

BIOLOGICAL RESPONSES OF THE PREDATORY MITE, *Agistemus exsertus* (ACARI: STIGMAEIDAE) TO PHOTOPERIOD AND LIGHT INTENSITY

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ABSTRACT

A laboratory study revealed that the high intensity of light retarded the development of the immature stages of the predatory stlgmaeid mite, *Agistemus exsertus* Gonzalez. Additionally, the predatory adults showed a high photoperiodic response. Adult longevity correlated negatively with increasing light intensity or photoperiod. Moreover, reproduction and predation capacity of females were negatively responded to photoperiod and light intensity.

Keywords: *Agistomus exsertus*, light intensity, photoperiod, oviposition, predatory capacity.

INTRODUCTION

There is a resurgence of interest in the effect of biotic factors on the behaviour and biology of mites, but few studies reported the effect of photoperiod and light intensity on biology of mites. Veerman (2001) stated that photoperiod may govern vital processes in the life cycle of insects and mites.

However, Polcik *et al.* (1965) and Maeda *et al.* (2000) reported that the two spotted spider mite, *Tetranychus urticae* Koch exhibited a higher oviposition rate and was noted feeding for a longer period during the daylight than at night. Likewise, Rasmy (1972) noted that high light intensity increased the rate of oviposition of the tetranychid mite *T. cinnabarinus* (Bois.). On the contrary, Elbanhawy (1977) reported that the lowest light intensity shortened developmental duration and increased the rate of reproduction of the phytoseiid mite, *Amblyseius brazilli* Elbanhawy, while a positive correlation was noted between photoperiod and reproduction.

Therefore, it was of interest to study the effect of photoperiod and light intensity on some biological aspects, i.e. development, reproduction and predation capacity of the stigmatid mite, *Agistemus exsertus* Gonzalez. This predatory mite plays a significant role in the biological control of acarine pests and scale insects infesting fruit trees and ornamental plants in Egypt (Rasmy, 1972).

MATERIALS AND METHODS

The predatory mite, *A. exsertus* was obtained from a laboratory culture maintained on mulberry leaves, *Morus alba* L., infested with the two spotted spider mite, *T. urticae* as prey. The leaves were placed upside down on cotton soaked in water in Petri-dishes.

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Five groups consisting of 20 predator larvae each were singly transferred to mulberry leaf discs, 2cm in diameter. Each predatory larva was then supplied with a sufficient number of prey, i.e. 20 nymphs of the two-spotted spider mite. Two groups of these predatory larvae were subjected to light intensity of 1300 Lx, as one group was exposed for 3 hours daily, while the other group was exposed for 6 hours, then both predatory groups were maintained under daylight regime during the rest of the day. Likewise, two other groups of predatory larvae were subjected to light intensity of 2900 Lx, as one group was exposed for 3 hours, while the other group was exposed for 6 hours daily. The fifth group of larvae was maintained under natural daylight regime as a check.

Prey were replaced daily by fresh ones and number of prey consumed was recorded. Emerged females were coupled with emerged males for mating and the number of eggs deposited per female was recorded. Experiments were carried out in the laboratory at temperature of $27\pm 1^{\circ}\text{C}$ and $75\pm 5\%$ R.H.

RESULTS

Effect of photoperiod

Developmental duration: Data presented in table (1) show that photoperiod did not exhibit significant correlation with developmental duration of the immature stages. The developmental duration of immature stages exposed to 1300 Lx for 3 hours was significantly prolonged compared to their counterparts of the check, but did not differ from that of conspecific individuals exposed to the same light intensity for a longer period of 6 hours. Likewise, immature stages of the predator exposed to light intensity of 2900 Lx for either 3 or 6 hours reacted similarly.

Table (1): Effect of light intensity and photoperiod on developmental duration (days) of *Agistemus exsertus* fed on nymphs of *Tetranychus urticae*

| Predatory stage | Check | Light intensity 1300 Lx | | Light intensity 2900 Lx | | L.S.D. at 5% |
|---------------------|------------------|-------------------------|------------------|-------------------------|------------------|--------------|
| | | 3 hours | 6 hours | 3 hours | 6 hours | |
| Larva | 1.86± 0.10 c | 2.56± 0.24 a | 2.00± 0.00 c | 2.13± 0.13 bc | 2.44± 0.13 ab | 0.35 |
| Protonymph | 2.50± 0.14 ab | 2.33± 0.17 abc | 3.00± 0.00 c | 2.73± 0.15 ab | 2.81± 0.10 a | 0.34 |
| Deutonymph | 2.21± 0.11 b | 3.00± 0.29 a | 3.06± 0.06 a | 3.07± 0.30 a | 3.06± 0.06 a | 0.51 |
| Total | 6.57± 0.17 b | 7.89± 0.39 a | 8.06± 0.06 a | 7.93± 0.12 a | 8.31± 0.12 a | 0.46 |
| % Reaching maturity | 100 | 100 | 100 | 100 | 100 | |
| Adult longevity | 39.43± 1.47 a | 35.13± 3.35 a | 29.13± 1.12 b | 26.80± 1.86 b | 26.63± 1.07 b | 4.58 |

Different letters in the same row denote significant differences.

Adult longevity: Longevity of predatory adults exposed to 1300 Lx for 3 hours was shorter compared to those of the check, but the difference was not significant, whereas their counterparts exposed for 6 hours to the same light intensity exhibited a pronounced significant shorter longevity (Table 1). Longevity of adults exposed to 2900 Lx either for 3 or 6 hours was significantly shorter compared to those of the check.

Oviposition period: Predatory adults exposed to 1300 Lx exhibited a distinct shorter oviposition period when the exposure period extended to 6 hours, whereas conspecific exposed to 2900 Lx, either for 3 or 6 hours, exhibited a marked significant shorter oviposition period compared to those of the check (Table 2).

Table (2): Effect of light intensity and photoperiod on oviposition of *Agistemus exsertus* fed on nymphs of *Tetranychus urticae*

| Light intensity/ photoperiod | Duration in days | | | Average number of eggs/female | |
|---------------------------------|------------------|------------------|------------------|-------------------------------|------------------|
| | Preoviposition | Oviposition | Postoviposition | Total | Daily rate |
| Check | 1.79± 0.11 c | 32.50± 1.51 a | 5.14± 0.49 a | 86.50± 3.68 a | 2.68± 0.08 a |
| 1300 Lx/3 hours | 1.67± 0.17 c | 29.25± 2.75 a | 4.00± 0.71 ab | 43.56± 5.24 b | 1.54± 0.07 c |
| 2900Lx/3 hours | 1.60± 0.19 c | 23.20± 1.83 b | 2.20± 0.44 c | 46.47± 4.31 b | 2.11± 0.21 b |
| 1300 Lx/6 hours | 2.31± 0.12 b | 22.13± 0.92 b | 4.69± 0.41 ab | 40.38± 2.08 b | 1.86± 0.10 bc |
| 2900 Lx/6 hours | 2.75± 0.11 a | 20.19± 0.99 b | 3.69± 0.30 b | 30.19± 2.08 c | 1.50± 0.09 c |
| L.S.D. at 5% | 0.40 | 4.23 | 1.26 | 9.56 | 0.36 |

Different letters in the same column denote significant differences.

Fecundity: Results presented in table (2) revealed that total number of eggs laid per predatory female exposed to either light intensity for 3 hours decreased and the decline in oviposition was more pronounced when the exposure period prolonged to 6 hours. Moreover, the decline in egg reproduction of predatory females exposed to either intensity averaged 50%.

Predation capacity: Immature and adult stages of the predator exhibited a distinct lower rate of predation capacity when were exposed for 6 hours daily to light intensity of 1300 Lx or 2900 Lx compared to those of the check. In contrast, immature stages exposed for a shorter period, 3 hours, to either light intensity showed a significant higher rate of prey consumption compared to those exposed for 6 hours to the aforementioned light intensities (Table 3).

Effect of light intensity:

Developmental duration: Immature stages of the predator exposed to either light intensity of 1300 Lx or 2900 Lx developed into adulthood after a similar duration (Table 1).

Adult longevity: Results presented in table (1) revealed that light intensity had negative effect on adult longevity. Adult exposed to light intensity of 1300 Lx survived longer than conspecific adults subjected to 2900 Lx light intensity.

Oviposition period: Results presented in table (1) showed that oviposition period correlated negatively with increasing light intensity from 1300 Lx to 2900 Lx.

Fecundity: Number of eggs laid by females exposed for the higher light intensity, 2900 Lx, was significantly lower than that of their counterparts exposed to the lower light intensity, 1300 Lx, when the exposure period extended to 6 hours (Table 2).

Predatory capacity: Prey consumption of the predatory adults exposed to either light intensity 1300 Lx or 2900 Lx declined sharply (Table 3) as their consumption rate did not significantly differ between 1300 Lx and 2900 Lx.

Table (3): Effect of light intensity and photoperiod on predation capacity of *Agistemus exsertus* fed on nymphs of *Tetranychus urticae*

| Predatory stage | Average number of consumed prey | | | | | L.S.D. at 5% |
|------------------|---------------------------------|--------------------|---------------------|-------------------|-------------------|--------------|
| | Check | 1300 Lx/ 3 hours | 2900 Lx / 3 hours | 1300 Lx/ 6 hours | 2900 Lx/ 6 hours | |
| Larva | 1.75± 0.14 c | 7.78± 0.57 a | 6.33± 0.44 b | 1.88± 0.09 c | 2.00± 0.00 c | 0.78 |
| Protonymph | 6.21± 0.26 a | 7.87± 0.74 a | 6.57± 0.71 a | 6.56± 0.26 a | 6.06± 0.14 a | -- |
| Deutonymph | 10.07± 0.45 a | 9.44± 0.67 a | 7.60± 0.65 b | 7.00± 0.26 bc | 6.31± 0.18 c | 1.26 |
| Total | 17.86± 0.38 c | 25.00± 1.00 a | 20.60± 1.33 b | 15.44± 0.36 d | 14.38± 0.22 d | 2.12 |
| Female longevity | 494.86± 21.33 a | 262.67± 35.37 b | 217.13± 28.30 bc | 186.50± 9.35 c | 172.44± 9.05 c | 57.84 |
| Adult female/day | 12.59± 0.26 a | 7.48± 0.43 b | 7.87± 0.67 b | 6.38± 0.14 c | 6.21± 0.21 c | 1.09 |

Different letters in the same row denote significant differences.

DISCUSSION

The present study reveals that exposure the immature stages of the predatory mite, *A. exsertus* to high intensity of light retarded their development as they developed into the adulthood after a longer period compared to those maintained under natural daylight regime. On the contrary, the longevity of predatory adults correlated negatively with increasing the exposure period of light. Additionally, increasing light intensity exhibited adverse effect on adult longevity. Also, photoperiod and light intensity correlated negatively with oviposition period, whereas preoviposition period reacted positively with increasing light intensity and photoperiod.

Reproduction of the stigmatid mite, *A. exsertus* was highly reacted to either photoperiod or light intensity as the number of deposited eggs sharply declined when adult females were exposed to either light intensity used. These findings are in harmony with that of Elbanhawy (1977) on *A. brazilli*. On contrast to these results, Rasmy (1972) reported that females of the

phytophagous mite, *T. cinnabarinus* exhibited a higher rate of oviposition when were subjected to light compared to conspecific females maintained continuously in the darkness.

It is of interest to note that the effect of light intensity on predation capacity was disastrous as the number of prey consumed during adult longevity declined sharply to about 50% when predatory adults were exposed to the light intensities used. It was noted that exposure predatory females to high light intensity led to a dispersal behaviour as they became restless and their movements increased. This behavioural pattern could be related to the innate character of *A. exsertus*. The predatory mite *A. exsertus* is noted in the field searching for prey on the lower surfaces of the leaves preferring the inside ones.

Therefore, it could be concluded that exposure the predatory stigmaeid mite, *A. exsertus* to high light intensity elicited disastrous reaction on its different biological aspects, i.e. immature development, adult longevity, reproduction and predation capacity.

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تأثير شدة وطول فترة الإضاءة على بعض النواحي البيولوجية للحلم المقترس

Agistemus exsertus (Acari: Stigmaeidae)

على حسن رسمي و هدى حسين و جمعة أبو العلا

قسم أبحاث ووقاية النبات - المركز القومي للبحوث

اجريت دراسة معمليّة لمعرفة تأثير شدة وطول فترة الإضاءة على بعض النواحي البيولوجية للمقترس (*Agistemus exsertus*) ، وقد أوضحت هذه الدراسة أن طول فترة التعريض للضوء وكذلك شدة الإضاءة لها تأثير سلبي على نمو الأطوار غير الكاملة وكذلك طول حياة الاناث. كما لوحظ أن تكاثر الاناث وقدرتها الافتراضية تناسبت عكسيا مع شدة وطول فترة الإضاءة حيث أنه كلما زادت فترة الإضاءة وشدتها انخفض معدل وضع البيض وقلت القدرة على الافتراس.