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Integrated Mangmant of the Oriental Citrus Mite Eutetranychus *Orientalis (Klein)* (Review Article).

Shaymaa A.K. Al-Hamawandy[1] Samar Muthanna Shahrabani[1] A.B. Aljuboory[1]
[1]*Department of Plant Protection, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq.*
*Corresponding Authorshayma.abd@coagri.uobaghdad.edu.iq.

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ABSTRACT

The Integrated control mite *Eutetranychu orientalis* that uses a group of methods that simultaneously meet all of the environmental, economic, and health requirements, relying in particular on the use of biological enemies and the principle of critical economic limit. That is, integrated control, in other words, is a strategy for combating mites, based on the environment, as it relies on natural death factors by Biological enemies and unsuitable climate factors and rely little on other control techniques, as chemical control is used only when needed and through studying the numerical detection of the pest and natural death factors. The integrated management of the oriental citrus mite *E. orientalis* done by the botanical pesticide Oxymetrine 2.4% SL, the fungicide Hirsutella thompsonii, or mixtures of them, has proved its efficiency by controlling the growth of the mite practically, and the mixture was more potent despite using half the dose. Additionally, when using the *Scolothrips sexmuculatus* predator, great benefits were achieved in the context of reducing the number of pesticides by using the minimum recommended doses; this was reflected in reducing environmental pollution and decreasing the control costs, as well as achieving efficient management against the mite stages without any significant negative impact on the predator.

***Keywords*:** Eutetranychus orientalis, Hirsutella thompsonii, Oxymatrine, Integrated citrus, Mite

INTRODUCTION

The integrated control methods are a program that combines in a coordinated manner all available control technologies to increase the efficiency of controlling pests and reduce potential environmental, health, and economic problems. It is an important part of the pest management system IPM, which is an integrated program to manage the pest and keep it below the harmful economic limits that begins with agricultural operations Like varieties selection, plant control and pest emergence through the use of various control methods and crop Service operations ending with harvesting [1], [2], [3]. Explained; [4] reported that in recent years, in citrus orchards, control strategies have been developed using plant-based pesticides such as plant extracts, as these extracts showed repellent effect and high toxicity to female mites and reduced reproductive efficiency.

These good specifications for the activity of the extracts were developed as a common alternative to chemical pesticides in integrated pest management programs.[5]stated that success in integrated control of mite control programs in citrus orchards depends mainly on the compatibility between the correct management of agricultural operations and the cultivation of citrus varieties that are resistant or tolerant to mite infestation and the rational use of acaricides Optional (selective) in combination with classical biological control, which together help reduce the density of *orientalis mites*. Many researches have emphasized the need to pay attention to monitoring programs and periodic sampling to detect infestation early and prevent its spread and take the necessary measures promptly and not limit the process of taking sample to estimate the infestation of mites only, but rather to know the number of living enemies and their types spread in the environment of the pest and the extent of their efficiency in regulating the density of the pest and following the means to preserve it and encourage it to play its role in controlling the pest [1], [6].

Explain [7] that among the strategies of integrated control programs for mite pests commonly applied is the use of agricultural methods (tillage, weed removal, water management and irrigation regulation, balanced fertilization and crops attractive to live enemies) that ensure. The crop is not exposed to any biotic or abiotic factors that may contribute to increasing the plant's tolerance against type *E. orientalis*, [8] found that there is a relationship of climatic factors to the seasonal presence of *E.orientalis* on different citrus cultivars, as it was found that the density of mites was positively correlated with the maximum and minimum temperature, and negatively related to rain and relative humidity, and the light had a positive effect on the presence of predators and the seasonal abundance of the eastern citrus mite and its preference for citrus varieties and its peak activity over 12 months. Needed on time.

Showed [9] that the food preference of the host species had a direct effect on the growth period of the immature stages of the oriental spider mite survival rate when it arises on those species, it recorded the shortest period of egg incubation and larval

and nymph development and life cycle and higher survival rate for spider mite stages arising on lemon were recorded 4.03 days, 6.97 days, 11.00 days and 65.97%, respectively. The longest duration of egg incubation, larval and Nymphal development, and the lowest survival rate of spider mite stages arising on grapefruit were 4.93 days, 7.96 days, 12.89 days, and 57.60%, respectively.

The systematic position of *Eutetranychus orientalis* The Family Tetranychidae is one of the economically important families in the rank of Khartoumi Mite Order Trombidiformes, which has more than 60 species registered on citrus in various parts of the world [10] [11] and [12] stated that in the previous 10 years adjustments had been made to the classification scale of the spider class, incorporating all previous classification systems, and that the latest classification of suborder Prostigmata, which included the economically harmful plant A carus including the family of the Red Mite, which belonged to the Eastern citrus mite type, had been developed by [13]. the classification ladder of the Eastern Citrus Mite, as follows

Kingdom Animalia Linnaeus, 1758
Phylum Arthropoda von Siebold, 1848
Subphylum Arachnomorpha Heider, (1913).
Superclass Chelicerata
Class Arachnida Cuvier, 1812
Subclass: Acari Leach, 1817
Superorder: Acariformes Zakhvatkin, 1952
Order Trombidiformes Reuter, 1909
Suborder: Prostigmata Kramer, 1877(Actinedida)
Supercohort: Eleutherengonides Oudemans, 1909
Cohort: Raphignathina Kethley, 1982
Superfamily: Tetranychoidea Donnadieu, 1875
Family: Tetranychidae Donnadieu, 1875
Subfamily: Tetranychinae Donnadieu, 1875
Tribe: Eurytetranychini Reck
Genus: *Eutetranychus* Banks 1917
Species: *orientalis* (Klein1936)

Economic damage of the eastern citrus mite, *E. orientalis:*

The mite *E. orientalis* lives on the upper surface of citrus leaves, where it absorbs plant juice and appears around the feeding areas with bullet stains. This mite affects citrus trees of all ages, from small trees in the bulb to large, productive trees, and unlike other species of the same family, this kind of mite does not produce silk threads [14]. The damage arises due to the active and moving roles of the Eastern citrus mite on the upper surface of the leaves and the fruit cortex. The symptoms are visible on mature leaves whenever the mite can damage the papery tissue. The symptoms are the appearance of white spots and the loss of chlorophyll, where the leaves become yellow, and then they may die. The fruits are damaged when the population of the mite is high density [15].

Explain [16] members of the Eastern Mite gather around the oil glands on the surface of leaves and fruits. As a result of continuous feeding, white spots appear to transform the surface of leaves and produce fruit, causing paper damage, feeding on the upper surface of the leaves, and resulting in the formation of many grey spots. The injury leads to the weakening and fall of modern leaves.

[17] explained that the Eastern citrus mite feeds on the upper side of the leaf along the middle sweat, and the leaves become decorated, developing in pale yellow ribbons extending along the middle sweat and the spinal veins and, in cases of high Infestation, feeding and laying eggs on the entire upper surface of the leaf. Researchers in plant diseases believe that the mite may be responsible for the phenomenon of the autumn snail on citrus that causes the yellowing of acid leaves and the death of some branches in the fall as a result of the feeding of the mite, leaving a faint chlorophyll-free spot, especially at the end of the summer. The combined effect of insufficient water for trees and the low incidence of an East citrus mite results in a large amount of leave falling and twigs and their deaths, and trees become naked when the injury is severe [5]; [18] explain [19] the Eastern citrus mite strikes the palm leaves of the tiger, does not activity and the reduction of fruit.

[20] explained that this scourge absorbs plant juice in leaves and fruits as leaves change to yellow, grey, and fruit to a pale colour. In severe injuries, leaves and fruits fall and small branches dry.

Explain [21] The oriental citrus mite causes damage to the ornamental and medical plants by the mechanism of absorbing the plant sap of the newly developed leaves and buds, resulting in the appearance of necrotic spots on the targeted leaves, upward bending of their edges, and ultimately fall and death of these leaves. Consequently, this will conduct a significant high loss of the harvest. [22] pointed out that mite *E. orientalis* sucks the Palm leaves from the upper surface, stretching along the middle axis of the leaves, and watches eggs, moving stages, and slush skins in this area of the leaf. Plant juice absorbs the tissues of the leaf, loses Color decomposes the green living tissue, turns the leaf to a bright Yellow color makes a clear curvature in the leaves, appears in the form of length strips along the middle axis of the leaves, as well as the spider threads it produces, covering parts of the paper in cases of severe injury, which start in March and peak in the hot summer months, especially in July and August, and continue until February ,It product in the leaf edge bending upward, its death and its fall

Result and Discussion

Procedures for of the oriental citrus mite *Eutetranychus orientalis (*Klein)control

1-Agricultural control:

Agricultural control is the conduct of all agricultural methods that reduce the number of mites. This is represented in creating environmental conditions so that they appear in an inappropriate way for the pest, either by causing a defect in its reproductive capacity, or by getting rid of its alternative food hosts such as weeds, or by creating appropriate conditions for its vital enemies to destroy it. This method is considered the first line of defense for pest control. Many of these agricultural methods were discovered by farmers through observation and years of practical experience, passed down through generations, and among the preventive agricultural methods from mite pests such as early detection of the pest, irrigation, balanced fertilization and selection of varieties resistant to Infestation [23] [20]and [24] explained that it is necessary to locate the trees at appropriate distances so that the trees do not crowd in the future and cause many problems. Lower or internal branches, and to the spread of diseases and pests significantly. [25] also showed that the difference in plant hosts affected some of the life aspects of *E. orientali*,as it showed that the citrus plant host is the most preferred type and suitable for feeding, growing, and developing immature female titmouses, *E. orientalis*.

2-Fertilization:

[26] mentioned that mites are delicate and sensitive to all types of pesticides used against other mites. They mentioned that this mite can benefit from the techniques used in cultivating this crop, such as increasing the percentage of irrigation, using nitrogen fertilizers, and increasing the intensity of afforestation. [27] he Show different concentrations of nitrogen have a significant effect on the number of eggs laid, the longevity of the female and the various developmental stages remained unaffected. In contrast, the incubation duration of eggs, the pre-laying period, and the longevity of the male for citrus mites showed no significant changes. *E. orientali*,as an increase in nitrogen fertilizer more than required causes excessive vegetative growth of the plant at the expense of fruits, and increases the rates of mite and insect infestations [28].

Also, excessive fertilization with ammonium nitrate causes the highest rate of spider infestation. [29]. [30] and [31] found that citrus trees respond to fertilization to a large extent, and this affects their growth and fruiting, especially compound fertilizers that contain the major elements such as nitrogen, phosphorus and potassium, the observed increase in the weight and number of fruits, attributed to the addition of compound fertilizer, can be linked to the roles of nitrogen and phosphorus. These elements contribute to enhancing vegetative growth, as evidenced by an increase in both leaf area and the overall leafy area of the tree, which leads to an increase in the rate of photosynthesis and an increase in the nutrients processed in the leaves, and then an increase in the share of the fruits from these food and weight gain [32]. Indicated that the

Different levels of chemical fertilizers (K + NPK), (N + NPK) and (NPK) were significantly affected by the difference in the infection rate and the number of larvae of the citrus leaf miner, *Phyllocnistis citrella*, in the new branches of different citrus species (citrus orange, orange and lalanki).

3- Biological control:

The biological control measures for mites have achieved varying successes when applied in many regions of the world, despite The identification and registration of many of their living enemies as pathogens or predators of insects and mites [1]. Among the most important elements of successful biological control are predators[33],[34] Which feeds and kills its prey during its lifetime, and among the most important families of predators is the family of the predatory mites Phytoseiidae, and this family is one of the most prominent families of the mites prevalent in the world, as it contains more than 1,600 species belonging to 70 genera, but there are from this family what There are approximately 30 species that can be used on a commercial and global scale to apply the best biological control method[23]

4- Mite Predators:

The population of *E. orientalis* n citrus fruits is almost effectively controlled by the natural enemy community, the most common of which is the Phytoseiid mite [8,[25],[36] reported that nine phytoseiid species were tested to assess their reproductive capacity when fed on all stages of *E. orientalis*, [36] noted that the use of biological control with the predator Amblyseius cucumeris (Oudemans) In orange and mandarin orchards in China, efficiency in controlling the red citrus mite *Panonychus citri* (McGregor) ranged between 93.8 and 98.1%. In Iraq, [15] indicated the presence of the predatory mite *Amblyseius longispinosus* on bitter orange in citrus groves and is highly efficient in feeding on moving individuals of the eastern citrus mite (larvae, nymphs and adults), as it was observed that the predatory mite leaves traces of its feeding on the body of the prey in the form of holes in addition to feeding on eggs.

[37] indicated that there are more than 24 different species of Known predatory mite species on the four-legged citrus mite, including Euseius stipulatus, which specializes in consuming eggs and adults of citrus rust mite, [38], [39] and [7] found; *Euseius prisulatus*, Typhlodromus phialatus, Neoseiulus californicus, and Phytoseiulus persimilis are the most widespread phytoseiid mites in Spanish citrus orchards. *Euseius prisulatus* accounts for 70-90% of leaf mites, depending on the most widespread citrus species such as oranges, lemons or larks. Hidalgo [38] indicated that the predatory mite *Euseius scutalis* fed very efficiently on all roles of *E. orientalis* only. [40] found in a survey conducted in different citrus orchards in Málaga for the period 2003-2004, that the species *E. scutalis*, Paraseiulus *talbii and Neoseiulus cucumeri*s were found to be predators of *E. orientalis*.

5- Insect Predators:

[41] showed that there is a group of insectivorous predators that feed on the different stages of the mite of *E. orientalis*, such as Thrips and insects belonging to the Coccinellidae family and the Staphylinidae family. [7] noted; indicated that the larvae and adults of the predator *Stethorus gilvifrons* were efficient in preying on *E.orientalis* mites in orchards of oranges, lemons, peaches, and grapes. [15] mentioned that there is a group of predatory insects found feeding on the mite of eastern citrus. In citrus orchards, including *Solothrips sexmaculatus*(Thysanoptera:Tripidae), *Orius albidipennis* (Hemiptera: Anthocoridae), *Stethorus gilivifrons* (Coleoptera: Coccinellidae), *Chrysoperla carnea* (Neuroptera: Chrysopidae), the most frequent insect predators were *Scolothrips sexmaculatus* and *Orius albidipennis* and *Stethorus gilivifrons* These predators are characterized by the efficiency of their mobile roles by preying on mites. 1] The study focused on examining the impact of cotton varieties on the behavior of the predator *Scolothrips sexmaculatus* (Perg.), including its food preferences and predatory efficiency against various stages of the two-spotted mite *T. urticae* on cotton crops. The findings revealed that the time needed for the predator to consume different parts of the prey decreased as the predator's age increased, but it increased with the developmental stage of the prey.

[42] showed that the most common living enemies in citrus orchards located in the Numaniyah district / Wasit governorate is the predator Chrysoperla *carnea*, which was significantly superior to the rest of the living enemies present in the study area, as it reached the highest rate in July on bitter orange, lanki and orange 25.5 and 33.5 and 14.6 adults/sample, respectively, and the lowest rate in March was 7.4, 10.2, and 14 adults/sample, respectively. It also found other vital enemies, such as the seven-pointed ladybug, *Coccinella septempunctata*, the eleven-pointed ladybug, *Coccinella undecimpunctata*, and the predator *Clitostethus arcuatus*. It was observed that Scolothrips *sexmaculatus* leaves traces of its feeding on its prey in the form of holes, which was recorded on many plants that catch mites, most of which are from the Tetranychidae family, as they feed on their eggs [43] indicated that this predator is one of the important abiotic factors found in nature and has an important role in the control of mite species that infest citrus in Florida. [44] showed the predatory efficiency of the predator Stethorus *gilviforus* on the small stages of the mite of the shalik, as [15] showed that it is widespread in citrus orchards, preying on all stages of the eastern citrus mite *E. orientalis.*

6. Pathogens:

On the other hand, biological control agents are suitable alternatives to control pests, including Entomopathogenic fungi that live in fields under natural conditions [45]. Recent studies indicate that entomopathogenic fungi have the potential to work successfully alongside other groups of natural enemies used for biological control [46]. Some studies have also shown that pathogenic fungi do not produce harmful substances to plants, do not have a negative effect on the environment, and have no intrusive ability on humans and animals, which encouraged many researchers in various countries of the world to study the possibility of using it in biological control programs [46] found that all the stages of oriental citrus mite were susceptible to infection with the pathogenic fungus *Verticillium lecani*i (Zimn).[47] that treatment with fungus *V. lecanii* was effective against all stages of *E. orientalis*, and the adult stage showed high sensitivity (high impact) compared to other life stages. [48] It was noted that the efficacy of the the fungus filtrate from *Beauveria bassiana*, in the destruction of different stages of brown citrus mite *E. orientalis*, that the fungus *B. bassiana* Production of specific toxins, including Beauvericin, Bassianin, Bassianolide, Beauverolides, and Tenellin, and these toxins kill the host by destroying the host's tissues, deteriorating its cells, and more. The most common toxins are Beauvericin, which breaks down the insect's cuticle. ultimately leading to the death of the host. [49], [50]. Mentioned in a study to evaluate the effect of pathogenic fungal preparations Hirsutella thompsonii Fisher and Paecilomyces fumosoroseus on all stages of the oriental citrus mite *E. orientalis* under laboratory conditions, it was observed that all mite stages exhibited sensitivity to both pathogenic fungi under the tested concentrations. The larval and nymph stages were usually less sensitive than the adults.[8] Additionally,confirmed, when evaluating the fungal preparation Hirsutella thompsonii, that all individuals from the egg and active stage were included, with phenotypic variables, such as egg shrinkage, changes in the size and color of active stages, and the observation of dense fungal growth on .dead ndividuals

7- Herbicides:

Pesticides of plant origin include natural plant products called secondary metabolites, which include alkaloids, terpenes, phenols, and others [48] Botanical Insecticides are characterized by their effectiveness against a wide range of pests, as well as their lack of effect in most cases on non-targeted of natural enemies and bees. They are generally safe to use and do not have significant side effects on humans and their environment. Thus, they are considered a successful and effective alternative to pesticides. Chemical [51]

[52] indicated, in the light of his experience in the field of using plant extracts for forty years, that the world must move towards pesticides of plant origin, as he identified seven important plant families and considered them to be the main factories for the production of pesticides in the future, such as the neem pesticide to combat various pests, whether they are insects or Non-insects such as mites, fungi and viruses [53]. These pesticides contain many repellent and lethal substances and substances that inhibit nutrition and growth, the most important of which is Azadiractin, and commercial preparations contain different percentages of this active substance in addition to neem oil [54]. Among the latest commercial preparations of plant-based pesticides are those that contain active substances (Martin and Oxymatrin) extracted from plant alkaloids prepared and produced from the roots of wild plants belonging to the legume family, such as Sophra flavescencs, Sophora japonica, S. wsbprostrata and S. alopecuroides that grow in China [55], [56]. Many pesticide preparations have been produced based on

these alkaloids, which have been used against a number of insect, apical, bacterial, fungal and helminth pests. caecilians infecting vegetable crops, fruit trees and citrus [56]; [57]. The substance Oxamatrine affects the central nervous system of insects, which results in the inhibition of the transmission of nerve impulses, and the pesticide manufactured from these plants is relatively toxic to humans, animals and biosphere factors such as air, water and soil. It has an antifeedant and repellent effect

Conclusion: -

The average family of the Red Mite (Acari: Tetranychidae) is one of the most important mite pests on agricultural plants around the world, and most of its species cause a high population explosion that can cause serious damage and produce high economic losses. Among these types, *Eutetranychus orientalis* (Klein) is particularly important as the most multi-family species in the fields and Green houses in the Middle East and Africa, and when controlling the mits, I have to use the integrated control of the Mit not one way to control it. The oriental citrus mite, *Eutetranychus orientalis (Klein)*, is a worldwide key pest of citrus. It has various stages on citrus seedlings and trees throughout the year, and it has two peaks of activity, the spring and the autumn peaks. The difference in the plant host, lemon and grapefruit, has a significant effect on the biological and reproductive features of the mite adults.

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المكافحة المتكاملة لحلم الحمضيات الشرقي Eutetranychus orientalis (KLEIN) (مقالة مراجعة).

شيماء عبد الخالق الهموندي[1] سمر مثنى نجم شهرباني[1] احمد باقر الجبوري[1]

[1]قسم وقاية نبات، كلية علوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق.

الخلاصة

الادارة المتكاملة لحلم ***Eutetranychu orientalis*** هو برنامج يجمع بشكل منسق بين جميع تقانات المكافحة المتاحة لرفع كفاءة السيطرة على الآفة وتقليل المشاكل البيئية والصحية والاقتصادية المحتملة، وتعتمد بشكل خاص على استخدام الأعداء الحيوية ومبدأ الحد الاقتصادي الحرج. أي أن المكافحة المتكاملة بمعنى آخر هي استراتيجية اساسها البيئة التي تعتمد على عوامل الموت الطبيعي من قبل الأعداء الحيوية وعوامل مناخية غير مناسبة وتعتمد بشكل اقل على تقنيات المكافحة الأخرى حيث تستخدم المكافحة الكيميائية فقط عند الحاجة ومن خلال دراسة الكثافة العددية للافة للآفة وعوامل الموت الطبيعية.ان افضل الطرق المكافحة المتكاملة لحلم الحمضيات الشرقي ***E. orientalis*** باستخدام المبيد النباتي الأصل ***Oxymetrine 2.4% SL*** أو المستحضر التجاري للمبيد الفطري ***Hirsutella thompsonii*** أو الخلط بينهما قد اثبتت كفاءتها في السيطرة على جميع أدوار حلمة الحمضيات الشرقية حقلياً، وأن معاملة الخلط كانت أكثر فاعلية على الرغم من استعمالها بنصف التراكيز. وعند استخدام المفترس ***Scolothrips sexmuculatus*** مع المعاملات السابقة، حققت فائدة كبيرة عن طريق تقليل كمية المبيدات المستعملة وذلك باستعمال الحد الأدنى من التراكيز الموصى بها، الأمر الذي ينعكس على تقليل تلوث البيئة واختصار تكاليف المكافحة وفي الوقت نفسه مكافحة كفوءة ضد أدوار الحلمة دون أي تأثير سلبي ملموس على المفترس.

الكلمات المفتاحية: ***Eutetranychus orientalis, Hirsutella thompsonii, Oxymatrine*** ، حمضيات، ادارة .