R-2630
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REVIEW ARTICLE Agricultural Reviews

Garlic Mite, *Aceria tulipae* (Acarida: Eriophyidae): A Review

Ipsita Ghosh[1], Shamik Dey[2], Pranab Debnath[1]

10.18805/ag.R-2630

ABSTRACT

Garlic (*Allium sativum*), belonging to the family Amarylidaceae, is a bulbous plant which is widely used as a condiment for its pungent flavour. India holds second position in garlic production after China. It is attacked by many insect pests. The most hazardous pest is Garlic mite (*Aceria tulipae*). This mite is also known as dry bulb mite or onion mite. It attacks in both field and storage condition. In field condition a typical pig tail appearance is seen in infected plants. In storage condition reddish brown spots appear on the garlic cloves due to the feeding of this mite. This article contains different aspects of *Aceria tulipae, viz*., host range and host specificity, invasive history and distribution, morphology, taxonomic confusion, dispersal, biology and relationship with abiotic factors, population dynamics, damage symptoms in field and storage and its management.

Key words: *Aceria tulipae*, Biology, Dispersal, Garlic, Host range, Invasive history and distribution, Management, Morphology, Population dynamics, Symptoms, Taxonomic confusion, Virus transmitted, Varietal preference, Yield loss.

Garlic (*Allium sativum*) is a bulbous plant that belongs to the family Amaryllidaceae. Its very close relatives include onion, shallot, leek and Chinese onion, Chives (Block 2010). Garlic is widely used for its pungent flavor as a condiment. The sulfur compounds Allicin, Ajoene and Vinyldithiins are responsible for the pungency of garlic (Block, 2010). Garlic contains about 33 sulfur compounds, several minerals like calcium, potassium, copper, iron, zinc, selenium, magnesium, vitamins (A, C, B1), fiber and water and 17 amino acids are (Josling, 2005). India ranks second in garlic production after China and the other major garlic-producing countries are The Republic of Korea, Egypt, Spain, Bangladesh, Algeria, Uzbekistan, Ukraine and the United States of America (FAO, 2019).

Prodution wise also Madhya Pradesh occupies the first position, followed by Rajasthan and Uttarpradesh. Other garlic producing states are Gujrat, Orissa, Assam, Punjab, Haryana and Maharastra (National Horticulture Board, 2021-22). Garlic is attacked by many harmful dipteran insects like seedcorn maggot (*Delia platura*), Onion fly (*Delia antiqua*), Leaf miner (*Liriomyza* sp. and stem and bulb nematode *Ditylenchus dipsaci*, *D. platura, D. antiqua* that result into massive damage, if not controlled (Erdogan *et al*., 2022).

One of the most dangerous pests of garlic is *Aceria tulipae* (Acariformes: Eriophyoidea), which is also a prominent allexivirus carrier. The immature garlic leaves are a common location for this sort of mite, but it can also feed and grow on the matured cloves, which may cause them to wither and develop matte brown blotches (Jeppson *et al*., 1975; Keifer *et al*., 1982). This eriophyid mite species can cause serious harm to garlic production, causing it to decline by up to 23%. The majority of *A. tulipae*'s damage occurs when garlic bulbs are stored (Larrain, 1986). Because of this, *Aceria tulipae* has become a major pest concern and has gained attention. Despite the fact that this mite has been in the news for its negative effects on various crops over the past 75 years, still, the information generated about A. tulipae is dispersed.

[1]Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741 252, Nadia, West Bengal, India.
[2]School of Agricultural Sciences, JIS University, Kolkata-700 109, West Bengal, India.

Corresponding Author: Pranab Debnath, Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741 252, Nadia, West Bengal, India.
Email: pranab.bckv@gmail.com

How to cite this article: Ghosh, I., Dey, S. and Debnath, P. (2023). Garlic Mite, *Aceria tulipae* (Acarida: Eriophyidae): A Review. Agricultural Reviews. DOI: 10.18805/ag.R-2630.

Submitted: 23-03-2023 **Accepted:** 06-07-2023 **Online:** 11-08-2023

Host range and host specificity

Most *Allium* species, including the garlic (*Allium sativum* L.), leek (*Allium ampeloprasum* L.), onions (*Allium cepa* L.), chives (*Allium schoenoprasum* L.), shallot (*Allium ascalonicum* L.), rakkyo (*Allium chinense* G. Don.) and tulips (*Tulipa* spp.) are hosts of garlic mite (Keifer, 1938; Keifer, 1952; MacLeod, 2007; Torre De La and Martinez, 2004; Song *et al*., 2008). Although numerous writers (Lin *et al*. 1987; Chen *et al*., 1996; Golya 2002; Al-Azzazy *et al*., 2013) have described this mite as a pest of various graminaceous crops and weeds, but it appears that the mite attacking graminaceous crops and weeds are taxonomically different from *A. tulipae* (Shevtchenko *et al*. 1970; Halliday and Knihinicki, 2004; Skoracka *et al*., 2014). Dry bulb mite also attacks plants belonging to the families like Melanthiaceae and Asparagaceae. Among this vast host range of *Aceria tulipae*, garlic and leek are reported as the most vulnerable (Kiedrowicz *et al*., 2017).

Invasive history and distribution

The dry bulb mite, tulip mite and onion leaf mite are other names for the garlic leaf mite, *Aceria tulipae* (Keifer) (Navia *et al*., 2010). Keifer first recognized it from tulip bulbs in 1937. Later, in 1952, Keifer discovered it in onion and garlic bulbs. It was also detected from hosts like chives, shallots and leeks. For the first time from India, Puttarudriah and Channabasavanna (1958) described *A. tulipae* infesting garlic crops in Mysore. In Maharashtra, Pawar *et al*. (1990) investigated how different garlic varieties responded to *A. tulipae*.

The pest is reported from Japan and it was spread from France and the USA on infested shallots (Masaki 1991) (Table 1). Halliday and Knihinicki described *Aceria tulipae* from Australia as a pest of bulbs in 2004. The mite accidentally invaded Japan (Mito and Uesugi 2004) and China (Hong *et al*. 2006) infesting the following plants *i.e*. *Allium sativum*, *Allium cepa* and *Tulipa* spp. Through the use of contaminated onion planting materials, it was brought from the Netherlands to the United Kingdom (Ostoja-Starzewski and Matthews 2006). Khanjani and Haddad (2006) reported that this mite was present in Iran and had infested a cultivar of tulips. It has been recorded from all continents, with the exception of Antarctica, in about 33 different nations around the world (CABI, 2006; Ostoja-Starzewski and Matthews, 2006). Navia *et al.* (2010) listed the eriophyid mite as an invasive alien species.

Morphology

In the description of garlic mite made by Keifer (1938), he described distinctive characters of *A. tulipae*. Female of this mite is spindle shaped, whitish in colour, measuring 210-250 microns long and 50-60 microns wide. Rostrum is 28 microns long. Subtriangular shield is little curved, overlying base of rostrum, 39 microns long by 36 microns wide. Abdomen has 85-90 rings having some ventrad reduction in number, rings are 2 microns wide, partly resting microtubules are seen on rear edge of each ring, microstriation is seen in last 5 or 6. Lateral seta is found on ring 10, above genital seta, is 35.5 microns long. 1st ventral seta is 54 microns long on ring 27. 2nd ventral seta is 35 microns long situated on ring 50. 3rd ventral is 31 microns long, 5 or 6 from rear. Caudal seta is 80 microns and accessory seta is 4.5 microns long. Female genitalia is about 17.5 microns long and 24 microns wide, subcordate, longitudinally furrowed coverflap, genital seta is 12 microns long.

Aceria tulipae consists of three distinct body regions, gnathosomal region consisting of mouthparts, podosoma with 2 pairs of legs and opisthsoma bearing genital region. The flattened, subtriangular dorsal shield of *Aceria tulipae* has many longitudinal lines which is formed by cuticule. On the anterior region of opisthosoma male and female genitalia

Table 1: Country-wise distribution of *Aceria tulipae*.

Continent	Country	Source
1.Asia	India	Puttarudriah and Channa Basavanna, 1958
	China	Xin, 1984; Yang *et al.,* 1995; Hong *et al*., 2006; Song *et al*., 2008
	Hungary	Budai, 1997
	Iran	Khanjani and Haddad 2006; Xue *et al*., 2009
	Japan	Mito and Uesugi, 2004
	Thailand	Charanasri *et al*., 1984
	Korea Republic	Koo *et al.,* 1998
	Bangladesh	Ahmed and Benigno, 1984
	Kazakhstan	Halliday and Knihinicki, 2004
	Turkey	Denizhan, 2012
2. Africa	South Africa	Daiber, 1996
	Egypt	Zaher and Abou-Awad, 1979; Wahba *et al.,* 1984
3. Europe	Italy	Laffi *et al.,* 1994
	Poland	Boczek, 1964
	France	Courtin *et al*., 2000
	Netharland	Sapakova *et al*., 2012
	United Kingdom	Ostoja-Starzewski and Matthews, 2009
	Georgia	Flechtmann and Davis, 1971; Cavcanidze, 1978
	Finland	Liro and Roivainen, 1951
	Germany	
	Spain	del Estal *et al.,* 1985
4. Australia	Australia	Halliday and Knihinicki, 2004
5. South America	Brazil	Scalopi *et al.,* 1971; Rossetto 1972
6. North America	South Dakota	Briones and McDaniel, 1976
	Cuba	Almaguel *et al*., 1985
	California	Keifer, 1938
	USA	Keifer, 1938
	Mexico	Hoffmann and Lopez-Campos, 2000

are found accompanied with a pair of genital setae. Each leg has five regions, granulated coxal plate, trochanter, femur, tibia and tarsus. Distal end of each tarsus has a featherclaw and solenidion. Its featherclaw is simple having an undivided central shaft. Number of rays in each featherclaw varies among sexes which is 7 in case of females and 6 in case of male mites (Chandraptya 1986).

According to the observation of Shevtchenko *et al.* (1970), *Aceria tulipae* has 7 number of rays on empodium I, In case of dorsal shield, median lines are short, submedian lines are angled laterally at 90°. Dorsal shield length is 40-43 micrometer, 82-88 number of dorsal annuli, body length is 193-295 micrometer, Width of genital coverflap is 24-26 micrometer.

Taxonomic confusion

Aceria tulipae (Keifer), which originated in Holland, was named based on specimens that were collected by W.B. Carter from tulip bulbs in Sacramento in October 1937 (Keifer, 1938). Later, in 1952, Keifer had expressed concern about a widespread infestation of wheat by *A. tulipae* in Alberta, Canada, as well as in Nebraska and Kansas. From that point until the publishing of Shevtchenko (1970), *A. tulipae* was still referred to as the wheat curl mite. Shevtchenko was the first to prove that the mites that infest onions and wheat are separate species, despite having a morphology that is extremely similar. In 1970, he described the wheat curl mite (*Aceria tritici*) as a new species. Amrine and Stasny concluded that the name *Aceria tosichella* was given to the wheat curl mite by Keifer (1969), who also established its final description. But it is very unfortunate that many scholars continued to call wheat curl mite as *Aceria tulipae* or *Eriophyes tulipae* till the catalog by Amrine and Stasny (1994) was published and even for several years thereafter.

Keifer never acknowledges his mistake which was made in 1953 of incorrectly referring to wheat curl mite as *A. tulipae*, not even in the publication of *tosichella*, nor in his book "An illustrated guide to plant abnormalities caused by Eriophyid Mites in North America" (Keifer, 1982). Most researchers now understand that *A. tulipae* is restricted to the Liliaceae: tulips, onions and garlic.

Still, some authors mention the wheat curl mite as *Aceria tulipae* in their publications (Al-Azzazy *et al*., 2013; Chen *et al*., 1996).

Dispersal

Wind plays a significant part in the mite's ability to disperse and wind barriers did not prevent this from happening (Pady, 1955; Slykhuis, 1955; Staples and Allington, 1956). *Aceria tulipae* has been shown to stand upright due to their caudal setae (h^2 setae) on the leaf surface, which makes them easier for the wind to carry (Debnath and Karmakar, 2013). According to Gibson (1957), mites can adhere on the legs and bodies of aphids. According to Del Rosario and Sill (1958) and Del Rosario (1959), mites can move 4 to 5 cm on a smoked glass slide every hour.

Biology and relationship with abiotic factors

This mite develops from egg to egg in 18.4 days, having a mean ovipositional time of 25.1 days, fecundity of this mite is 44 eggs per female and lays an average of 1.76 eggs each day (Wahba *et al*., 1984). According to Acua-Soto *et al*. (2012), this mite may cover one generation at a temperature of 25±2°C in 13.8±1.5 days. The ideal relative humidity for egg hatching is close to 100% and it takes 8-10 days at 75-80° F to complete the life cycle from egg to adult to egg (CABI 2006).

Only about 5 µm can be penetrated due to *A. tulipae*'s stylet and subcapitulum structure (Orlob, 1966a). Because of its 500 nm-wide mouth opening and foregut, adult *A. tulipae* may consume larger plant pathogens and spread a variety of viral diseases (Whitmoyer *et al*., 1972). According to Del Rosario and Sill (1964), PDA (Potato Dextrose Agar) media was superior to other culture media in that garlic mite adults exhibited the longest persistence on it for roughly 80 days.

The temperature at which development occurs in a relatively short period of time is 25°C, the deadly temperature is 45°C and the highest threshold temperature for egg development is 6°C (Courtin, 2000). A high percentage of egg hatching requires relative humidity near to 100%, however water condensation on leaves is hazardous. Transpiration from the host has a significant regulatory impact on the levels of humidity that promote mite survival.

Abiotic factors like temperature, rainfall and relative humidity have an impact on the mite population. It has been observed that the mite has a negative correlation with rainfall and positive correlation with temperature and relative humidity (Debnath and Karmarkar, 2013).

Population dynamics related to environmental factors

The population of garlic mites begins to rise in February and reaches its peak in the third week, when there are 49.7 mites/cm^2 of leaf area. The essential factors in preserving their population level are temperature and relative humidity. It had been noted that the average maximum, minimum and relative humidity for the typical meteorological week were, respectively, 30.3°C, 15.3°C and 95.7% during that time. However, a rise in the maximum temperature and the presence of moderate rainfall later contributed to a decline in their population. At the end of February, a low mite population (2.7 mites/cm^2) was observed (Debnath and Karmakar, 2013).

According to Bala *et al*. (2015), the standard meteorological week's mean maximum temperature, minimum temperature and relative humidity were 28.26°C, 10.26°C, 79.86% and 51.14%, respectively, during the last week of January, when the mite population reached its highest level, or 16.6 mites/cm^2 leaf area. Due to an increase in the average temperature, the occurrence of moderate rainfall and crop maturity, there will be a later population decline. At the end of February, a very low population (2.9 mites/cm^2 leaf area) was reported.

Colonization of garlic mite on different garlic plants

The dry bulb mite, also known as the garlic mite (*A. tulipae*), establishes colonies on the leaves, garlic cloves with and without husks. It has been noted that this mite prefers garlic cloves without husk over leaves and cloves with husk (Kiedrowicz *et al*., 2017).

Symptoms

Garlic mite attacks the garlic plant in both field and storage conditions.

Symptoms in field condition

Within 20 days of planting, when the plant is in its third leaf stage, symptoms in the field begin to manifest. Infested leaves curl, which eventually causes the leaves to turn yellow. When the problem is severe, the tip section of the leaves touch the next plant, curling into the familiar "PIG TAIL" shape (Debnath and Karmakar, 2013). Typically, infected leaves are curved downward with their tips tucked into the subsequent young leaves (Channabasavanna, 1966). The green growing tip and the spaces between the bracts are where dry bulb mite prefers to feed. The infected bulbs typically started to rot. Later, the mites climbed up into the leaf folds to continue feasting (Lange, 1955). According to reports, both adults and immature stages of the dry bulb mite feed on young leaves and the spaces between layers of garlic cloves. Due to their feeding, foliage stunts, twists, curls and discolors and bulb tissue scarifies and dries out. This pest may spread through mulch or seeds. The damaged plants have yellowish or pale green stripes on their leaves and they become twisted and deformed. The leaf blade may not come out of the cloves easily and the leaves may separate poorly. The harm is referred to as "tangle top"(Ahmed *et al*., 1984).

Symptoms in storage condition

This mite also attacks garlic in stored condition. They prefer to settle beneath the scale of the garlic clove, where they destroy the tissue by sucking the sap out of it, eventually leaving a reddish-brown stain on the clove (Debnath and Karmakar, 2013). According to reports, contaminated clove serves as the major inoculum (CABI, 2006). Lange and Mann (1960) and Wahba *et al*. (1984) reported that a single bulb in the storage become the inhabitat of mite colony where they complete their all life stages (Egg and Nymphal stages). In stored condition, mite feeding leads to develop brown spots on infected garlic cloves which leads finally in rotting by disease organisms (Jepsom and Putnam, 2008). Na *et al*. (1998) reported that due to infestation of this mite, the scales of garlic cloves gradually turn into dark brown in color.

Virus transmitted by *Aceria tulipae* and its host name

Several viruses believed to be spread by the mites are to blame for this damage (Shevtchenko *et al*., 1970, Ahmed and Beningo, 1984b, 1985; Van Dijk *et al*., 1991; Van Dijk and Vlugt, 1994; Latif and Raboni, 1994; Yamashita *et al*., 1996).

Viral accumulation and evolution in garlic plants (*Allium sativum* L.) have had huge consequences for global commerce in garlic. It is also known that aphids and eriophyid mites (*Aceria tulipae*), which carry Potyviruses, Carlaviruses and Allexiviruses, are responsible for these viral epidemics (Table 2). Aphids are the main vectors of the potyviruses and carlaviruses (Sumi *et al*., 1993, Howitt *et al*., 2001, Van Dijk *et al*., 1991). However, eriophyid mites (*Aceria tulipae*) are also a significant vector, in accordance with a previous study (Tsuneyoshi *et al*., 1998), although little is known about the epidemic patterns of Allexivirus genus and family distribution in garlic plants.

In garlic plant three genera, including Garlic mosaic virus (GarMV) of Potyvirus, Garlic mite-borne mosaic virus (GMbMV), Garlic latent virus (GarLV) of Carlavirus and Garlic virus X (GarV-X) of Allexivirus, all were detected in Korea (Chang *et al*., 1991; Chung and Chang, 1979; Koo *et al*., 1998; Song *et al*., 1997). According to Koo *et al.* (1998) the genus Allexivirus was widespread, causing mosaic or streak symptoms in cultivated garlic plants of Korea.

Flexuous and filamentous virus particles having a length of 700-800 nm were observed in *Allium sativum* L. having mosaic symptoms. This virus was transmissible from garlic to seven out of 25 tested plant species, which includes systemic mosaic of garlic, local lesion of *Chenopodium murale* and *Gomphrena globosa*. This virus could be

Table 2: Name of the viruses transmitted by *A. tulipae.*

Virus name	Host name	Source
1. GarV-A	Garlic	Sumi *et al.* 1993
2. GarV-B	Garlic	Sumi *et al.* 1993
3. GarV-C	Garlic	Sumi *et al.* 1999
4. GarV-D	Garlic	Sumi *et al.* 1993
5. GarV-E	Garlic	Chen *et al.* 2001
6. GarV-X	Garlic	Song *et al.* 1997
7. Tulip virus-X with the association of *Rhizoglyphus echinopus*	Tulip	Lommen, *et al.* 2012
8. Shallot virus-X	Shallot	Hamed, *et al.* (2012)
9. Flexuous viruses	Crow garlic (*Allium vineale*)	Van and Vlugt (1994)

transmitted by garlic mite (*Aceria tulipae*), not by aphids. (Yamashita *et al*., 1996).

Razvjazkina (1971) was the first to report mite-borne viruses infecting *Allium* species and the virus was given the name Onion mosaic virus (OMV). The first well-known mite-borne viruses were the onion mite-borne latent virus (OMbLV) and the shallot mite-borne latent virus (SMbLV) (Van Dijk *et al*., 1991). Serological studies revealed that these are close to Shallot virus X (ShVX) (Kanyuka *et al*., 1992; Van Dijk and Van der Vlugt, 1994). In addition, due to their strong sequence similarity to ShVX, other mite-borne viruses like Garlic virus A (GarV-A), Garlic virus B (GarV-B), Garlic virus C (GarV-C) and Garlic virus D (GarV-D) were added to this group. The eriophyid mite *Aceria tulipae* transmits mite-borne viruses (Van Dijk *et al*., 1991) that cause minor mosaic, short weak stripes, or no symptoms in *Allium* species (Yamashita *et al*., 1996; Van Dijk *et al*., 1991; Van Dijk and Van der Vlugt, 1994). These viruses, together with potexviruses and carlaviruses, were recently placed in a new genus called Allexivirus that belongs to the sindbisvirus-like virus supergroup (Hillman and Lawrence, 1995). Potex- and carlaviruses share similarities in their genome organization and predicted amino acid sequences of multiple open reading frames (ORFs), although they are clearly different from these two genera (Sumi *et al*., 1993; Song *et al*., 1998). ShVX (Kanyuka *et al*., 1992), GarV-A, GarV-B, GarV-C and GarV-D (Sumi *et al*., 1993) and Garlic virus X (GarV-X) are also members of this genus (Song *et al*., 1998).

GarV-A, GarV-B, GarV-D and GarV-X are the six different garlic viruses that have so far been identified from the Allexivirus genus (Chen *et al*., 2001, Sumi *et al*., 1999) and they have all been discovered in Korea (Koo *et al*., 2002, Song *et al*., 1997). However, in addition to long-term vegetative propagation, these viruses are also spread by aphids and plant eriophyid mites, causing significant economic damage (Delecolle *et al*., 1981, Fujisawa *et al*., 1989; Koo *et al*., 1998; Koo *et al*., 2002; Song *et al*., 1997; Van Dijk *et al*., 1994). Therefore, it is strongly advised that garlic farmers take action to manage aphids and mites.

Varietal preference

Garlic cultivar Katki was shown to be tolerant of the garlic mite, whereas Goldana was vulnerable to mite infestation during varietal screening (Debnah and Karmakar, 2013). According to Sapáková *et al*. (2012), the semi-bolting kind of Plovdiv Rogosh has a greater infestation percentage than the bolting and non-bolting types.

Maximum mite population was observed in mite susceptible garlic variety B-25 following B-32 in last week of February. Similarly, the highest percentage of damage was also observed in these two varieties. Mite incidence was very low in the garlic varieties C-37, B-30 whereas in C-47, C-65, C-63, C-49, C-37, B-30, B-19, B-22 and B-28 varieties mite infestation was found to be fairly low and regarded as tolerant against *A. tulipae* (Mandal 2014). According to Pawar *et al*. (1990), of the seven cultivars examined for resistance to the garlic leaf mite, G-41, IC-49383 and G-1 were the most resistant to *A. tulipae*.

Yield loss

According to Debnath and Karmakar (2013), the yield loss caused by the garlic leaf mite in field conditions is greater than 32%. Larrain (1986) estimated that yield loss occurs up to 23%. According to Courtin *et al*. (2000), *A. tulipae* is regarded as a significant garlic pest that greatly reduces yield. Yield loss occurs upto 40% by this mite and Garlic mosaic virus (Ahmed and Benigno 1984). In onion yield loss upto 30% have been reported (Liro, 1942). Budai *et al*. (1997) reported that a huge loss of garlic takes place in storage condition due to this mite attack. A reduction of 19% in bulb weight in Brazil and 20% in Chile has been reported (Ostojá-Starzewskie and Matthews, 2006).

Management

Management of *A. tulipae* can be achieved by cultural, physical, biological and chemical practices.

Physical practices

Treating the garlic clove with hot water at 35°C for 20 minutes or warm water at 40°C for 15 minutes are very effective to control the pest in storage condition (Kamali *et al*., 2012).

Cultural practices

Huges, 2010 reported that decomposition of plant residue from previous crop by cultivation reduce the population of *A. tulipae.* Dry bulb mite can also be managed by adopting cultural practices like-flood irrigation, the inundation process of field can reduce the mite population in soil and avoiding mono cropping *i.e.* only cultivation of garlic throughout the successive years.

Biological practices

Casthilo *et al*. (2009) reported that a predatory mite (*Stratiolaelaps scimitus*) can be used as a biocontrol agent of *A. tulipae*. Another predatory mite *Neoseiulus cucumeris* is reported against *A. tulipae* (Lesna *et al*., 2004). Several biocontol agents also have been reported that can be used against *A. tulipae. i.e.* predators such as anthocorid bugs (*Orius* sp.), mirid bugs, syrphid/hover flies, green lacewings (*Mallada basalis* and *Chrysoperla zastrowi sillemi*), predatory mites (*Amblyseius alstoniae*, *A. womersleyi*, *A. fallacies* and *Phytoseiulus persimilis*), predatory coccinellids (*Stethorus punctillum*), staphylinid beetle (*Oligota spp*.), predatory cecidomyiid fly (*Anthrocnodax occidentalis*), predatory gall midge (*Feltiella minuta*), spiders *etc* (NIPHM, 2014).

Chemical practices in field

Dipping of garlic planting material in the mixture of wettable sulfur and dimethoate results in reducing the mite population (Katkar *et al*., 1998). According to Hafez and Maksoud (1984) Bromopropylate insecticide showed the best result in suppressing the mite population in field. Bala *et al*. (2015) reported that prophenophos and dicofol show good result.

Chemical practices in storage

Garlic bulb is fumigated by Mbr (Methyl bromide) @ 32 g/m³ for 2 hours at 21°C results in the controlling of mites (Jones and Mann, 1963). Na *et al*. (1998) reported that treatment of garlic cloves by alluminium phosphide tablet (celphos) @3 g/mł for 72 hours in airtight plastic boxes (1 m*1 m*1 m) which results in achieving a huge percentage of mortality factor.

CONCLUSION

From this article it can be said that Garlic mite (*Aceria tulipae*) is very much problematic for garlic cultivation. It is a threat of garlic in case of both field and storage condition. It causes major yield loss in garlic. So, proper management practices should be carried on to keep garlic free from this infestation both in field and storage.

Conflict of interest: None.

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