uttar Pradesh and prey on mulberry garden flora. They can be particularly damaging in greenhouses. The fascinating thing about spider mites is that they belong to the arachnid family, which includes spiders, ticks, and scorpions, rather than being real insects. Adults are quite little, about the size of the period at the conclusion of this line, and have an oval shape with a reddish brown or pale color. With the exception of their size, immature forms resemble the adults. Mites typically live in colonies, primarily on the undersides of leaves, and feed by puncturing leaf tissue and absorbing plant liquids. The leaves have light spots that indicate feeding marks. The leaves start to become yellow and may eventually dry up and fall off as the feeding continues. Hot, dry environments, especially when pesticides have wiped out their natural predators, are where spider mites are most prevalent. The majority of the several species found in Eastern Uttar Pradesh are predators of the plant-eating mites. Another factor contributing to the frequent unnoticed development of severe infestations before plants exhibit symptoms is their high productivity. Fine webs are frequently associated with big populations. Strawberries, melons, beans, tomatoes, eggplant, ornamental flowers, mulberry trees, and the majority of indoor plants are among the many host plants. In this article, we'll cover all you need to know about spider mites, including how to recognize and avoid their harm, as well as how to manage them successfully.

Signs of injury Sap sucking tender leaf Problem: Infested leaves turn reddish brown and bronzy, serious infestation larvae create a silken web over the leaves, the leaves wilt and dry out, and the production of blooms and fruits is impacted.

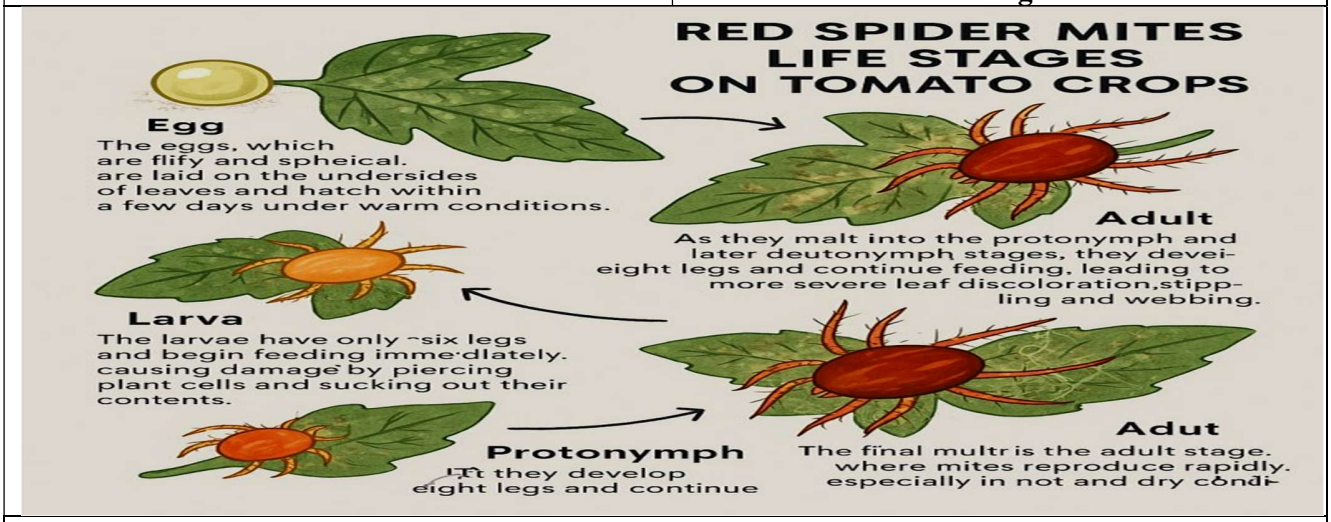
Identifying the pest: As there are several life stages, Eggs: Hyaline, spherical lay in mass Yellowish in hue are the nymphs. Red-colored, little size in adults.

Red Spider Mite Infestation

Red Spider Mite Infestation

Spotted Spider Mite Infestation on leaf

Red Spider Mite Infestation to suck photosyn Pigment



Red Spider mites Life stages on Tomato similar to Mulberry infestation

Fig: Shows the Red Spider mites Mite infestation on leaf and life cycle.
(Reference: All photo stages off Red spider mites viewed from Google site)

Economic Damage Caused by Spider Mites on Mulberry:

From the mulberry garden, the harm that the pest did to the leaves is obvious. The damage is caused by the larval stage; the infestation is mostly concentrated in the 4th and 5th larval stages. The larvae weave the leaves together and then consume them from the inside. The larvae skeletonized mulberry leaves by eating all of the interior green flesh. The affected area of the leaf lacks a number of substances, including water content, chlorophyll, sugars, proteins, and other things, and is coated with black and white molds. Due to their invisibility to the human eye, spider mites may enter our gardens unnoticed. They feed on sap from plant cells on the underside of leaves with their penetrating-sucking mouthparts. Visible harm results from significant infestations. The leaves first display patterns of minute yellow spots or stippling. They could fall off, curl up, or change color. Due to this injury, some plants, such as azalea, may even produce flowers and leaves that are misshapen. In the dense webs that are created beneath leaves and along stems, the mites' activity is evident. These indicators and symptoms might frequently be mistaken for drought stress.

According to the Integrated Pest Management, the damage caused by mites is as follows: Loss of leaves can have a major impact on the yield of annual vegetable crops like mulberry, squash, melons, and watermelons, as well as cause sunburn. Spider mites can inflict direct harm to plants like beans and sugar peas,

which are prone to pod attacks. Mites are mostly a cosmetic issue on ornamentals, but they can kill plants if their numbers get out of hand, particularly on annuals. Spider mites are another significant pest of roses cultivated in fields.

Damage Prevention and Treatment:

Regular inspection is one of the most effective ways to safeguard your plants. This will be made much simpler with a 10x handheld lens. Inspect your plants every three to five days for leaves that have white or yellow patches. Use the 10x hand lens to inspect the bottom side of the leaf if you discover any. If you see webs or mites, you should treat the plant. If you don't have a magnifying glass, you may also tap the leaf firmly after putting a white sheet of paper beneath the plant leaves. The spider mites will fall from the leaf onto the paper. If you find spider mites during a plant inspection, it's best to keep the affected plant separate from others to prevent the spider mites from spreading. If this is not feasible, then prompt treatment of the mites is essential to prevent a significant infestation in your garden plants. The best course of action for badly infected plants might be to get rid of them and put them in the trash since they are unlikely to recover. Don't put the plant in a compost heap.

Management strategies of pests:

Use dicofol 18.5 EC at a rate of 2.5 ml/liter or wet table sulphur 50 WP at a rate of 2 g/liter. By destroying the helpful insects that prey on spider mites, the usage of chemical pesticides promotes the spread of these pests. Mites are also known to develop rapid resistance to a variety of insecticides. For these reasons, it is crucial to manage mites using efficient organic and natural techniques. Trim Your Plants Thoroughly prune leaves, stems, and other contaminated areas of plants far beyond any webbing, and dispose of them in the trash (rather than in compost piles). To prevent the mites from spreading to nearby plants, don't be afraid to uproot whole plants. Aquatic Plants Appropriately Additionally, it's crucial to remember that water stress increases the vulnerability of trees and garden plants to mite infestations. Check to see that your plants are getting enough water. Apply water spray Use the Bug Blaster to wash plants with a high-pressure water spray to kill pests. Additionally, dust on leaves, fruits, and a branch attracts mites. It's a good precaution to dust trees with a mid-season spraying (or twice). Introduce helpful insects Ladybugs, lacewings, and predatory mites are examples of commercially available helpful insects that are significant natural enemies. Release when pest levels are low to medium for the best results. Use oils for horticulture heavily infested areas can be treated on a spot basis with botanical insecticides or insecticidal soaps. To kill overwintering eggs on fruit trees, horticultural oil should be used early in the season or late in the fall. To eliminate pest eggs indoors and disrupt the reproductive cycle, combine pure neem oil with coco-wet and administer every three to five days. Remember to treat every part of the plant, including the undersides of the leaves. Do not apply if the temperature is above 90°F, and wait at least six hours before turning on any lights. Use Insecticides A comparatively recent organic pesticide called NukeEm, which has food-grade components, is effective at killing the majority of indoor gardening pests at the egg, larva, or adult stage. Most importantly, it accomplishes this without leaving behind a residue on the leaves that might affect taste. Another very effective biological insecticide that you should think about using is the mulberry garden of Eastern Uttar Pradesh. It includes Beauveria bassiana, an entomo pathogenic fungus that targets a wide range of invasive crop pests, including resistant kinds! Weekly applications can provide protection that is equal to or superior to traditional chemical pesticides while also preventing insect population

surges. Release predatory mites to maintain control after using the least harmful and shortest-lasting pesticide to reduce infestations if there are a lot of people. Because this pest develops rapidly, especially during warm weather when eggs are laid continuously, management techniques must account for this. Only targeting the adults won't be very effective if the eggs and larvae live. Treatments must be repeated in almost all cases. Leaf shines and washes are used to manage and prevent future infestations.

Discussion:

One of the most frequent garden pests is the spider mite (Tetranychus ludeni). Due to their size they are smaller than the head of a pin they are difficult to see. Because they have eight legs as opposed to six, these creatures are classified as arachnids (similar to spiders) as opposed to insects. The majority of spider mites are capable of creating thin silk webs **(Reddy, DNR et al. 1999).** The two-spotted spider mite and the red spider mite are the most prevalent in the United States among the over 1,600 species of spider mites. Their colors can be anything from brown, red, green, yellow, or orange **(Hardman, J. M., et al 1985)**. The two-spotted spider mite (Tetranychus ludeni) is orange in color and has two black spots on its sides. Additionally, it is the primary cause of infestations in greenhouses and houseplants, as well as in the majority of decorative plants. When the weather turns warmer in the spring, spider mites emerge to feed on plants. Plants may become susceptible to disease and other problems as a result of this (Kumar, R. et al. , 1993). Each female spider mite lays hundreds of eggs, and they reproduce quickly. Red spider mites (Tetranychus ludeni) have a life cycle that consists of five primary stages: The Egg Stage The undersides of tomato leaves are covered in small, round eggs. Depending on the temperature and humidity, they hatch in a few days **(Karmakar, K., J. et al 1998)**. Larval stage Just after hatching, larvae have six legs and start eating right away by puncturing plant cells and absorbing their contents. Leaves may become yellowed and stippled as a result of this feeding. Stage of the Proto Nymph The larva transforms into an eight-legged proto nymph following molting, which continues to eat and harm the plant. The deutonymph stage are which resembles the adult stage but is not yet completely mature, is the result of another molt **(Ramegowda, G. K., et al, 2012)**. Webbing could start to develop on leaves as feeding becomes more intense. The Adult Phase The last molt produces an adult with eight legs that is fully developed. Adults reproduce quickly; females lay up to 100 eggs during their lifetime. The entire life cycle may be finished in as little as a week in warm, dry environments, which results in rapid population expansion and significant harm to tomato crops. Miticides, insecticidal soaps, biological control using predatory mites, and appropriate irrigation to minimize population explosions are all examples of control techniques. The majority of mite species hibernate as eggs on the mulberry leaves and bark of their host plants. As temperatures rise in early spring, minute six-legged larvae start to hatch and feed for a few days before finding shelter to molt into the first nymphal stage **(Dar, M. Y., et al 2019)**. Before reaching maturity, nymphs go through two additional molts and possess eight legs. Females lay up to 300 eggs at a time for a few weeks after mating. These insects thrive in hot, dry conditions **(Ahmed N, et al 2019)**. The time it takes to go from egg to adult can be as little as five days in these circumstances. Each year has numerous overlapping generations. Wind surfing is a favorite pastime for spider mites. They spread out over large regions, riding their web on the wind. Infested mulberry and other plants are best managed and disposed of with care.

Conclusion:

The Red Spider Mite (Tetranychus ludeni) severely reduces the leaf yield on mulberry (Morus sp.) plants, which has a detrimental impact on the leaf's quality. Consequently, an attempt was made to determine

how the photosynthetic pigments and biochemical makeup of mulberry leaves changed when they were infested with pests. The pieces of the mulberry tree that were afflicted by pests varied. Giving silkworms mulberry leaves that are contaminated with pests can have a detrimental effect on the leaves' nutritional content, which can then affect the mulberry larvae's growth and development as well as the quantity and quality of silk produced. Since the quantity and quality of mulberry leaves are crucial for the success of silkworm culture, it is imperative to utilize the authorized integrated pest management techniques to control the threat of Red Spider Mite (Tetranychus ludeni) infestation of mulberry without posing a major environmental risk, especially if autumn rearing is to be conducted commercially. This research offers crucial insights for hot air disinfection initiatives against this invasive Red Spider Mite (Tetranychus ludeni) pest. The data presented here might be used as a guide for assessing its invasion potential in the future. Consequently, Red Spider Mite (Tetranychus ludeni), if not handled seriously, may be recognized as one of the main biological variables causing sap sucker infestation in silk production under the sericulture industry.

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