

BIBLIOGRAPHY

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ABSTRACT

The study was conducted at the Mites Predatory Rearing House from December 2010 to March 2011, to determine the duration and morphological characteristics of the different growth stages of black-banded wing thrips, determine the feeding and oviposition behavior, fecundity and generate information on the rate of consumption of the different growth stages and the host preference of the predatory stages of black-banded wing thrips (*Aelothrips sp.*).

The developmental stages and duration of the different growth stages are as follows: egg- 11.74 to 16.03 days with a mean of 14.51 ± 0.78 days, larva I: 4.80-7.89 days with a mean of 6.32 ± 0.52 days, larva II: 2.86-4.2 days with a mean of 3.76 ± 0.237 days, pupa I: 1.05-2.23 days with a mean of 1.71 ± 0.23 days, pupa II: 3.10-4.22 days with a mean of 3.79 ± 0.20 days. The longevity of adult female was 25.87-33.91 days with a mean of 29.58 ± 1.28 days.

The egg is transparent and kidney shape, 3-4 μm long and a width of 6-9 μm . The larva I is whitish, 13-15 μm long and a width of 3.00 μm . The larval II is yellowish, 20-24 μm long and a width of 5-7 μm . The pupa I is yellowish, with wing pads half of the

body, 29-33 μm long and a width of 7-8 μm . The pupa II is yellowish, with longer wing pads than pupa I and antennae that is drawn back over the prothorax with a 31-34 μm long and a width of 8 μm . The adult thrips is yellowish with red eyes, black head, white prothorax, black mesothorax and metathorax and wings and abdomen with black and white bands. The body length is 34-42 μm and a width of 8-10 μm .

The predatory stages catch and hold the prey with the aid of its forelegs and mouthparts as they pierce the integument and suck the body contents of the prey by means of their mandibular and maxillary stylets aided by slight rotation of its head. On the other hand, the female oviposits its egg into the leaf tissue through the use of its saw-like ovipositor. It can lay as many as 15 to 31 eggs.

In terms of prey consumption, the larva I may consume an average of 10.2 eggs, 11.6 larvae, 5.8 nymphs and 2.6 adults. The larva II may consume an average of 32.2 eggs, 30.6 larvae, 20.2 nymphs and 8.8 adults. The adult stage may consume an average of 342.6 eggs, 435 larvae, 255.6 nymphs and 126 adults.

The black-banded wing thrip larvae preferred both the eggs and larvae while the adult preferred adult two-spotted spider mites.

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INTRODUCTION

Predatory thrips are common predators of spider mites and other insects. In our locality, predatory thrips are common predators of spider mites. In 1995, Pecdasen reported the presence of predatory thrips on the chrysanthemum. In 1996, Tanyag identified two predators of two-spotted spider mites one of them was the six-spotted thrips (*Scolothrips saxmaculatus* Pergande) which was also noted earlier by Pacdasen, and a phytoseiid mite (*Amblyseuis longispinosus* Evans). In 2010, Das-ilen reported that there was black-banded wing thrips (*Aelothrips* sp.) feeding on the two-spotted spider mites on the cordyline plant.

The two-spotted spider mites attack hundreds of field and forage crops, horticultural crops, ornamentals and weeds. In our locality two-spotted spider mite is the mayor the pest of strawberry, rose plantations, chrysanthemum and leguminous crops.

The two-spotted spider mite adults and immature feed by rasping and sucking leaf surfaces causing mottling, speckling, and bronzing of foliage. They commonly cover the undersides of the leaves with fine webbing. Mites can float long distances on silken threads they produced. Drought stressed and unthrifty plants are most subject to attack (Hancock, 1999). Damaged fruits on the other hand, show yellowish or brownish spots, dwarfed and cracked or distorted. As a result, the quality and yield are greatly reduced.

One of the characteristics of two-spotted spider mites is resistance to many pesticides and often growers find them difficult to control.

In view to this problem the use of predators, parasitoids and entomophagous microorganisms is being pursued as alternatives of using chemicals against crop pests. One among the natural enemy of spotted-spider mites that was reported by Das-ilen



(2010) is the black-banded wing thrips (*Aeolothrip* sp.). However, its efficiency as predator and information regarding on the developmental stages has never been evaluated.

Thus, the result of the study may provide benchmark information on the predation of black banded wing against the two-spotted spider mites. The research finding can be a guide for the release of predatory thrips to control the injurious plant-feeding mites in the field.

The study aimed to determine the duration and morphological characteristics of the different growth stages of black-banded wing thrips, to determine the feeding and oviposition behavior of the predator, fecundity and to generate information on the rate of consumption of the different growth stages and the host preference of the predatory stages of black-banded wing thrips (*Aeolothrips* sp.).

The study was conducted at the Mites Predatory Rearing House, Benguet State University, La Trinidad, Benguet from December 2010 to March 2011.



REVIEW OF LITERATURE

Predation

McGinley (2009) defined predation as an interaction between species in which one species uses another species as food. Predation is a process of major importance in influencing the distribution, abundance, and diversity of species in ecological communities. Generally, successful predation leads to an increase in the population size of predators and a decrease in population size of the prey.

Morphological Description and Life Cycle of Two-Spotted Spider Mites

Egg. The eggs are laid singly and glued to undersurfaces. Eggs are laid any time of the day and on any part of the whole leaf. The eggs are protected by translucent and loosely built web suspended on the sides by thin threads. Newly laid eggs are translucent but gradually become green colored then turn into shining red pearls when about to hatch. The eyes of the developing embryo are reddish which can be seen through the translucent egg shell as true red spots. The incubation ranged from 5.3 to 7.0 days with a mean of 5.90 ± 0.96 days (Tanyag, 1996).

Larva. The larvae are six-legged and feed upon hatching 10-12 days after egg deposition. After a short feeding period of one to few days, they settle down and rest in preparation for molting, Corpuz-Raros (1966), as cited by Tanyag (1996).

Protonymph. The protonymphs have four pair of legs. The body of protonymph is light green to yellow green and later assumed light orange at quiescent stage. The body was teardrop shape for males and ovate for females both which measures 8.0 to 8.5 micrometer long with a mean of 6.0 micrometer. The development ranged from 1.7 to 2.0



day with mean of 1.60 ± 0.35 for male and 2.0 to 3.39 days with a mean of 2.5 ± 0.31 days for female (Tanyag, 1996).

Deutonymph. This is second nymphal stage and much bigger than the protonymph with four pairs of legs, Villegas (1964) as cited by Tanyag (1996). The duration of male ranged from 1.5 to 2.2 days with mean of 1.67 days. The female ranged from 2.0 to 4.0 days with a mean of 2.89 days (Tanyag, 1996).

Adult. The adult females are carmine red with dark marks at the back of sides that are in most respects similar to the protonymph and deutonymph stages but are bigger and broader. The adult males are slender and tapered idiosoma and lighter orange red. The body appears teardrop-shaped and legs are proportionately longer. The development of period of adult female ranged from 29.00 to 50.10 days with a mean of 32.50 ± 0.70 days while adult male lived 20.00 to 34.80 days with mean of 23.10 ± 0.39 days (Tanyag, 1996).

The Thrips

The thrips are minute, slender and agile, rarely as long as one half inch. They live in flowers or other parts of plants, feeding on the sap. Many are serious pests of fruits, vegetables, flowers and field crops (Flint and Metcalf, 1962).

The mouthparts of thrips are unique, in some respects being intermediate between the chewing and piercing-sucking types. The head bears well-developed compound eyes and ocelli, and well developed but not extremely long antennae of six to nine segments. The head capsule tapers downwards in a shape of a cone to a small mouth opening at its lowermost part. Around this opening are two maxillary and smaller two labial palps as are the bases of the maxillae and the labrum. The labrum is not elongated into a beak,



fused into the head cone as are the bases of the maxillae and labrum. In and out of this funnel-like opening three jobbers or stylets operates by end thrusts to lacerate the epidermis of the plant. The three stylets consist of the left mandible and two maxillae. The eggs are laid on the tissue of the plant in some species, inserted into slits made by a sharp ovipositor. Parthenogenesis is common. There is four or more nypal instar. The last two do not feed and may be quite inactive - a foreshadowing of the complete metamorphosis of the higher orders (Flint and Metcalf, 1962).

Distinguishing Feature of Banded Wing Thrips
(*Aeolothrips fasciatus*)

Banded wing thrips is black with three broad white bands on each forewing. Both sexes are with complete banded wings, median pale band shorter than distal dark band. Body and legs brown, antennal segment III yellow with extreme apex dark. Head and pronotum with no long setae. Fore tarsus apically with stout recurved ventral hamus. Antennae 9-segmented III long and slender with linear sensorium scarcely 0.3 as long as segment, IV with sensorium almost 0.5 as long as segment and curved distally; segment V – IX forming a single unit with V about the same length as VI – IX. Abdominal tergite X with pair of very small trichobothria. Marginal setae on sternites arising at or close to margin; sternite VII supernumerary paired setae arising well in front of margin. Male tergite IV and V sometimes with very small paired dorsal tubercles; setae at base of bifurcate claspers on tergite IX much longer than clasper, with no stout curved seta lateral to claspers; antennal segment III almost fuscous rather than yellow, but abdominal segments III – V sometimes paler than II and V (University of California, 2008).



Life History of *Aeolothrips* sp.

In 2009, Barbara made observations on the development of banded thrips (*Aeolothrips intermedius*) under laboratory conditions with average temperatures of $23 \pm^{\circ}\text{C}$ and $27 \pm^{\circ}\text{C}$. It was observed that the duration of embryonic development was 6.8 and 3.7 day; duration of the first larval instars was 3.2 days and 2.4 days; duration of second instars was 5.4 and 4.1 days and finally, duration of the pre-pupa and pupa was totally 6.2 days and 5.6 days. The life cycle duration (egg-adult) was 21.6 ± 2.2 days and 15.7 ± 1.6 days.

Studies on Predatory Thrips

In 1995, Pacdasen studied the biology of mites on the chrysanthemum and reported the presence of predatory thrips. In 1996, Tanyag studied the biology and abundance of the red spider mites on strawberry. She identified two predators; one of them was the Six-spotted thrips (*Scolothrips saxmaculatus* Pergande) which was also noted earlier by Pacdasen, and a phytoseiid mite (*Amblyseius longispinosus* Evans). The result of their preliminary trials under laboratory condition showed that the larval and adult stages of the thrips preferred the egg of spider mites than nymph and adult.

In 1998, Layao studied the voracity of predatory thrips (*Scolothrips saxmaculatus* Pergande) on red spider mites (*Tetranychus kansawai* kishida) and found out that the first instar thrips can consume 54.00 eggs, 27 nymphs and 18.67 adults while the second instar can consume 66.29 eggs, 38.11 nymph and 28.15 adults.



Searching Behavior and Feeding Behavior
Predatory Thrips (*Scolothrips*
saxmaculatus Pergande)

In 1998, Layao reported that larval instars of predatory thrips (*Scolothrips saxmaculatus* Pergande) find their prey by random searching and recognized their prey upon contact or very near to the prey. The thrips catch and hold the prey through forelegs and mouthparts and pierce the integument then suck the body contents of the prey by means of their mandibular and maxillary stylets aided by slight rotation of its head.



METHODOLOGY

Materials

The important materials used in the study were strawberry leaves, plastic pots, plastic cups, cotton, fine forceps, scissor, dissecting microscope, magnifying glass, ocular micrometer, camel brush, pen, digital camera, strawberry runners and watering can.

Propagation and Maintenance of the Host Plants

Strawberry runners were grown on potted soil under greenhouse condition. One strawberry runner was transplanted in a 6.5 inch diameter plastic pot. All necessary cultural methods were employed except application of insecticides to encourage mites and black-banded wing thrips.

Collection and Culture of Prey

Cassava and strawberry leaves infested with two-spotted spider mites in the field were collected and brought to the laboratory for verification. The leaves were examined with the aid of microscope. After verification, the two-spotted spider mites were introduced into the potted strawberry with four true leaves. The two-spotted mites were allowed to multiply until enough specimens are available. This served as the source of prey for the duration of the study.

Collection and Culture of Predator

Black-banded wing thrips was collected from four o'clock flower (*Mirabilis jalapa*) plant at the Research Extension Office, Benguet State University (Figure 1). The identification of predatory thrips was made when there are thrips directly striking on the





Figure 1. The four o'clock flower (*Mirabilis jalapa*)

two-spotted spider mites on the o'clock leaves through the use of magnifying. The leaves were excised and brought to laboratory for further identification with the aid of microscope. The predatory thrips were reared on excised strawberry leaves with prey under laboratory condition until enough specimens can be harvested.

Life History of the Black Banded Wing Thrips

Healthy and succulent leaves of strawberry were used as host plant of two-spotted spider mites and predatory thrips. The leaves were cut into disc with a diameter of two cm. The leaf disc was cleaned first with the used of camel brush to remove the debris including unwanted insects and mites. The leaf disc was placed individually on top of water-soak cotton inside the plastic cup to retain the freshness of the leaf (Figure 2). The leaf disc was replaced when necessary.

Duration of development. One adult female black banded wing thrips was transferred to each leaf disc for laying. The adult females were provided with different stages of prey. The disc containing the adult female was checked for every five minutes





Figure 2. Plastic cup with leaf disc used in studying the life history of black-banded wing thrips

to monitor if the thrips was laying. Spotted adult female inserting its ovipositor into the leaf tissue was observed until it removed its ovipositor into the leaf. After the female thrips removed its ovipositor the time was noted and recorded. The adult female was removed from the leaf disc after it laid its egg. The egg was confirmed by dissecting the leaf through the use of fine forceps. The exposed egg was observed daily to monitor the emergence of larva. The newly emerge larva was provided with different stages of prey. Daily observation was done to monitor the duration of development of larva to pupa and pupa to adult.

Five individuals were observed. The duration of development was counted per hour and converted to days. All observations were done under dissecting microscope.

Morphological descriptions. At every sample of banded wing thrips development a representative sample of the specimen was observed under a dissecting microscope to determine the morphological characteristics. Observations were focused on the color, shape and size of each developmental stage. Body of the thrips was measured from the



head up to the tip of abdomen. Body width was measured on the widest part of the abdominal region with the use of ocular micrometer.

Feeding Behavior

Two-spotted spider mites as prey were introduced to the excised strawberry leaf and followed by the predator. Microscope and digital camera were used in observing and recording how the predator consumed its prey.

Oviposition Behavior

The oviposition behavior of female black-banded wing thrips was observed. The predators were provided with prey. Microscope and digital camera were used in recording their behavior, respectively.

Fecundity

Newly emerged adult female black-banded wing thrips was reared on the excised strawberry leaf and allowed to lay its egg. The predator was provided with different stages of prey. The egg was determined when scar or marking on the leaf caused by the saw-like ovipositor of female as shown in Figure 3. The egg was confirmed by dissecting the leaf with the aid of fine forceps. The eggs were counted and noted. Observations were done using dissecting microscope.





Figure 3. The scar made by the saw-like ovipositor

Predation Test

Fifty eggs, 50 larvae, 50 nymphs and 50 adults of two-spotted spider mites were transferred separately into each leaf disc with the aid of camel brush. This was followed by the introduction of one predatory stage of black-banded wing thrips. The set-up of the study was considered as the predation of larvae and adult on eggs, larvae, nymphs and adult of two-spotted spider mites.

The determination of consumed prey was done 24 hours after the introduction of prey. The number of the prey that was consumed per day by the first and second instars larvae and adult was recorded. After counting each consumption sufficient number of preys was added to the discs to maintain the preys number (50). The total number of prey that was consumed by the first and second instars larvae and adult were recorded. Microscope was used in determining the number of the preys that was consumed by the predator.



Experimental Design for the Predation Test

The study was arranged in completely randomized design (CRD) and it was replicated in five times. The treatments were as follows:

Treatments

T₁ = Larva I

T₂ = Larva II

T₃ = Adult

Host Preference

Five different stages of two-spotted spider mites were transferred into a leaf disc followed by the introduction of one predatory stage of the black-banded wing thrips at the center with the aid of camel brush (Figure 4). When the predator consumed one prey the predator was removed then another new predator of similar age was introduced. The eaten or consumed prey was replenished. This was done until 30 predators were introduced. The prey that was eaten was recorded. The determination of the host preference of the predatory stages of thrips was done through percentage. The higher the percentage of prey consumed was considered as the most preferred by the predatory stage of thrips.

All observations were done under dissecting microscope.



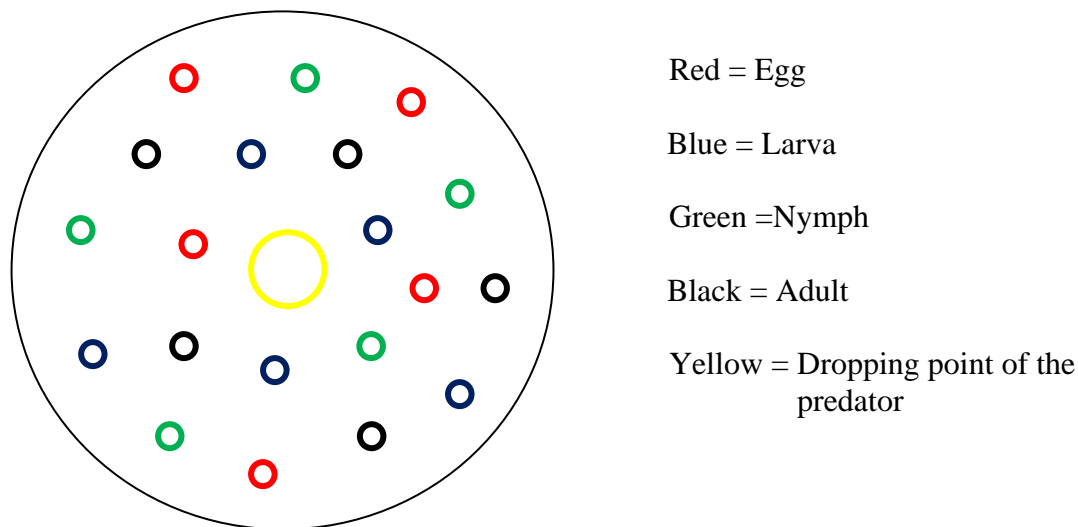


Figure 4. Arrangement of the different growth stages of prey and the dropping point of the predator

Data Gathered

1. Duration of the different life stages of black-banded wing thrips.

- Eggs. This refers to the incubation period of the egg.
- Larvae. This refers to the duration of development of the larvae.
- Pupa. This refers to the duration of development of pupa
- Adult. This refers to the life span of adult female.

2. Morphological characteristics of the different growth stages of black-banded wing thrips.

- Eggs. This refers to the color, shape, length and width of the egg.
- Larvae. This refers to the color, length and width of larvae.
- Pupa. This refers to the color, length and of pupa.
- Adult. This refers to the color, length and width of adult female.

3. Feeding behavior. This refers to the behavior of the predator when feeding.

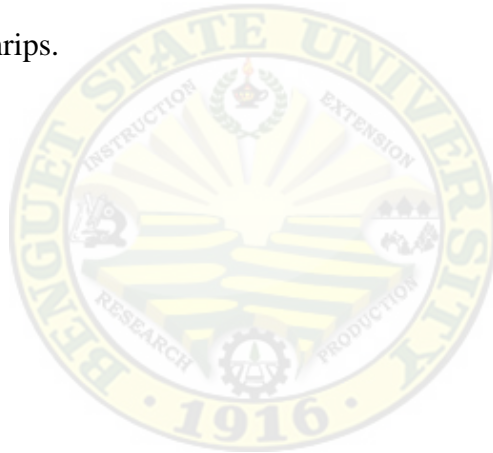


4. Oviposition behavior. This refers to the behavior of black-banded wing thrips when laying.

5. Fecundity. This refers to the number of eggs laid by the adult female black-banded wing thrips.

6. The number of prey that were consumed by the black-banded wing thrips. This refers to the number of the different life stages of the prey that were consumed by the different life stages of black-banded wing thrips.

7. Host preference. This refers to the most preferred developmental stages (egg, larva, nymphs and adult) of the prey that was first consumed by the larvae and adult black-banded wing thrips.



RESULTS AND DISCUSSION

Life History of Black-Banded Wing Thrips (*Aelothrips* sp.)

Duration of the Different Growth Stages

The mean duration of different stages of black-banded wing thrips is shown in Table 1. It ranged from 49.42-68.48 days. Among the stages the longest in duration is the adult and the least is the pupa I.

Egg. The duration of the egg stage ranged from 11.74-16.03 days with a mean of 14.51 ± 0.78 days.

Larva I. The larva I developed from 4.80-7.89 days with a mean of 6.32 ± 0.52 days.

Larva II. The duration of development of the larva II range from 2.86-4.2 days with a mean of 3.76 ± 0.23 days.

Pupa I. The pupa I developed from 1.05-2.23 days with a mean of 1.71 ± 0.23 days.

Pupa II. The pupa II developed from 3.10-4.22 days with a mean of 3.79 ± 0.20 days.

Adult. The longevity of adult female ranged from 25.87-33.91 days with a mean of 29.58 ± 1.28 days.



Table 1. Mean duration (days) of the different life stages of a female black-banded wing thrips under room temperature

GROWTH STAGES	RANGE	MEAN
Egg	11.74-16.03	14.51 ± 0.78
Larva I	4.80-7.89	6.32 ± 0.52
Larva II	2.86-4.20	3.76 ± 0.23
Pupa I	1.05-2.23	3.79 ± 0.20
Pupa II	3.10-4.22	3.79 ± 0.20
Adult	25.87-33.91	29.58 ± 1.28
Total life span	49.42-68.48	59.64 ± 2.01

Morphological Characteristics of the Different Growth Stages of Black-Banded Wing Thrips (*Aeolothrips* sp.)

The body length and width of the different growth stages of black-banded wing thrips are shown in Table 2.

Egg. The egg of black banded wing thrips is transparent when newly laid (Figure 5) and as the egg matures the red pigmented eyes is visible. The egg is kidney or bean shaped. The egg was inserted into the leaf through the saw-like ovipositor of the female thrips and laid singly on any part of the lower surface of the leaf.

The egg measures from 3-4 µm in length with a mean of 7.75 ± 0.31 µm and 6-9 µm in width with a mean of 3.63 ± 0.18 µm.

Larva I. After a few days of incubation period a six-legged larva hatched out from the egg. The first instar is whitish when newly hatched as shown in Figure 6. It changed to red orange or green after feeding on the body contents of spider mites (Figures 7 and 8).



The first larval instar has piercing and sucking mouthparts, three pairs of slender legs, slender body and no wing pads. The antenna is beat-like or moniliform.

The body length of the larva I measures from 13-15 μm in length with a mean of $14.25 \pm 0.31 \mu\text{m}$ and 3.00 μm in width with a mean of $3.00 \pm 0 \mu\text{m}$.

Table 2. Length and width of the different growth stages of a female black-banded wing thrips reared under room temperature

GROWTH STAGES	LENGTH (μm)		WIDTH (μm)	
	RANGE	MEAN	RANGE	MEAN
Egg	6-9	7.75 ± 0.31	3-4	3.63 ± 0.18
Larva I	13-15	14.25 ± 0.31	3	3.00 ± 0
Larva II	20-24	21.75 ± 0.49	5-6	5.13 ± 0.12
Pupa I	29-33	31.25 ± 0.52	7-8	7.75 ± 0.16
Pupa II	31-34	33.00 ± 0.42	8	8.00 ± 0
Adult	34-42	39.88 ± 0.89	8-10	8.75 ± 0.25



Figure 5. Egg (40X)

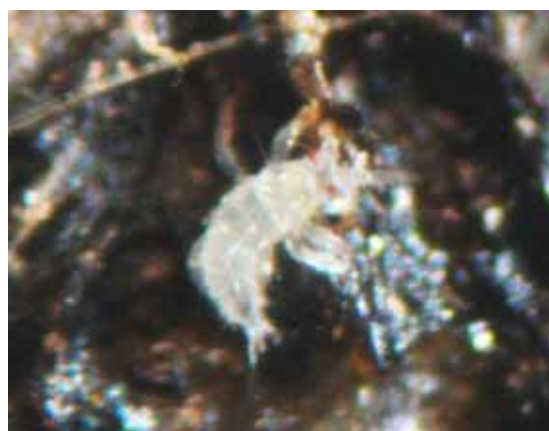


Figure 6. Newly emerge larva I (40X)





Figure 7. Larva I (40X)



Figure 8. Larva I (40X)

Larva II. The second larval instar is yellowish when newly emerge as shown in Figure 9. It changed to orange, red or green after feeding on the body content of the two-spotted spider mites (Figure 10).

The second larval instar was the same as the first larval instar except of its size. However, as it assumed its full size, its feeding activity gradually ceases. The larva became restless and seeks a suitable place in preparation for the next stage.

The larva II measures from 20-24 μm in length with a mean of $21.75 \pm 0.49 \mu\text{m}$ and 5-7 μm in width with a mean of $5.13 \pm 0.12 \mu\text{m}$.

Pupa I. At the second molt, the pupa I emerged from the cast cuticle. In contrast to the larva, the pupa I was inactive. It moves only when disturbed and prefers to stay in leaf surface with webs of spider mites. The pupa I is yellowish, with wing pads half of the body and does not feed (Figure 11). It moves only when disturbed and prefers to stay in leaf surface with web of spider mites.

The pupa I measures from 29-33 μm in length with a mean of $31.25 \pm 0.52 \mu\text{m}$ and 7-8 μm in width with a mean of $7.75 \pm 0.16 \mu\text{m}$.



Pupa II. The pupa II exhibits the same behavior as the pupa I. Morphologically it differs from the pupa I in having longer wing pads, antennae turned back over the prothorax and the body appendages assume adult proportions (Figure 12).

The pupa II measures from 31-34 μm in length with a mean of $33.00 \pm 0.42 \mu\text{m}$ and 8 μm in width with a mean of $8.75 \pm 0.250 \mu\text{m}$.

Adult. At the final molt, the adult emerged from the pupa. The body of the newly emerged thrips is yellowish in color, the eyes are red, the wings are white (Figure 13). After an hour the band of black and white is visible. The head is black, prothorax is white, mesothorax and metathorax is black and the wings and abdomen are banded with black and white colors (Figure 14).

The adult did not feed immediately. Only on the first day, after full hardening has been achieved, it started to move about and search for the prey.

The adult female measures from 34-42 μm in length with a mean of $39.88 \pm 0.89 \mu\text{m}$ and 8-10 μm in width with a mean of $8.75 \pm 0.25 \mu\text{m}$.



Figure 9. Newly emerge larva II (40X)



Figure 10. Mature larva II (40X)





Figure 11. Pupa I (40X)



Figure 12. Pupa II (40X)



Figure 13. Newly emerge adult (40X)



Figure 14. Adult (40X)

Feeding Behavior

The thrips uses its forelegs and mouthparts to catch and hold the prey (Figures 15-18). They pierce the integument and suck the body contents of the prey by means of their mandibular and maxillary stylets aided by slight rotation of its head and wagging of antennae.

The thrips inserts its stylets in any part of the body of the prey, but after it sucks the one body part of its prey it will transfer its stylets to other body part of the prey.





Figure 15. Larva I feeding on an egg of two-spotted spider mites (40X)



Figure 16. Larva I feeding on an adult of two-spotted spider mites (40X)



Figure 17. Larva II feeding on an egg of two-spotted spider mites (40X)



Figure 18. Adult feeding on an egg of two-spotted spider mites (40X)

The results collaborate with the report of Layao (1998) that the thrips catch and hold its prey through their forelegs and mouth parts then pierce the integument through their mandibular and maxillary stylet aided by slight rotation of their heads.



Oviposition Behavior

The oviposition behavior of black-banded wing thrips took place during the saw-like ovipositor penetrates into the leaf tissue as shown in Figure 19. After penetration of the ovipositor, there were three specific oviposition sequences observed; sawing of the ovipositor, release of an egg into the leaf, and partial or complete withdrawal of the ovipositor from the leaves.

The results coincided with the reports of Flint and Metcalf (1962) that some species of thrips inserted their eggs into tissues of the plant through the sharp ovipositor of the female black banded wing thrips.



Figure 19. Adult female black-banded wing thrips ovipositing its egg inside the leaf tissue (Lateral view, 40X)



Fecundity

The total eggs laid by the female adult black-banded wing thrips is shown in Table 3. A female adult can lay as many as 15 to 31 eggs.

Total Consumption Rate of the Different Growth Stages of Black-Banded Wing Predatory Thrips on the Different Growth Stages of Two-Spotted Spider Mites

The total consumption rate of the different growth stages of black-banded wing predatory thrips on the different growth stages of two-spotted spider mites is shown in Table 4.

Statistical analysis revealed a highly significant number of the different stages of spider mites consumed by the adult as compared to the consumption rate of larvae black-banded thrips. The consumption rate of larvae on egg, larva and adult were not significant except on the nymph which was highly significant.

The adult had the highest consumed egg with an average of 342.6 followed by larva II with an average of 37.2 eggs and larva I with an average of 10.2 eggs, respectively. The consumption rate of adult on larva had the highest with an average of 435 larvae followed by larva II with an average of 30.6 larvae and larva I with an average

Table 3. Total number of eggs laid by the adult female black-banded wing thrips

SAMPLE NO	TOTAL NO. OF EGGS LAID
1	31
2	15
3	26



Table 4. Total consumption rate of the different growth stages of black-banded wing predatory thrips on the different growth stages of two-spotted spider mites

PREDATORY STAGE OF THRIPS	GROWTH STAGE OF PREY			
	Egg	Larva	Nymph	Adult
Larva I	10.2 ^b	11.6 ^b	5.8 ^c	2.6 ^b
Larva II	37.2 ^b	30.6 ^b	20.2 ^b	8.8 ^b
Adult	342.6 ^a	435 ^a	255.6 ^a	126 ^a

*Means with the same letter in column are not significantly different at 5 % level by DMRT

of 11.6 larvae. The adult had the highest total consumption rate on nymph with an average of 255.6 nymphs followed by larva II with an average of 20.2 larvae and larva I with an average of 5.8 nymphs. The adult had the highest total consumption on adult with an average of 126 adult followed by larva II with an average of 8.8 adult and larva I with an average of 2.6 nymphs, respectively.

Among the stages, the adult consumed more prey compared to the larva I and larva II. This was probably because the adult is more active in searching and it requires more prey. This implies that as banded wing thrips grows to another stage, the number of consumed prey increases.

Host Preference

Table 5 shows the percent host preference of the different predatory stages of the thrips on the different stages of prey.

Results show that the most preferred prey of larva I were both egg (33.3 %) and larva (33.3 %) and the least preferred was the adult stage (6.67 %). The larva II prefers



larval stage (43.33 %) while the least preferred was the adult stage. Mean while, the adult prefers the adult (53.33 %) and least preferred was the eggs (3.33%).

As it was observed that the larva I preferred the egg and larva, the probable reason could be due to the less motile of larva and egg stage as compared to the larger and motile nymphs and adults. Although there were some case that the larvae tried to catch the larger prey however some prey tried to escape and the predator turned over. The female adult preferred the adult stage of prey probable reason could be the adult want the motile prey and it can get more food on the adult as compared to the immature.

Table 5. Host preference (%) of the different growth stages of black-banded wing predatory thrips on the different growth stages of two-spotted spider mites

PREDATORY STAGE OF THRIPS	GROWTH STAGE OF PREY			
	Egg	Larva	Nymph	Adult
Larva I	33.33	33.33	26.67	6.67
Larva II	26.67	43.33	26.67	3.33
Adult	3.33	16.67	26.67	53.33



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The life cycle and predation rate of black-banded wing thrips (*Aelothrips* sp.) on spider mites (*Tetranychus urticae* Koch) was studied at the Mites Predatory Rearing House from December 2010 to March 2011 to determine the duration and morphological characteristics of the different growth stages of banded wing thrips, determine the feeding and oviposition behavior, fecundity and generate information on the rate of consumption of the different growth stages of black-banded wing thrips and the host preference of the predatory stages of black-banded wing thrips.

The black-banded wing thrips underwent six developmental stages namely; egg, larva I, larva II, pupa I, Pupa II and adult. The incubation period of egg was from 11.74-16.03 days with a mean of 14.51 ± 0.78 days. The larva I developed from 4.80-7.89 days with a mean of 6.32 ± 0.52 days. The duration of development of the larva II range from 2.86-4.2 days with a mean of 3.76 ± 0.23 days. The pupa I developed from 1.05-2.23 days with a mean of 1.71 ± 0.23 days. The pupa II developed from 3.10-4.22 days with a mean of 3.79 ± 0.20 days. The longevity of adult female ranged from 25.87-33.91 days with a mean of 29.58 ± 1.28 days.

The egg is transparent, kidney shaped and measures from 3-4 μm in length and 6-9 μm in width. The first instar is whitish and measures from 13-15 μm in length and 3.00 μm in width. The second larval instar is yellowish and measures from 20-24 μm in length and 5-7 μm in width. The pupa I is yellowish, with wing pads half of the body and measures from 29-33 μm in length and 7-8 μm in width. The pupa II is yellowish wing longer wing pads, antennae turned back over the prothorax and measures from 31-34 μm



in length and 8 μm in width. The body of adult thrips is yellowish, red eyes, black head, white prothorax, black mesothorax and metathorax and wings and abdomen with black and white bands. The body length is 34-42 μm and 8-10 μm in width.

The predatory stages use its forelegs and mouthparts to catch and hold the prey. They pierce the integument and suck the body contents of the prey by means of their mandibulatory and maxillary stylets aided by slight rotation of its head.

The female thrips oviposit its egg into the leaf tissue through the saw-like ovipositor. It can lay as many as 15 to 31 eggs.

The larva I consumed an average of 10.2 eggs, 11.6 larvae, 5.8 nymphs and 2.6 adults. The larva II consumed an average of 32.2 eggs, 30.6 larvae, 20.2 nymphs and 8.8 adults. The adult banded wing thrips consumed an average of 342.6 eggs, 435 larvae, 255.6 nymphs and 126 adult.

The host preference of larva I were both egg and larva, the larva II prefers larva while the adult prefers the adult two-spotted spider mites.

Conclusion

It is therefore concluded that the life cycle of black-banded wing thrips (*Aelothrips* sp.) under laboratory condition ranges from 49.42-68.48 days. The predatory stages catch and hold the prey with the aid of its forelegs and mouthparts as they pierce the integument and suck the body contents of the prey by means of their mandibulatory and maxillary. The eggs are inserted into the leaf tissue through their saw-like ovipositor. The adult female *Aelothrips* sp. can lay as many as 15 to 31 eggs. The thrips is effective predator of two-spotted spider mites. The host preference of larva I are both egg and larva, the larva II prefers larva while the adult prefers the adult two-spotted spider mites.



Recommendation

It is recommended to study the field efficiency of black-banded wing thrips against two-spotted spider mites.



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APPENDICES

Appendix Table 1. Duration (days) of the different growth stages of a female black-banded wing thrips

STAGES OF PREDATOR	REPLICATION					TOTAL	MEAN
	I	II	III	IV	V		
Egg	11.74	16.03	15.31	13.81	15.65	72.54	14.51
Larva I	7.02	5.96	4.80	7.89	5.91	31.58	6.32
Larva II	2.86	3.79	3.86	4.09	4.2	18.8	3.76
Pupa I	1.05	2.23	1.66	1.38	2.22	8.54	1.71
Pupa II	3.96	3.10	4.13	4.22	3.56	18.87	3.79
Adult	33.91	29.60	29.57	28.95	25.87	147.9	29.58
TOTAL	60.54	60.71	59.33	60.34	57.4	298.32	59.646



Appendix Table 2. Length (μm) of the different growth stages of a female black-banded wing thrips

STAGE OF PREDATOR	REPLICATION								TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII		
Egg	8	8	8	9	8	7	6	8	62	7.75
Larva I	15	14	13	15	15	13	15	14	114	14.25
Larva II	20	20	22	22	23	24	21	22	174	21.75
Pupa I	31	32	32	29	33	30	30	33	250	31.25
Pupa II	32	32	33	31	34	34	34	34	264	33
Adult	41	42	41	34	41	41	40	39	319	39.88



Appendix Table 3. Width (μm) of the different growth stages of a female black-banded wing thrips

STAGE OF PREDATOR	REPLICATION								TOTAL	MEAN
	I	II	III	IV	V	VI	VII	VIII		
Egg	4	3	3	4	4	4	4	3	29	3.63
Larva I	3	3	3	3	3	3	3	3	24	3
Larva II	5	5	5	5	5	5	5	6	41	5.13
Pupa I	8	8	7	8	8	8	7	8	62	7.75
Pupa II	8	8	8	8	8	8	8	8	64	8
Adult	8	9	9	10	9	9	8	8	70	8.75



Appendix Table 4. Total consumption rate of the different growth stages of black-banded wing predatory thrips on two-spotted spider mite egg

PREDATORY STAGE	REPLICATION					TOTAL	MEAN
	I	II	III	IV	V		
Larva I	10	8	13	9	11	51	10.2 ^b
Larva II	22	32	56	44	32	186	37.2 ^b
Adult	371	354	421	220	347	1713	342.6 ^a

ANOVA TABLE

SOURCE OF VARIANCE	DF	SS	MS	F VALUE	TABULATED F	
					0.05	0.01
Treatment	2	340813.20	170406.60	89.56**	3.88	6.93
Error	12	22832.80	1902.73			
TOTAL	14	363646.00				

** - Highly significant

CV = 33.55 %



Appendix Table 5. Total consumption rate of the different growth stages of black-banded wing predatory thrips on two-spotted spider mite larva

PREDATORY STAGE	REPLICATION					TOTAL	MEAN
	I	II	III	IV	V		
Larva I	12	13	7	13	13	58	11.6 ^b
Larva II	34	29	39	28	23	153	30.6 ^b
Adult	246	442	379	511	600	2178	435.6 ^a

ANOVA TABLE

SOURCE OF VARIANCE	DF	SS	MS	FVALUE	TABULATED F	
					0.05	0.01
Treatment	2	573603.3333	286801.6667	47.75**	3.88	6.93
Error	12	72081.6000	6006.8000			
TOTAL	14	645684.9333				

** - Highly significant

CV = 48.66 %



Appendix Table 6. Total consumption rate of the different growth stages of black-banded wing predatory thrips on two-spotted spider mite nymph

PREDATORY STAGE	REPLICATION					TOTAL	MEAN
	I	II	III	IV	V		
Larva I	7	6	5	6	5	29	5.8 ^c
Larva II	22	17	20	22	20	101	20.2 ^b
Adult	245	267	256	258	252	1278	255.6 ^a

ANOVA TABLE

SOURCE OF VARIANCE	DF	SS	MS	F VALUE	TABULATED F	
					0.05	0.01
Treatment	2	196700.9333	98350.4667	4203.01**	3.88	6.93
Error	12	280.8000	23.4000			
Total	14	196981.7333				

** - Highly significant

CV = 5.15 %



Appendix Table 7. Total consumption rate of the different growth stages of black-banded wing predatory thrips on two-spotted spider mite adult

PREDATORY STAGE	REPLICATION					TOTAL	MEAN
	I	II	III	IV	V		
Larva I	3	3	2	3	2	13	2.6 ^b
Larva II	6	13	9	8	8	44	8.8 ^b
Adult	79	181	92	120	158	630	126 ^a

ANOVA TABLE

SOURCE OF VARIANCE	DF	SS	MS	F VALUE	TABULATED F	
					0.05	0.01
Treatment	2	48336.60	24168.20	38.78**	3.88	6.93
Error	12	7478.00	623.1667			
Total	14	55814.40				

** - Highly significant

CV = 54.51 %

