NATURAL CONTROL POTENTIAL OF GALENDROMUS FLORIDANUS (ACARINA: PHYTOSEIIDAE) ON TETRANYCHIDAE ON FLORIDA CITRUS TREES

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ABSTRACT

The identity, life cycle, food habits, and host-predator relationships of the predatory mite, Galendromus floridanus (Muma), are reviewed and new substantiating data are presented. It is concluded that the predator is capable of reducing six-spotted mite infestations but is probably ineffective in the natural control of the Texas citrus mite or citrus red mite.

The purpose of this paper is to evaluate the potential of Galendromus floridanus (Muma) in the natural control of spider mites, Tetranychidae, in Florida citrus groves. The following paragraphs present available historical information concerning this predatory mite.

Originally described as Typhlodromus floridanus Muma (1955), the species has been variously taxonomically assigned as Typhlodromus (Typhlodromus) helveolus Chant (1959); Galendromus floridanus Muma (1961); Galendromus (Galendromus) floridanus Muma (1993); Metaseiulus floridanus, Schuster and Pritchard (1965); and Typhlodromus floridanus, Chant and Baker (1965).

In the original description (Muma 1955), the species was recorded as feeding on six-spotted mites, Eotetranychus sexmaculatus (Riley); citrus red mites, Panonychus citri (McGregor); and Texas citrus mites, Eutetranychus banksi (McGregor). Later (Muma 1955A, 1958, 1961A, 1964, and Muma et al. 1961), evidence was presented and discussed concerning the association with and feeding of the species upon E. sexmaculatus. In most cases, however, the coincidence of the low host mite populations, high predator populations, higher temperatures, and increased rainfall prevented an evaluation of the predator as a biotic natural control agent.

Muma (1964) reported that the species was the sixth most common phytoseiid on Florida citrus leaves but represented only 2.8% of the total phytoseiid population on random leaf samples. The species was found to be most common in the central and west coast citrus-growing areas in the spring with a sex ratio of 1 male to 4 females. Despite these findings, however, Muma (1965) did not report the predator as a prevalent species on citrus owing, it was believed, to its remarkably consistent coincidence with sporadic infestations of the six-spotted mite.

The present paper presents additional experimental and observational data on G. floridanus which is known locally as the “tan mite.” On the basis of these supplementary data, the biological control potential of the tan mite is reevaluated.

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METHODS

Since the data presented here have been accumulated over a 16-year period and methods have been modified as new knowledge was gained, no consistent methods or techniques have been utilized. Therefore, pertinent procedures are detailed and discussed in preliminary paragraphs of each section.

PREDATOR IDENTITY

The species under consideration conforms to the following diagnoses. Females are typical phytoseiids of the genus Galendromus and subgenus Galendromus as delineated by Muma (1963). They are distinguished from the very closely related or synonymous Galendromus gratus (Chant) by proportionately longer L₀ and L₄, nodular dorsal scutal ornamentation between the opposite members of M₃, and a slightly longer epimerae. The distinctly shorter M₁, longer peritreme, and larger size distinguish the species from Galendromus longipilus (Nesbitt), G. occidentalis (Nesbitt), G. annecensis (DeLeon), and G. ferruginens DeLeon. Males are readily distinguished from all other species of the genus and, as far as is known, from the family by possession of a pair of strong nodular processes between the opposite members of M₂ and a ventral connate process on the trochanter of Leg II.

The generic nomenclature is, as indicated by Pritchard and Baker (1962) and Schuster and Pritchard (1965), open to question. For the present, however, the genera Galendromus Muma, 1961 and Metasciulus Muma, 1961 are conservatively maintained separately until the variation ranges of the type species have been determined. The overly conservative use of the genus Typhlodromus Scheuten, 1857, as proposed by Chant (1965) and Chant and Baker (1965), is untenable.

PREDATOR LIFE CYCLE

Data on the life cycle of the tan mite were obtained in 2 different ways. In 1956, 30 daily stage counts were made on 3 laboratory cultures of the predator, fed six-spotted mites, and maintained at 75° to 80° F. These data were then arrayed in bar graphs for each day, and the number of days between numerical peaks of each stage were computed. In 1967, individual newly hatched larvae were isolated in the laboratory on excised citrus leaves, in plastic boxes on water-saturated cotton batting at 80° F, fed six-spotted mites, and observed daily until maturity. The eggs were deposited in the laboratory by grove-collected females. Altogether, 27 individuals were reared to adults with this technique and the maximal, minimal, mean, and modal times for development computed.

Egg production and mating experiments were conducted in the laboratory at 80° F with laboratory-reared males and females.

The 1956 data did not produce any usable information on the duration of eggs, larvae, protonymphs, and deutonymphs but did indicate a complete cycle from egg to adult of 7 to 9 days. The 1967 data are arrayed in Table 1. From these results, it is obvious why the 1956 method did not
prove satisfactory; all stages completed development in 1 to 2 days. Both sets of data, however, indicated a maximum cycle of 9 days; and the 1967 data showed that development can be completed in a much shorter period of time—4 days.

**TABLE 1. LIFE CYCLE, EGG DEPOSITION TO ADULT, OF FEMALE AND MALE *Galendromus floridanus* (Muma) WHEN FED SIX-SPOTTED MITES AT 80° F UNDER LABORATORY CONDITIONS.**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Females (19)</th>
<th>Males (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Mean</td>
</tr>
<tr>
<td>Egg</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td>Larva</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Protonymph</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>Deutonymph</td>
<td>3</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Egg production of laboratory-reared virgin females following primary mating varied from 10 to 45 eggs with a mean of 20.2 for 6 females. Females deposited eggs for 1 to 2 weeks, frequently depositing 6 or more eggs per day in a cluster. Males mated 2 or more times, depositing in the 5 females 1 spermatophore in each spermathecum. Females would not permit a second mating until after deposition of 20 or more eggs. Virgin females lived for 1 to 2 weeks but did not deposit eggs. Unmated males also lived for 1 to 2 weeks. Mating procedure and position was the same as that reported for other phytoseids. For details, see Muma (1970) on mating of *Typhlodromalus peregrinus* (Muma).

**PREDATOR FOOD HABITS**

Studies on the food habits of the tan mite involved feeding observations under grove conditions and in the laboratory. Specimens, primarily adult females, were also isolated on excised citrus leaves in plastic boxes on water-saturated cotton batting in the laboratory at 80° F, and starvation, survival, and reproduction were used as indices of food suitability. Since the rate of host consumption is also pertinent, 51 females and 6 nymphs retained in plastic boxes as indicated above were also exposed to known numbers of the various growth stages of six-spotted mites.

Observations have demonstrated that although this predatory mite is most commonly associated with and is seen feeding upon six-spotted mites, it will also readily feed on other *Tetranychidae*. It has been observed several times, under grove conditions, feeding on the eggs and nymphs of citrus red mites and Texas citrus mites. It has also been observed in the laboratory feeding on eggs and active stages of *Tetranychus tetranychus* Pritchard and Baker.

Laboratory experiments have demonstrated that the tan mite reproduces
readily and develops large populations when fed six-spotted mites, citrus red mites, and Texas citrus mites. On the other hand, the species lived for a limited time, up to 9 days, but did not reproduce when maintained on clean citrus leaves and when fed whitefly (*Dialeurodes* spp.) eggs and crawlers, Glover's scale (*Lepidosaphes Gloveri* Newm.) eggs and crawlers, honey, honey and citrus pollen, and honeydew.

Laboratory experiments on rate of consumption and stages consumed were conducted in 1958 and 1967 using six-spotted mites as food. In 1958, 27 female tan mites tested for a total of 231 hours consumed a mean of 0.12 six-spotted mite eggs per hr., 0.10 nymphs per hr., and 0.20 adults per hr. In 1967, 4 female tan mites tested for 24 hrs., consumed a mean of 1.62 six spotted mite eggs per hr., 0.33 nymphs per hr., and 0.00 adults per hr.; 6 nymphal tan mites tested for 45 hrs., consumed 0.37 six-spotted mite eggs per hr., 0.23 nymphs per hr., and 0.22 adults per hr.

**Host-Predator Relationships**

The interrelationships of host and predator populations were studied in several ways in the laboratory and in groves. In the laboratory, the ability of the predator to survive and to attain high population levels on large host populations and to reduce host populations was tested on excised leaves, green oranges, and citrus seedlings. Groves studies included investigation of the coincidence of predators and hosts in host infestations, a survey of the leaf-to-leaf populations of hosts and predators, and a continuing population dynamics study involving population interactions of hosts and predators on leaves in groves indicating injurious host infestations. The methods utilized in the several studies are detailed below.

Excised citrus leaves were placed in plastic boxes on moist cotton batting and covered with a layer of moist cotton batting cut out so as to expose most of the lower leaf surface. The leaves were then infested with a tetranychid host and 1 gravid tan mite female. Such leaves were held at 80° F, examined daily, and the number of predatory mites recorded. Host mites were added as needed to maintain adequate food supply. When Texas citrus mites were used as hosts, the predator population increased in 2 to 3 weeks to numbers that could not be accurately counted without destroying the culture. The same results were obtained with citrus red mites or six-spotted mites as hosts.

Green oranges were placed in Syracuse dishes for ease in handling. They were then infested with host tetranychids, six-spotted mites, citrus red mites, or Texas citrus mites, and held at 80° F until the fruit was heavily infested. Then, 1 to 4 gravid tan mite females were placed on each fruit. Within 2 weeks after addition of 1 or 2 predators, the predator populations increased to 20 to 30 mites per fruit. When more than 2 predators were added per fruit, the mite population was too numerous to count at the end of 2 weeks, or the host mite population was decimated and only 5 to 10 predators could be found on the test fruits.

Fig. 1. Mean index of six-spotted mites and number of *Galeidromus floridanus* (Muma) in 7 grapefruit groves under varying winter and spring temperatures and rainfall during 1955-56 in Polk County, Florida.
Citrus seedlings exhibiting 2 or more leaves in excess of the plumules were infested with host tetanychids, six-spotted mites, citrus red mites, and Texas citrus mites. Thirty days later, when the seedlings were heavily infested with the host mites, 5 gravid female tan mites were introduced on each of 2 seedlings; and 2 seedlings infested with six-spotted mites were retained without predators as controls. Two weeks later, all plants were examined for host and predator populations. Plants maintained as controls had many six-spotted mites; plants infested with six-spotted mites had no predators or host mites; plants infested with citrus red mites had no predators and only 1 or 2 eggs and nymphs of the host; plants infested with Texas citrus mites had no predators or host mites. Despite these evaluations, however, both six-spotted mites and citrus red mites recovered from the decimations and regained high population levels within 30 days. The Texas citrus mite infestations never recovered from the decimation.

Grove studies were necessarily biased to groves exhibiting infestations of six-spotted mites during years when economically injurious infestations could be located. Indication of such infestations usually consisted of light to severe yellowing and cupping of old and new flush leaves. When such infestations were noted, 5 or more groves were selected as study groves and 1 sample was collected from each grove once a week until the six-spotted mite infestation virtually disappeared. Each sample consisted of 20 randomly selected but damaged leaves, which were placed in plastic boxes for transportation to the laboratory. In the laboratory, each leaf was examined under a dissecting microscope and the number of active stages of *G. floridanus* and *E. sexmaculatus* recorded. In the case of *E. sexmaculatus*, the leaf-by-leaf population was coded—0 for no mites, 1 for 1 to 50 mites, 2 for 51 to 100 mites, and 3 for 101 or more mites. This was done to reduce counting time since heavily infested leaves frequently supported 200 or more mites. The resulting data were then analyzed for coincidence of the predator with its host and for predator potential, as a biotic factor, in the control of its host on a leaf-to-leaf and grove-to-grove basis.

Coincidence of *G. floridanus* with *E. sexmaculatus* was remarkably high. Every study grove in every year sooner or later developed a population of the predator. In most cases, the predator appeared within 2 weeks after initiation of sampling.

The leaf-to-leaf relations of *G. floridanus* numbers with *E. sexmaculatus* infestation levels is shown in Table 2. These data show that on leaves exhibiting previous or current damaging infestations of six-spotted mites, the host mite populations were lower where the predator population was greater in every year except 1965. During 1965, the higher host mite populations sustained greater predator populations.

The population interrelationships of predator and host under grove conditions have been shown for 1953, 1954, and 1955, Muma (1955, 1958). Data for 1956, 1958, and 1965 are presented in Fig. 1. 2, and 3. In 1956, six-spotted mite infestations did not produce significant injury until late
March and disappeared in May following predator, temperature, and rainfall increases. In 1958, seriously damaging six-spotted mite infestations developed in late January and maintained high levels into the first week of June; during this year, temperatures and rainfall increased during May but the predator population remained low. In 1965, the six-spotted mite infestations did not develop until mid-April and never produced serious infestations; spring temperatures were unusually high, rainfall was low until late May, and the predator population was variable.

### Table 2. Mean Number of Galendromus floridanus (Muma) on Damaged Citrus Leaves Infested with Varying Numbers of Eotetranychus sexmaculatus (Riley) during 1953, 1954, 1956, 1965, and 1966.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Groves/ Year</th>
<th>Mean Leaves/ Year</th>
<th>Mean Number Predators/Leaf with Varying Numbers SSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>7</td>
<td>5</td>
<td>None 1.00 0.80 0.25</td>
</tr>
<tr>
<td>1954</td>
<td>9</td>
<td>8</td>
<td>0.45 0.55 0.43 0.26</td>
</tr>
<tr>
<td>1956</td>
<td>7</td>
<td>7</td>
<td>0.11 0.52 0.66 0.19</td>
</tr>
<tr>
<td>1965</td>
<td>10</td>
<td>5</td>
<td>0.62 0.73 0.34 0.95</td>
</tr>
<tr>
<td>1966</td>
<td>10</td>
<td>6</td>
<td>0.18 0.22 0.14 0.03</td>
</tr>
<tr>
<td>Mean</td>
<td>8.6</td>
<td>6.2</td>
<td>0.33 0.72 0.47 0.35</td>
</tr>
</tbody>
</table>

**Discussion**

Published data and data presented here indicate that the tan mite, *G. floridanus* (Muma), is primarily a tetranychid predator. It is usually associated with high host densities, which under grove conditions are most frequently represented by the webbing colonial six-spotted mite, *E. sexmaculatus* (Riley). The life cycle of the predator, from egg to adult, on six-spotted mites, varies from 4 to 9 days, with an average of 6 to 7 days. It feeds on all stages of its host with a slight preference for eggs and nymphs. The predator has a high rate of coincidence with six-spotted mite infestations where it exhibits an inverse predator-host relationship on both a leaf-to-leaf and temporal basis.

Although data presented by Muma (1955A, 1958) and in Fig. 1 through 3 and Table 2 here indicate that other factors such as temperature and humidity also influence six-spotted mite populations, there is little doubt that this predator is capable of causing and in many instances is responsible for natural control of six-spotted mite infestations. Since the predator seems to require highly localized or colonial host densities for population

Fig. 3. Mean index of six-spotted mites and number of *Galendromus floridanus* (Muma) in 5 grapefruit groves under varying winter and spring temperatures and rainfall during 1964-65 in Polk County, Florida.
development, it is questionable that any predator control pressure is 
exerted by the species on infestations of citrus red mite or Texas citrus 
mite.

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