

BIBLIOGRAPHY

PATRICIO S. BEHIS JR. OCTOBER 2010. Life Span and Predation Rate of *Amblyseius longispinosus* Evans on Cyclamen Mite of Strawberry. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at Mites Predatory Rearing House from June to October 2010 to record the duration of the different growth stages of mated and virgin *Amblyseius longispinosus* Evans on cyclamen mite, fecundity, rate of consumption preference, feeding behavior and reproduction.

The duration and development of the different growth stages of mated *Amblyseius longispinosus* Evans are as follows: male egg: 2.73 ± 0.23 days, female egg: 2.73 ± 0.15 days, male larva: 0.71 ± 0.12 days, female larva: 0.72 ± 0.07 days, male protonymph: 1.92 ± 0.18 , female protonymph: 2.09 ± 0.43 days, male deutonymph: 1.85 ± 0.83 days, female deutonymph: 2.40 ± 0.65 days, male adult: 16.24 ± 14.03 days, female adult: 27.02 ± 3.05 days, pre-reproductive period: 2.30 ± 0.19 days, reproductive period: 22.36 ± 3.61 days and 2.36 ± 1.98 for its post reproductive period. The total life span for the male was 23.43 ± 14.28 and 34.97 ± 3.34 for the female.

The duration and development of the different growth stages of unmated *Amblyseius longispinosus* Evans are as follows; male egg: 2.77 ± 0.14 days, female eggs: 2.59 ± 0.46 days, male larva: 0.78 ± 0.13 days, female larva: 0.76 ± 0.13 days, male protonymph: 1.70 ± 0.33 days, female protonymph: 1.85 ± 0.23 days, male deutonymph: 1.65 ± 0.26 days, female deutonymph: 1.86 ± 0.45 days, male adult: 49.27 ± 4.20 days and 57.65 ± 7.57 days for the female. The total life

span of unmated *Amblyseius longispinosus* Evans was 56.25 ± 4.41 days and 64.40 ± 6.30 days for the female.

The cyclamen mite duration and development were as follows; 2.67 ± 0.07 days for the male egg, 2.65 ± 0.03 days for the female egg, male larva was 1.00 ± 0.03 days and 1.03 ± 0.09 days for the female, male nymph: 1.01 ± 0.02 days, female nymph: 1.00 ± 0.02 days, male adult: 10.89 ± 6.77 days and 14.64 ± 14.03 days for the female, 15.56 ± 6.82 days was the total life span of male and 19.31 ± 14.07 days for the female.

The mean total rate of consumption of the *Amblyseius longispinosus* Evans on cyclamen mite were as follows; protonymph: 9.17 eggs, 6.04 larvae, 3.92 nymphs and 3.89 adults, deutonymph: 14.11 eggs, 7.72 larvae, 9.13 nymphs and 3.89 adults and adult: 8.00 eggs, 5.38 larvae, 4.46 nymphs and 3.28 adults.

The female adult *Amblyseius longispinosus* Evans laid an average of 26.64 ± 8.33 throughout its life span.

The protonymph and adult of *Amblyseius longispinosus* Evans prefer to feed on adult cyclamen mite and the deutonymph prefer to feed on larva.

The predator attacks its prey on the dorsal portion using its foreleg to hold the prey while sucking the fluid content of the body through its needle-like chelicerae.

Both sexes of the predatory mite don't copulate. The sperms are packed in tiny capsules that are implanted into the females' genital opening through a sperm transfer organ borne on the pincer like chelicerae of the male. Sperm transfer is accomplished with a male and female assuming a copulatory position. The spermatozoa are released when the gelatinous capsules are dissolved inside the female's genital tract.

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INTRODUCTION

The predatory mite, *Amblyseius longispinosus* Evans belonging to the family Phytoseiidae and class Arachnida is one of the control measures of plant sucking arthropods especially cyclamen mite in some parts of the world. This specie is long-haired and easily recognized by this characteristic.

It is commonly associated with spider mites and flat mites, collected together with spider mites, *Eotetranychus sp.* on rose, *Eutetranychus orientalis* on papayas, *Oligonychus orthius* on sugarcane, *O. velascoi* on coconuts, *Tetranychus kanzawai* on soybeans and cassava, and *T. piercei* on *Canvalia maritina*. It was also found in association with the flat mites, *Brevipalpus phoenicis* and *Tenuipalpus pacificus* on *Wedelia biflora* (Raros, 1986).

This predatory mite is very common and occurs on a wide variety of plants and appears more frequently in open cultivated areas than forests.

At 28°C *Amblyseius longispinosus* Evans lays an average of 3 eggs per day. If the temperature falls below 28°C fewer eggs were laid. If the temperature climbs over 30°C fewer eggs hatch (Gerdeman and Garcia, 2006).

The pesticide usage increases production costs to the point where the crop can no longer be grown and marketed profitably. Pesticide residues in the soil may be at such high levels that other crops cannot be successfully grown and made to meet legal residues tolerances. Repeated applications of insecticides and often mixtures of two insecticides



no longer produce a crop that is acceptable to processors or the fresh market. There is a collapse of the existing pest control program (Metcalf and Luckman, 1982).

The importance of this study is to help lessen or reduce the use of chemicals to control plant pests. Less expense of money on chemicals and organic farmers will have another option in controlling pests. Farmers will also experience the health benefits from reducing the use of pesticides.

The effectiveness of *Amblyseius longispinosus* Evans on cyclamen mite of strawberry will result to the control of this mite, hence crop damage will be reduced. With the implementation of organic farming, predatory mites will be considered to be good biological agents. It will also provide an idea for other researchers who want to study on mites of strawberry.

The study was conducted to determine the duration of the different growth stages of *Amblyseius longispinosus* Evans on cyclamen mite, fecundity, rate of consumption, preference, feeding behavior and reproduction.

The study was conducted at the Mite Predatory Rearing House, Balili, La Trinidad, Benguet from June 2010 to October 2010.



REVIEW OF LITERATURE

Life cycle of mites generally would include four or five stages; egg, larva, 2 or 3 nymphal instars and the adult. The eggs are laid singly or in clusters in protected areas as in cracks and crevices, galls, erinea or on open leaf surfaces, sometimes underneath webs. Six-legged larva hatches out from an egg. The larva feeds soon after hatching and after a short feeding period of one or a few days, settle down and rest in preparation for molting. During this resting period of intense physiological activity, a new skin is laid down underneath the old one and a much bigger, 8-legged nymph soon emerges. The first nymph is called the protonymph, the second a deutonymph and the third a tritonymph (Raros, 1986).

High relative humidity (80 to 90%) and temperatures of 60°F favor the development of cyclamen mites. Severe outbreaks may occur in greenhouses in the fall and winter months. Females may live for up to one month and can reproduce without mating. Cyclamen mite females lay 2 to 3 eggs per day for up to two to three weeks. The eggs are deposited in moist, dark places in crevices and at the base of the plant. Cyclamen mite eggs are oval, smooth and about one half the size of the adult female. Most of the eggs will develop into females. Larvae hatch from the eggs in 3 to 7 days. The slow-moving, white larvae feed for 4 to 7 days. Adults emerge from the pupal stage in 2 to 7 days. Their life cycle varies from 1 to 3 weeks depending upon greenhouse temperatures. Outdoors, the adult female can overwinter in protected locations as far north as Canada (Pundt, 2005).



Adult cyclamen mites are minute, elliptical, semi-transparent, orange-pink and shiny, with eight legs. They are about 1/100 inch long and cannot be seen without magnification. The hind pair of legs in the female is threadlike, and those of the male are pincer-like. The eggs are laid about the base of the cyclamen plant and in injured areas of the leaves and on strawberries along the midribs of the unfolding leaves. Each female deposits about 90 eggs, of which 80 percent may develop into females. The mites develop through a six-legged larval stage and a dormant nymphal stage with eight legs. All stages of the mite are found on infested plants. Out-of-doors, the adult female overwinters in protected locations around the crown of the strawberry plant (Bessin, 2007).

Cyclamen mites are pests of many ornamental flowers and shrubs such as Cyclamen, African violet, begonia, gerbera, ivy, chrysanthemums, geranium, fuchsia, larkspur, petunia, snapdragon, and other greenhouse grown plants. If the humidity is high, field grown strawberries also may be infested (Denmark, 2000).

Infested plants by cyclamen mite may have a streaked and/or blotched appearance, distorted leaves with small distorted flowers, and fewer flowers than normal or complete abortion of flower buds. Infested strawberry plants produce a roughened, wrinkled upper leaf surface, irregular folding and fluting of the leaf margins, and veins that bulge upward like blisters. Plants with mild injuries assume a dense appearance because petioles fail to elongate. A heavy infestation will kill African violets and cyclamens by dwarfing the leaves at the crown, and some leaves fail to open (Denmark, 2000).



Because of their small size, cyclamen mites often go undetected until the damage becomes severe. Usually it is the nature of the injury, not the mites themselves, that alerts greenhouse managers to cyclamen mite infestations. Depending on the type of plant attacked, cyclamen mites may infest the entire plant or be concentrated around the buds. Infested leaves become distorted, often curl inward, and foliage may become darker and appear streaked and blotchy. Injured foliage may show purplish areas. Very small, white, green, or pale-orange mites, with six or eight legs, work about the base of the plants or in the buds or the injured areas on the leaves. These mites thrive when the temperature is around 60°F and can complete their life cycle in about 2 weeks (Bessin, 2007).

In a study with the cyclamen mite, *Steneotarsonemus pallidus*, on strawberry in California, plots were kept free of a predator mite, *Typhlodromus reticulatus*, with treatments of a selective insecticide. Because the insecticide had a little or no effect on the cyclamen mite, numbers of treated plots increased 15 to 35 times, whereas there was no significant increase in untreated plots. In greenhouse studies, hand picking predator mites from plants gave similar results as removal by the insecticide, indicating that pest resurgence was not caused by any stimulatory effect of the compound (Pedigo, 1989).

Several species of mite predators are commercially available. These are usually released when mites first appear and should be evenly dispersed throughout the greenhouse. If mite infestations are heavy, consider spraying with an insecticidal soap before releasing predator mites. Selection of the proper predatory mite species will depend on greenhouse temperatures and humidity. If predatory mites are used, early release at the first sign of mite infestation is critical. Unlike the use of a miticide, it will take some time for predatory mites to control infestations (Bessin, 2007).



The goal of using predatory mites is to reduce the chemical spraying, which has results in the spider mite outbreaks, and to develop a reliable system of strawberry culture that reflects this. Our strategy includes releases of predatory mite *Amblyseius longispinosus* as one of the tools to replace some of the sprays (Hermano, 2006).

Amblyseius cucumeris is a predatory mite which can keep thrip damage at low level. It is pale pink in color, similar to the predatory mite *Phytoseiulus* and with a comparable life cycle. The eggs are laid on the hairs in the axils and side veins underneath the leaf (Forsythe, n.d.).

The newest, most unusual modification of the inoculative-release tactic is to release insecticide-resistant natural enemies. This tactic greatly improves the potential for integration of biological control with insecticides. It is based on the finding that some natural enemy populations have the ability to develop insecticide resistance with repeated exposure to the toxicant. Although the loss of known resistant natural enemies is not yet long, it includes diverse groups, the most notable of which are the Phytoseiid mites, *Metaseiulus* species and *Amblyseius* (Pedigo, 1989).

The nymph and adults of predatory mites attack and feed on other mites, such as spider mites, apple and plum rust mites and the like. They can often survive by feeding as a diet of pollen grains, fungal spores and plant vegetation. The variety of food eaten by these predatory mites means that they are not dependent on any particular prey so, although they do not become more numerous as their prey increases, they will remain on the tree when their prey is in short supply, unlike insects which tend to move off elsewhere when they have decreased their prey to low numbers (Forsythe, n.d.).



MATERIALS AND METHODS

Materials

The materials that were used during the study are strawberry runners, plastics pots, hose, petriplates, cotton, scissor, hairbrush, dissecting microscope, hand lens, micrometer, watering cans, cork borers, predatory mites and cyclamen mites.

Methodology

Propagation and Maintenance of Host Plants

Strawberry runners were grown on potted soil under greenhouse conditions. It was maintained as a source of runners for the duration of the study. Each new runner was transplanted in plastic pots (8cm in diameter) and it was maintained free from arthropods by hand picking.

Collection of Prey (Cyclamen Mite)

Strawberry leaves infested with cyclamen mite were collected and brought to the laboratory and examined directly with the use of microscope for conformation and



identification. Cyclamen mites were reared singly on excised strawberry leaves on petri plates.

Duration of the Different Life Stages

Healthy and fresh leaves of strawberry were collected and cut three centimeters in diameter. Mites and other insects were removed from the leaves to ensure that it is clean. The cut leaves were placed on top of water-soaked cotton inside a petriplate. Newly laid eggs of *Amblyseius longispinosus* Evans were placed on top of the strawberry leaves with the use of the hairbrush. The eggs were made to hatch and observed on the same leaves until they become an adult.

Fecundity

10 Adult female *Amblyseius longispinosus* Evans were reared singly on excised strawberry leaves and were placed on top of water-soaked cotton. The predators were provided with the prey. The number of eggs that were laid by the female *Amblyseius longispinosus* Evans was counted with the use of microscope until the female stops to lay eggs.

Rate of Consumption

The different stages of the prey were introduced to the different stages of the predatory mites. The number of each of the life stages of the prey that was consumed per



day by the protonymph, deutonymph and adult *Amblyseius longispinosus* Evans were recorded.

Feeding Behavior

The prey, cyclamen mites were introduced to the predatory mites, *Amblyseius longispinosus* Evans. The feeding behavior then was observed using the microscope.

Preference

Each sample of the different growth stages of *Amblyseius longispinosus* Evans was provided with 5 eggs, 5 larva, 5 nymphs and 5 adults of Cyclamen mite.

Data Gathered

1. Number of days of the different life stages of the mated and virgin *Amblyseius longispinosus* Evans
2. Number of days of the different life stages of the cyclamen mite
3. Fecundity. Number of eggs laid by a female predator.
4. Rate of consumption. Number of the different life stages of the prey being consumed by the different life stages of the predator in a daily basis.
5. Preference. The stage of cyclamen mite being preferred by the *Amblyseius longispinosus* Evans.
6. Feeding behavior. Manner of the predator in consuming the prey.



7. Reproduction. Behavior of both male and female predator in mating.

8. Photo documentation



RESULTS AND DISCUSSION

Duration of the Different Growth Stages of Mated *Amblyseius longispinosus* Evans

The mean duration of the different growth stages of *Amblyseius longispinosus* Evans (mated) is shown in Table 1.

Egg. The male developed from 2.41-2.92 days with a mean of 2.73 ± 0.23 days while the female developed from 2.37-2.94 days with a mean of 2.73 ± 0.15 days.

Larva. After emerging from egg, a six-legged larva hatched from the egg, which is quiet and does not move much. The male larva developed from 0.54-0.81 days with a mean of 0.71 ± 0.12 days while the female developed from 0.46-0.82 days with a mean of 0.74 ± 0.07 days.

Protonymph. After a quiescent stage, the larva molts to become a fully developed protonymph. The male has a mean duration of 1.92 ± 0.18 days that ranged from 1.73-2.19 days while the female has a mean of 2.09 ± 0.34 days with a ranged of 1.42-3.05 days.

Deutonymph. As shown in table 1, the male can take 1.15-3.10 days with a mean of 1.85 ± 0.83 days while the female can take 1.88-5.27 days with a mean of 2.40 ± 0.65 days to complete its deutonymphal stage.

Adult. The adult female has a much bigger body size and appears shiny when gravid and red in color. The male is smaller and has brown orange color.



The male adult lasted from 1.21-32.00 days with a mean of 16.24 ± 14.03 days while the female lasted from 19.14-34.16 days with a mean of 27.02 ± 3.05 days. The pre-reproductive period of the female ranged from 1.85-2.76 days with a mean of 2.30 ± 0.19 days. The reproductive period was 15.66-30.42 days with a mean of 22.36 ± 3.61 days and the post-reproductive period was 0.44-9.94 days with a mean of 2.36 ± 1.98 days.

The total life span of mated *Amblyseius longispinosus* Evans for the male ranged from 8.28-40.15 days with a mean of 23.43 ± 14.28 days while the female has a life span of 26.55-42.14 days with a mean of 34.97 ± 3.34 days. From the results, it shows that the total life span of the female was longer than the male.

Table 1. Mean duration (days) of the different growth stages of *Amblyseius longispinosus* Evans (mated)

GROWTH STAGES	RANGE	MEAN
Egg		
Male	2.41 - 2.92	2.73 ± 0.23
Female	2.37 - 2.94	2.73 ± 0.15
Larva		
Male	0.54 - 0.81	0.71 ± 0.12
Female	0.46 - 0.82	0.74 ± 0.07
Protonymph		
Male	1.73 - 2.19	1.92 ± 0.18



Female	1.42 - 3.05	2.09 ± 0.34
Deutonymph		
Male	1.15 - 3.10	1.85 ± 0.83
Female	1.88 - 5.27	2.40 ± 0.65
Adult		
Male	1.21 -32.00	16.24 ±14.03
Female	19.14 -34.16	27.02 ± 3.05
Pre-reproductive period	1.85 - 2.76	2.30 ± 0.19
Reproductive period	15.66 -30.42	22.36 ± 3.61
Post-reproductive period	0.44 - 9.94	2.36 ± 1.98
TOTAL LIFE SPAN		
Male	8.28 -40.15	23.43 ±14.28
Female	26.55 -42.14	34.97 ± 3.34

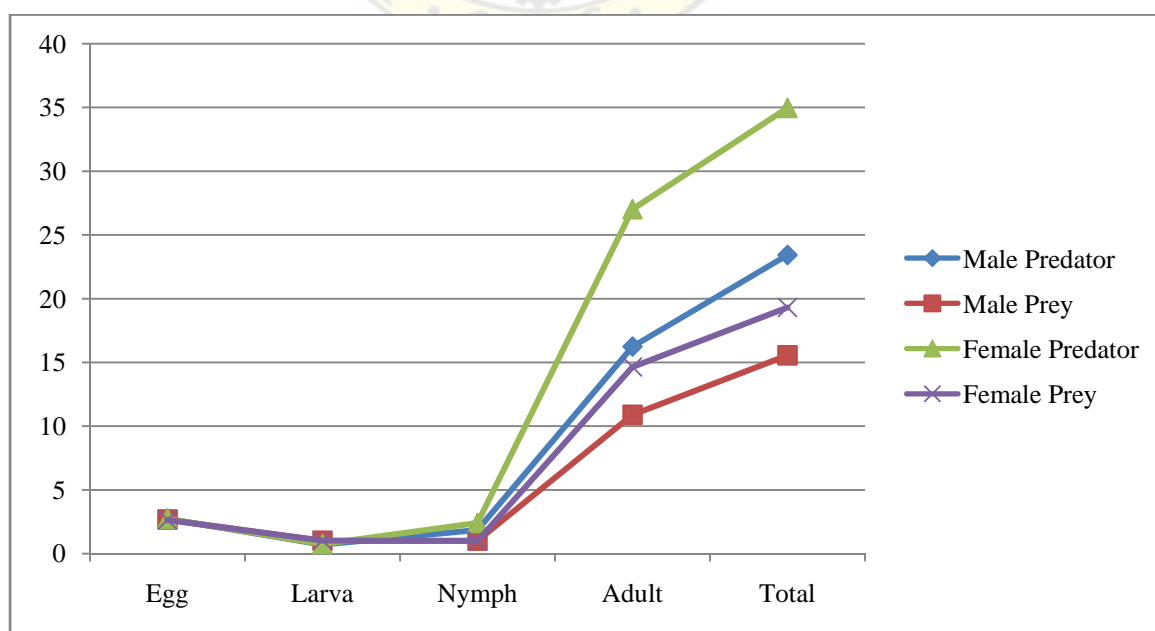


Figure 1. Mean duration of the different growth stages of mated *Amblyseius longispinosus* Evans (Predator) and Cyclamen mite (Prey)

Duration of the Different Growth Stages
of Virgin *Amblyseius longispinosus* Evans

The mean duration of the different growth stages of *Amblyseius longispinosus* Evans (virgin) is shown in Table 2.

Egg. The male egg lasted from 3.37-2.98 days with a mean of 2.77 ± 0.14 days while the female was 1.32-2.97 days with a mean of 2.59 ± 0.46 days.

Larva. The male larva has a duration of 0.42-0.99 days with a mean 0.78 ± 0.13 days while the female larva has a duration of 0.40-0.93 days with a mean of 0.76 ± 0.13 days.

Protonymph. The male developed from 1.18-2.74 days with a mean of 1.79 ± 0.33 days while the female developed from 1.42-2.38 days with a mean of 1.85 ± 0.23 days.

Deutonymph. The longevity of the male ranged from 1.08-2.19 days with a mean of 1.65 ± 0.26 days while the female ranged from 1.16-3.12 days with a mean of 1.86 ± 0.45 days.

Adult. The duration of male adult ranged from 38.88-56.00 days with a mean of 49.27 ± 4.20 days while the female duration ranged from 43.86-72.29 days with a mean of 57.65 ± 7.57 days.



The total life span of unmated *Amblyseius longispinosus* Evans with a mean of 56.24 ± 4.41 ranged from 44.84-62.93 while the female has a mean of 64.40 ± 6.30 days with a range of 52.04-78.59 days. Results show that the female has a longer life span than the male.

The mated and unmated females are longer than the male with means of 34.97 ± 3.34 days and 64.40 ± 6.30 days respectively, as compared to a mated male (23.43 ± 14.28 days) and a virgin male (56.25 ± 7.57 days).

Table 2. Mean duration (days) of the different growth stages of *Amblyseius longispinosus* Evans (virgin) under room temperature

GROWTH STAGES	RANGE	MEAN
Egg		
Male	2.37 - 2.98	2.77 ± 0.14
Female	1.32 - 2.97	2.59 ± 0.46
Larva		
Male	0.42 - 0.99	0.78 ± 0.13
Female	0.40 - 0.93	0.76 ± 0.13
Protonymph		
Male	1.18 - 2.74	1.79 ± 0.33
Female	1.42 - 2.38	1.85 ± 0.23
Deutonymph		
Male	1.08 - 2.19	1.65 ± 0.26



Female	1.16 - 3.12	1.86 ± 0.45
Adult		
Male	38.88-56.00	49.27 ± 4.20
Female	43.86-72.29	57.65 ± 7.57
TOTAL LIFE SPAN		
Male	44.84-62.93	56.25 ± 7.57
Female	52.04-78.59	64.40 ± 6.30

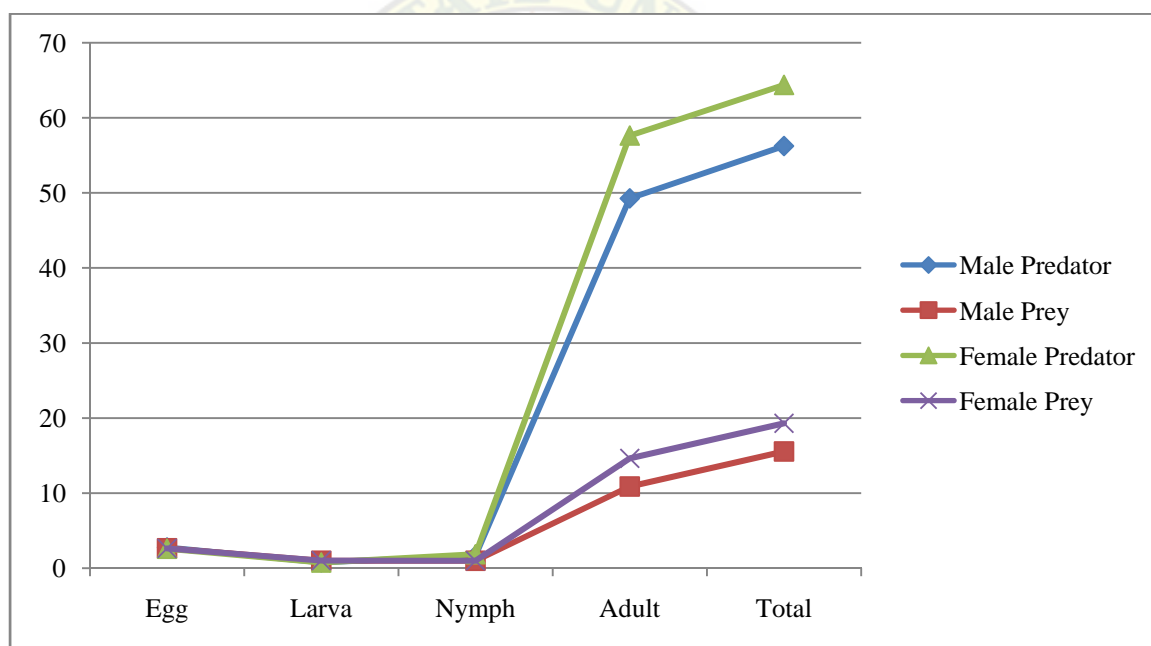


Figure 2. Mean duration of the different growth stages of virgin *Amblyseius longispinosus* Evans (Predator) and Cyclamen mite (Prey)

Duration of the different Growth Stages
of Cyclamen Mite



The mean duration of the different growth stages of Cyclamen mite is shown in Table 3.

Egg. The male egg developed from 2.62-2.76 days with a mean of 2.67 ± 0.07 days while the female developed from 2.64-2.68 days with a mean of 2.65 ± 0.03 days.

Larva. The male larva has a mean of 1.00 ± 0.03 days with a ranged of 0.97-1.02 days while the female has a mean of 1.03 ± 0.09 days with a ranged of 0.99-1.10 days.

Nymph. Both male and female duration is almost the same with a ranged of 0.99-1.02 days for the male nymph with a mean of 1.01 ± 0.02 days while the female developed from 0.99-1.01 days with a mean of 1.00 ± 0.02 days.

Adult. The male adult developed from 7.18-20.12 days with a mean of 10.89 ± 6.77 days while a range of 3.13-24.05 days with a mean of 14.64 ± 14.03 days for the female.

Table 3. Mean duration (days) of the different growth stages of Cyclamen mite under room temperature

GROWTH STAGES	RANGE	MEAN
Egg		
Male	2.62 - 2.76	2.67 ± 0.07
Female	2.64 - 2.68	2.65 ± 0.03
Larva		
Male	0.97 - 1.02	1.00 ± 0.07



Female	0.99 - 1.10	1.03 ± 0.09
Nymph		
Male	0.99 - 1.02	1.01 ± 0.02
Female	0.99 - 1.01	1.00 ± 0.02
Adult		
Male	7.18-20.12	10.89 ± 6.77
Female	3.13-24.05	14.64±14.03
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TOTAL LIFE SPAN		
<hr/>		
Male	11.85-24.88	15.56 ± 6.82
Female	7.76-19.31	19.31±14.07
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From the results, it shows that the female has a longer life span from 7.76-28.70 days with a mean of 19.31±14.07 days while the male has a range of 11.85-24.88 days with a mean of 15.56±6.82 days.





a. Egg



b. Larva



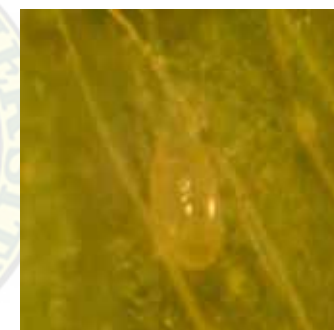
c. Protonymph



d. Deutonymph



e. Male adult



f. Female adult



g. Mating behavior



h. Gravid female

Figure 3a-h. Different growth stages of *Amblyseius longispinosus* Evans

Number of Consumed Mites Per Day

The number of consumed mites per day by the different growth stages of *Amblyseius longispinosus* Evans is shown in Table 4.

The larva of the predator does not feed. The protonymph consumed an average of 9.17 eggs, 6.04 larvae, 3.92 nymphs and 3.89 adults per day of the cyclamen mite. The deutonymph consumed an averaged of 14.11 eggs, 7.72 larvae, 9.13 nymphs and 3.89 adults of cyclamen mite per day. An average of 8.00 eggs, 5.38 larvae, 4.46 nymphs and 3.28 adults were consumed by the adult predator *Amblyseius longispinosus* Evans per day. The protonymph consumed lesser prey and as it develops to the next stage, deutonymph, it consumes more prey than the protonymph to sustain its growth and development. The adult is more active in searching its prey than the protonymph and deutonymph the reason for having a bigger body and more mobile. As the predator complete its development, the number of consumed mite's decreases until it dies.

Table 4. Mean total of consumed mites per day by the different growth stages of *Amblyseius longispinosus* Evans on Cyclamen Mite

GROWTH STAGES OF PREDATOR	GROWTH STAGES OF CYCLAMEN MITE				
	Egg	Larva	Nymph	Adult	Mean Total
Protonymph	9.17	6.04	3.92	3.89	23.02
Deutonymph	14.11	7.72	9.13	3.89	34.85
Adult	8.00	5.38	4.46	3.28	21.12
Mean Total	31.28	19.14	17.51	11.06	



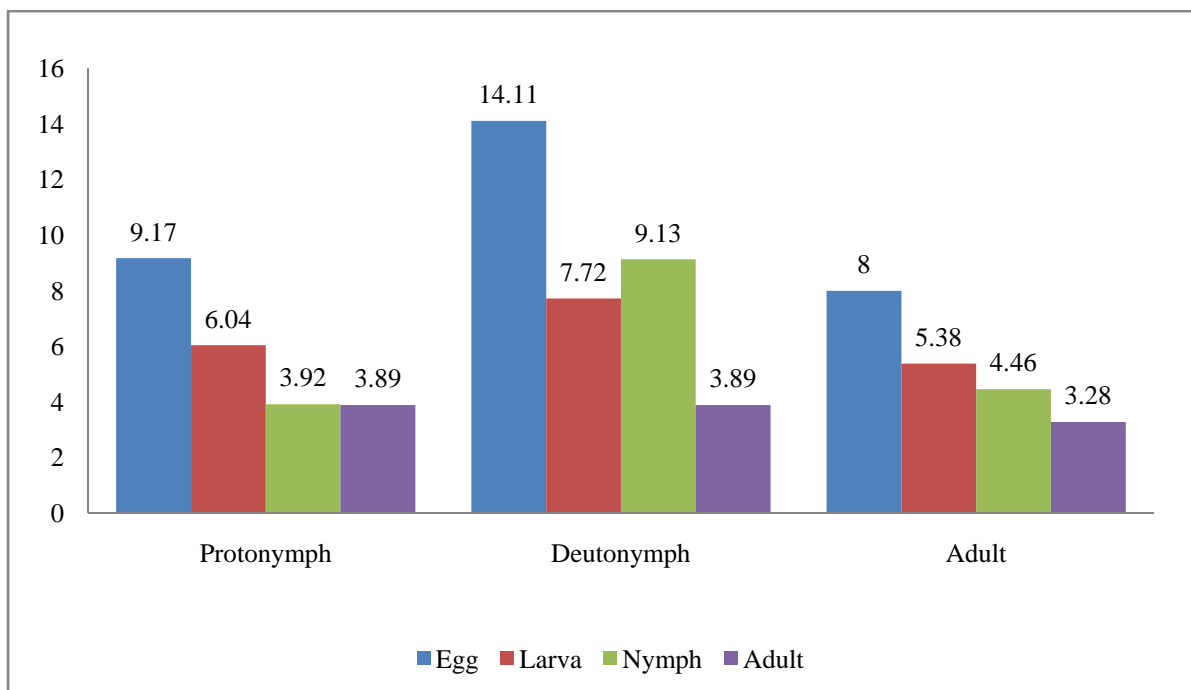


Figure 4. Mean total of consumed mites per day by the different growth stages of *Amblyseius longispinosus* Evans on Cyclamen mite

Preference

The total percentage on the preference of the *Amblyseius longispinosus* Evans in feeding on cyclamen mite is shown in Table 5.

Table 5. Total percentage of the preference on the different stages of Cyclamen mite being preferred by the *Amblyseius longispinosus* Evans on what to feed



GROWTH STAGES OF PREY	GROWTH STAGES OF PREDATOR					
	Protonymph		Deutonymph		Adult	
	Total	%	Total	%	Total	%
Egg	2	16.67	0	0.0	2	16.67
Larva	1	8.33	6	50.00	3	25.00
Nymph	1	8.33	2	16.67	2	16.67
Adult	8	66.67	4	33.33	5	41.66

Based on the result on what stage of the prey is most preferred by the different growth stages of the predator. The protonymph *Amblyseius longispinosus* Evans prefer most to eat the adult stage of the prey while the deutonymph *Amblyseius longispinosus* Evans prefer to feed on larva. Adult prey is most preferred by the adult predator. Table 5 shows that the protonymph *Amblyseius longispinosus* Evans most preferred to feed on the adult prey with 8 (66.67%) from the 12 samples, 2 (16.67%) eggs and 1 (8.33%) each for both larva and nymph. The deutonymph *Amblyseius longispinosus* Evans prefers to feed on larva with 6 (50%), 4 (33.33) adult, 2 (16.67%) nymph and 0 (0%) egg. The adult *Amblyseius longispinosus* Evans prefers to feed on adult with 5 (41.66%), 3 (25%) larva and 2 (16.67%) for both egg and nymph. From the observation, the predator attacks the prey that is mobile such as the larva and adult. The adult cyclamen mite is more mobile



than the larva and other stages having a reason of attacking by the predator *Amblyseius longispinosus* Evans

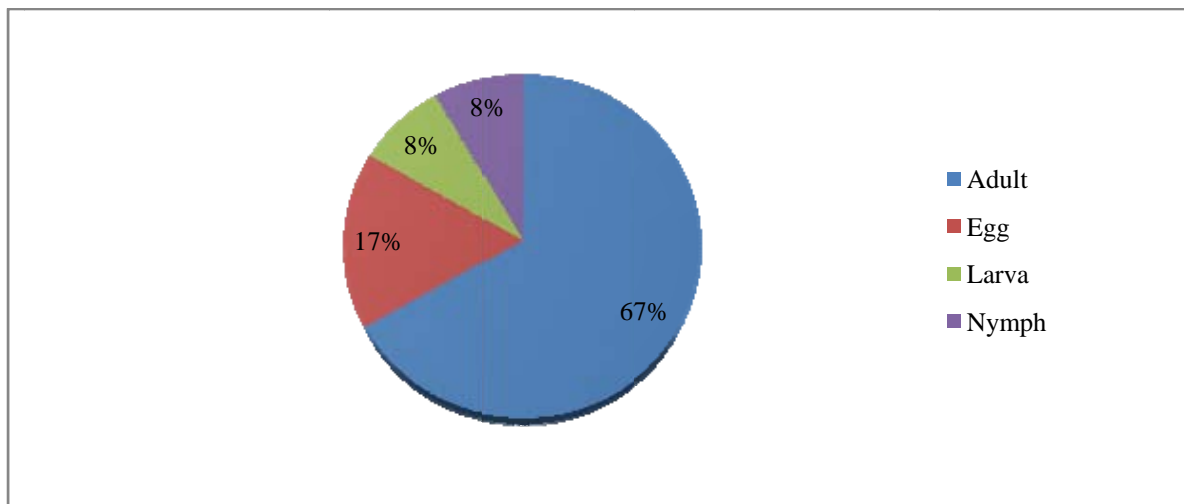


Figure 5a. Preference of the protonymph *Amblyseius longispinosus* Evans on the different growth stages of Cyclamen mite



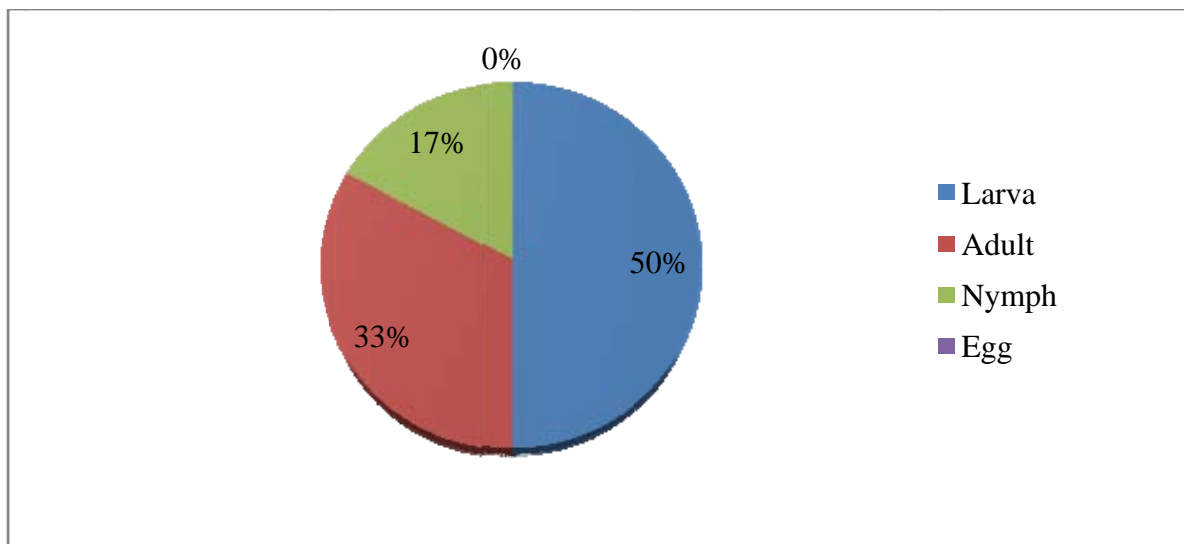


Figure 5b. Preference of the deutonymph *Amblyseius longispinosus* Evans on the different growth stages of Cyclamen mite

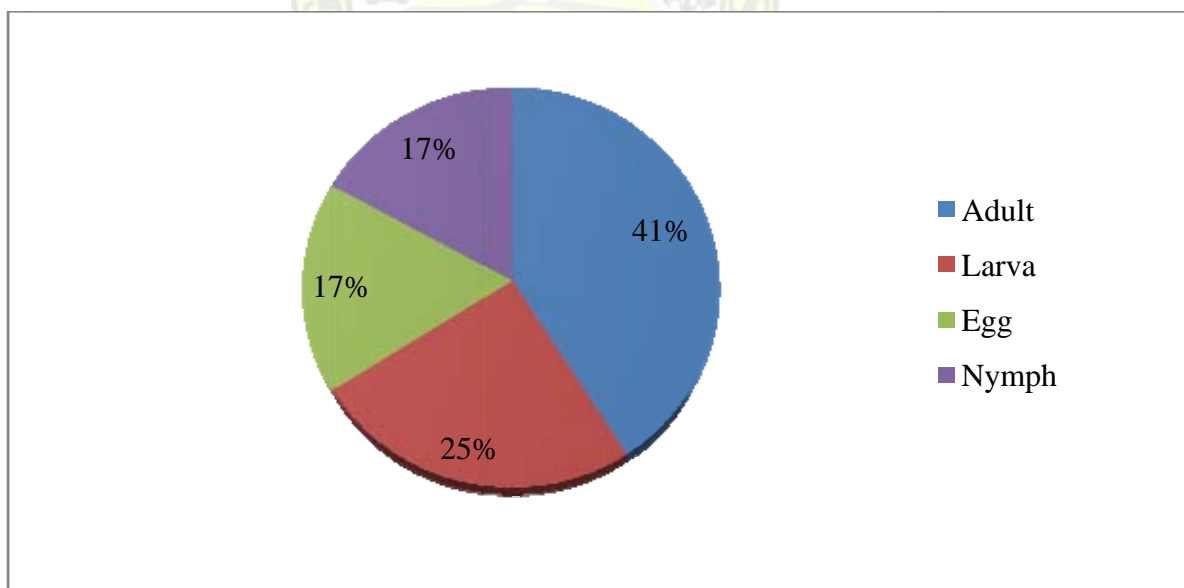


Figure 5c. Preference of the adult *Amblyseius longispinosus* Evans on the different growth stages of Cyclamen mite

Fecundity

Table 6 shows the total number of eggs laid by a single adult female *Amblyseius longispinosus* Evans.

A single adult female *Amblyseius longispinosus* Evans can lay 14-52 eggs with a mean of 26.64 ± 8.33 eggs throughout its life span. The eggs were laid under the leaf hairs and also on the leaf ribs.

Feeding Behavior

The *Amblyseius longispinosus* Evans attacks its prey on their dorsal portion using its foreleg to hold the prey while sucking the fluid content of the body through its needle-like chelicerae. The predator leaves the shrunken body of the prey after sucking the fluid content.

The number of each stage eaten depends on the density of prey, temperature, humidity, stage of predator feeding and which prey stages are available for them to feed upon, Shaw (1982) as cited by Damaso (2006).

Table 6. Total number of laid eggs by the adult female *Amblyseius longispinosus* Evans

SAMPLE NO.	TOTAL NO. OF LAID EGGS
1	14
2	28
3	19



4	43
5	21
6	33
7	30
8	14
9	14
10	52
11	25

Reproduction

Both sexes of predatory mite don't copulate. The sperms are packed in tiny capsules that are implanted into the females' genital opening through a sperm transfer organ borne on the pincer like chelicerae of the male. Sperm transfer is accomplished with a male and female assuming a copulatory position but don't actually copulate because male has no penis. The sperm are stored in a pair of sacs inside the body of the female. The spermatozoa are released when the gelatinous capsules are dissolve inside the female's genital tract, Raros (1986) as cited by Damaso (2006).



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at the Mites Predatory Rearing House from June to October 2010 to record the duration of the different growth stages of mated and virgin *Amblyseius longispinosus* Evans on cyclamen mite, fecundity, rate of consumption, preference, feeding behavior and reproduction.

Duration of mated and unmated *Amblyseius longispinosus* Evans were recorded and also with the duration of Cyclamen mite. The egg, larva, protonymph, deutonymph and adult were the five different stages of the predator *Amblyseius longispinosus* Evans. For the cyclamen mite, it undergoes four stages namely: egg, larva, nymph and adult.

The duration of the different stages of mated *Amblyseius longispinosus* Evans, male egg developed from 2.41-2.92 days while the female developed from 2.37-2.94 days. The male larva developed from 0.54-0.81 days while the female developed from 0.46-0.82 days. A range of 1.73-2.19 days for the male protonymph and 1.42-3.05 days for the female. The fourth stage deutonymph developed from 1.15-3.10 days for the male while the female can take 1.88-5.27 days. The male adult lasted from 1.21-32.00 days while the female lasted from 19.14-34.16 days. The pre-reproductive period of the female ranged from 1.85-2.76 days. An average of 15.66-30.42 days for its reproductive period and for the post-reproductive period, it ranges from 0.44-9.94 days. The total life span of mated *Amblyseius longispinosus* Evans for the male ranged from 8.28-40.15 days while the female has a life span of 26.55-42.14 days.



For the development of unmated *Amblyseius longispinosus* Evans, the male egg lasted from 3.37-2.98 days while the female was 1.32-2.97 days. The male larva has a duration of 0.42-0.99 days while the female larva has a duration of 0.40-0.93 days. The male protonymph developed from 1.18-2.74 days and the female developed from 1.42-2.38 days. The longevity of the male deutonymph ranged from 1.08-2.19 days while the female ranged from 1.16-3.12 days. The duration of male adult ranged from 38.88-56.00 days and the female duration range from 43.86-72.29 days. The total life span of unmated *Amblyseius longispinosus* Evans has a ranged of 44.84-62.93 and the female has a ranged from 52.04-78.59 days.

The cyclamen mite male egg developed from 2.62-2.76 days and the female developed from 2.64-2.68 days. The male larva has a ranged of 0.97-1.02 days while the female has a ranged of 0.99-1.10 days. The male nymph developed from 0.99-1.02 days and the female developed from 0.99-1.01 days. The duration of male adult developed from 7.18-20.12 days while a ranged of 3.13-24.05 days for the duration of female. For the total life span, it ranges from 11.85-24.88 days for the male and 7.76-28.70 days for the female.

The protonymph *Amblyseius longispinosus* Evans consumed an average of 9.17 eggs, 6.04 larvae, 3.92 nymphs and 3.89 adults per day of the cyclamen mite. The deutonymph consumed an averaged of 14.11 eggs, 7.72 larvae, 9.13 nymphs and 3.89 adults of cyclamen mite per day. An average of 8.00 eggs, 5.38 larvae, 4.46 nymphs and 3.28 adults was consumed by the adult predator *Amblyseius longispinosus* Evans



The protonymph *Amblyseius longispinosus* Evans prefer to feed on adult with 8(66.67%), 2 (16.67%) eggs and 1(8.33%) each for both larva and nymph. The larva of cyclamen mite is more preferred by the deutonymph *Amblyseius longispinosus* Evans with 6(50%), 4(33.33) adult, 2(16.67%) nymph and 0(0%) egg. The adult *Amblyseius longispinosus* Evans prefer to feed on adult with 5(41.66%), 3(25%) larva and 2(16.67%) for both egg and nymph.

A single female *Amblyseius longispinosus* Evans can lay eggs to as many as 14-52.

The *Amblyseius longispinosus* Evans attacks its prey using its needle-like chelicerae on their dorsal portion and uses its foreleg to hold the prey while sucking the fluid content of the body.

Male and female of predatory mite don't copulate. Sperm transfer is accomplished with a male and female assuming a copulatory position but don't actually copulate because male has no penis.

Conclusion

Results gathered on the life span, fecundity, predation rate, preference, feeding behavior and reproduction of *Amblyseius longispinosus* Evans as well as the cyclamen mite were successfully done under laboratory condition. This study will give way to future researches on the effectiveness of *Amblyseius longispinosus* Evans, a biological control agent for different plant sucking insects.



Recommendation

It is recommended that future researchers will focus on the mass rearing of different predators specifically *Amblyseius longispinosus* Evans on its effectiveness as a biological control of different plant sucking pests. The use of *Amblyseius longispinosus* Evans as control agent of the said pests is recommended.



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APPENDICES

Appendix Table 1. Duration (days) of the different growth stages of *Amblyseius longispinosus* Evans (mated)

STAGES OF REPLICATION		TOTAL MEAN									
		1	2	3	4	5	6	7	8	9	10
PREDATOR		11	12	13	14	15	16	17			
Egg											
	Male		2.68			2.92					2.89
2.92				2.41		2.56			16.38	2.73	
	Female	2.66		2.69			2.94	2.88	2.88	2.90	
2.89		2.93	2.37	2.38				2.52	30.04	2.73	
Larva											
	Male		0.81			0.54					0.78
0.79				0.70	0.61			4.23	0.71		
	Female	0.75		0.81		0.46	0.80	0.82	0.79		0.80
		0.77	0.75	0.75		0.65	8.15	0.74			
Protonymph											
	Male		1.73			1.74					2.19
1.97				1.94	1.92			11.49	1.92		
	Female	1.81		1.75		1.72	1.42	2.10	0.79		2.05
		3.05	2.13	1.89		2.93	22.94	2.09			
Deutonymph											



1.15	Male	1.22		2.18				1.21
			3.10	2.22	11.08	1.85		
	Female	2.19		2.09	2.16	1.94	2.25	5.27
		2.08	2.04	2.33	1.88	26.38	2.40	2.15

Adult

21.94	Male	2.68		1.21				1.21
			32.00	28.38		97.40	16.24	
2.15	Female	19.14		22.63	25.10	32.13	27.67	29.09
		28.27	22.84	30.67		34.16	297.20	27.02

Pre-reproductive

2.48	Period	2.11		1.85	2.10	2.10	2.47	2.76
		2.67	2.12	2.13	2.49	25.28	2.30	

Reproductive

22.36	Period	15.83		20.33	16.90	29.15	24.76	25.43
		21.34	15.68	18.64	27.45		30.42	245.91

Post-reproductive

1.08	Period	1.20		0.45	6.10	0.88	0.44	1.50
		9.94	2.08	1.09	1.25	26.01	2.36	

TOTAL

28.77	Male	19.12		8.59				8.28
			40.15	35.69	140.60	23.43		
32.79	Female	26.55		29.97	32.38	39.17	35.72	40.74
		37.10	30.13	38.02		42.14	376.71	34.97



Appendix Table 2. Duration (days) of the different growth stages of *Amblyseius longispinosus* Evans (virgin)

STAGES OF REPLICATION		TOTAL MEAN									
PREDATOR		1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19			
Egg											
Male		2.84		2.83		2.90		2.37	2.98		2.94
2.75		2.94						2.60	2.56		27.71 2.77
Female			2.35		2.81				1.32		2.93
2.97	2.97	2.76		2.78		2.76					23.65 2.59
Larva											
Male		0.99		0.96		0.86		0.88	0.84		0.84
0.53		0.75						0.42	0.73		7.80 0.78
Female			0.83		0.93				0.88		0.93
0.75	0.66	0.40		0.73		0.69					6.80 0.76
Protonymph											
Male		1.89		1.95		1.85		1.68	1.25		2.07
1.83		1.42						1.18			2.74 17.86
1.79											
Female			1.88		1.94				1.74		2.04
2.38	1.42	1.77		1.44		2.05					16.66 1.85
Deutonymph											
Male		1.42		1.59		1.48		1.42	2.19		1.08
1.99		2.13						1.76	1.42		16.48 1.65



	Female	1.24	1.42		3.12	1.99		
2.08	1.95	1.94	1.83	1.16		16.73	1.86	
Adult								
	Male	55.51	43.45	46.09	43.93	50.22		56.00
53.43		51.05		38.88	54.13	492.69	49.27	
	Female	72.59	58.10			64.85	57.10	
43.86	54.56	53.62	62.51	48.86		551.75	57.65	

TOTAL

Male		62.65	50.78	53.18	50.28	57.48		62.93
60.53		58.29			44.84	61.58	562.54	56.25
Female		78.59	65.20			71.91	64.99	
52.04	61.56	60.49	69.29	55.52			579.59	
64.40								

Appendix Table 3. Duration (days) of the different growth stages of Cyclamen Mite

STAGES OF	REPLICATION							
	TOTAL	MEAN						
PREDATOR		1	2	3	4	5	6	7
8	9							
Egg								
Male				2.76			2.68	2.62
2.62	2.68	13.36	2.67					
Female			2.68	2.64	2.64	2.65		
		10.61	2.65					
Larva								



	Male				0.98		0.97	1.02
1.02	0.99	4.98		1.00				
	Female		1.10	0.99		1.02	0.99	
		4.10		1.03				
Nymph								
	Male				1.02		1.02	1.00
1.00	0.99	5.03		1.01				
	Female		0.99	1.00		0.99	1.01	
		3.99		1.00				
Adult								
	Male				20.12		7.18	11.54
7.26	8.35	54.45		10.89				
	Female		17.93	3.13		13.44	24.05	
		58.55		14.64				
<hr/>								
TOTAL								
	Male				24.88		11.85	16.18
11.90	13.01	77.82		15.56				
	Female		22.70	7.76		18.09	28.70	
		77.25		19.31				

Appendix Table 4a. Number of consumed mites per day by the protonymph *Amblyseius longispinosus* Evans on Cyclamen Mite

STAGE OF PREDATOR	GROWTH STAGES OF CYCLAMEN MITE			
	Egg	Larva	Nymph	Adult
Ptonymph				
Days				



1	5.25	6.63	4.75	2.33
2	19.25	8.50	6.00	3.33
3	3.00	3.00	1.00	6.00
Total	27.50	18.13	11.75	11.66

Appendix Table 4b. Number of consumed mites per day by the deutonymph *Amblyseius longispinosus* Evans on Cyclamen Mite

STAGES OF PREDATOR	GROWTH STAGES OF CYCLAMEN MITE			
	Egg	Larva	Nymph	Adult
Deutonymph				
Days				
1	22.00	9.50	10.00	5.33
2	18.33	11.38	8.25	4.33
3	2.00	7.00		2.00



4		3.00		
Total	42.33	30.88	18.25	11.66

Appendix Table 4c. Number of consumed mites per day by the adult *Amblyseius longispinosus* Evans on Cyclamen Mite

STAGES OF PREDATOR	GROWTH STAGES OF CYCLAMEN MITE				
	Adult	Egg	Larva	Nymph	Adult
Days					
1		11.00	7.25	6.50	3.00
2		26.75	14.13	12.50	6.33
3		17.00	8.13	7.50	6.33
4		11.75	6.38	7.50	2.67
5		13.75	5.38	2.75	3.00



6	11.75	5.63	4.75	3.00
7	11.00	8.13	4.25	3.33
8	15.25	8.25	6.25	5.00
9	13.50	7.38	4.00	3.33
10	9.50	8.25	5.25	3.33
11	11.50	5.63	5.25	3.33
12	5.50	8.63	5.25	4.00
13	9.29	7.50	2.75	4.33
14	9.25	7.88	5.00	3.33
15	9.50	10.50	5.75	3.67
16	13.75	8.00	4.75	7.00
17	8.25	5.25	6.25	5.33
18	9.00	6.88	7.50	2.67
19	8.25	4.38	7.75	4.00
20	5.75	5.25	5.00	3.00
21	4.75	7.13	7.25	2.33
22	8.00	7.50	10.25	2.33
23	12.25	5.50	2.25	2.33
24	8.00	4.25	1.75	2.67
25	6.75	4.25	2.25	3.00
26	9.00	4.38	2.75	3.33
27	7.00	5.13	3.50	2.67
28	5.75	4.75	3.75	2.33
29	9.00	7.38	3.50	5.33



30	9.25	4.75	4.75	4.33
31	9.00	5.63	4.50	4.33
32	7.25	5.63	4.00	4.67
33	8.75	8.25	5.75	3.33
34	6.75	5.25	2.75	3.33
35	4.75	4.88	2.75	3.00
36	7.00	4.38	4.50	2.00
37	8.00	4.38	2.25	3.67
38	6.75	4.25	3.25	2.33



Appendix Table 4c. Number of consumed mites per day by the adult *Amblyseius longispinosus* Evans on Cyclamen Mite

39	6.00	4.13	3.00	2.00
40	4.00	5.38	2.50	2.33
41	4.00	3.13	1.67	1.67
42	3.67	3.13	2.67	1.33
43	5.00	3.00	2.67	1.67
44	5.00	4.00	5.00	3.00
45	4.00	4.33	3.00	1.50
46	3.00	3.00	5.33	3.50
47	5.33	4.00	3.33	1.50
48	2.33	3.67	5.33	4.00
49	3.33	4.00	2.67	2.00
50	3.00	4.33	4.67	2.00
51	3.00	5.00	2.67	
52	5.00	4.50	1.50	
53	5.00	5.50	2.00	
54	1.00	3.00		
55		3.00		
56		2.50		
57		2.50		
58		2.50		
59		4.50		



60			3.50		
61			2.50		
62			1.50		
Total	431.91		333.33	236.26	163.79

Appendix Table 5. The different stages of Cyclamen Mite being preferred by the *Amblyseius longispinosus* Evans

STAGES OF PREDATOR		REPLICATION							
		1	2	3	4	5	6	7	8
9	Stages of prey	10	11	12	TOTAL				
	Protonymph								
	Egg								√
	Larva				√	2			
					1				Nymph
1	Adult		√						
√	√	√		√	8		√		√
	Deutonymph								
	Egg				0				
√	Larva				√	√			√
						6			Nymph
	Adlut		√						√
√	√	√		4				√	
	Adult								
√	Egg		√	2					
				√		Larva		√	
									3
								√	
	Adult		2						
		√			√	√	√		√
						5			Nymph



Appendix Table 6. Total number of laid eggs by the adult female *Amblyseius longispinosus* Evans

SAMPLE NO.	TOTAL NO. OF LAID EGGS
1	14
2	28
3	19
4	43
5	21
6	33
7	30
8	14
9	14
10	52
11	25
Range	14-52
Mean	26.64±8.33

