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Short Communication

The oviposition of the chili fruit fly (*Bactrocera latifrons* Hendel) (Diptera: Tephritidae) with reference to reproductive capacity

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Abstract

The chili fruit fly, *Bactrocera latifrons* Hendel, is a serious pest of chili fruit production in Thailand. To determine the effective control planning of the fly population, the oviposition related to reproductive capacity of the female were observed. The female ovary was daily dissected through the entire life span and the eggs inside the ovary were examined and counted. There were 44.84±19.60 eggs/ovary. The oviposition of female was simultaneously conducted. Eggs inside the ovary presented on 8^{th} day and the female oviposited on 10^{th} day of the life span. The female laid 4.25±2.28 eggs, which was 12.45± 9.56 fold less than the reproductive capacity. The female longevity was 31.1±8.40 days and the oviposition period was 40 days.

Keywords: ovary, life span, oviposition, reproductive capacity, longevity, *Bactrocera latifrons*

1. Introduction

The chili fruit fly, *Bactrocera latifrons* Hendel, is a serious pest of chili fruit production in Thailand. It is considered to be a pest of crops such as chili (*Capsicum annuum* L.), tomato (*Lycopersicon esculentum* Miller) and egg plant (*Solanum melongena* L.). It has a potential impact on production of solanaceous and sometimes cucurbitaceous crops (McQuate *et al*., 2004). In Malaysia, the fly caused 60-80% infestations on red peppers crop (Vijaysegaran and Osman, 1991). This fly is native to South and South-East Asia (White and Elson-Harris, 1994), such as Malaysia, Thailand, Taiwan, India and southern China, and is locally distributed in Hawaii (Wang, 1996; White and Elson-Harris, 1997). The fly infests chili fruit from the fruiting stage to the harvest stage. In the early infestation, it is very difficult for the farmer to observe symptoms of chili fruit damage, which means the farmer cannot control it in time. The female adult fly lays eggs into the chili fruit. When the eggs hatch into larvae, they feed inside the fruit. The fruit becomes rotten and falls to the ground. The larvae pupate in the soil. Current literature contains little information on the fecundity and oviposition of the fruit fly. Understanding this, is necessary to determine is pest potential and to develop an appropriate method to control the fruit flies.

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2. Materials and Methods

2.1 Insects rearing

B. latifrons adults were reared from infested peppers collected at Chaiyapum province. Newly emerged adults were held in screen cages. Adults were fed water and a diet of three parts sugar and one part autolyzed brewers yeast. Adult females deposited eggs in a perforated plastic glass egg collection. Papaya juice was spread inside the glass wall and a slice of papaya was placed at the bottom (Vagas and Nichida, 1985; Vargas *et al*., 1993). After 24 hour, eggs were collected and transferred onto an artificial diet and kept for pupation in sand. Eight days later, pupae were separated from the medium and held in a plastic box until eclosion. After that, the emerged adults were used for this study. Insect were reared in a room at 25±2°C, 65±5% RH.

2.2 Adult reproduction

The insects used in these experiments were obtained from a laboratory colony. The emergent females and males at same age were divided into two groups for two parts of this study. Firstly, the colony of females and males were maintained in a screen cage at room temperature and fed on sugar + brewer yeast in proportion 1:3. Twenty females were random taken from the cage each day. The fecundity was determined by the number of eggs found by daily dissecting and counting eggs in the ovaries of female flies after adults emerged. Dissection of ovaries of females was performed under a stereomicroscope, their reproductive system examined and the classification of morphology was referent to *Bactrocera cacuminata* (Hering) (Raghu *et al*., 2003). Then the immature and mature eggs per ovary (eggs load) were counted. Secondly, oviposition was investigated by pairing of male and female adults in sealed plastic boxes. The eggs were counted and removed daily until the female adult died. Twenty adult pairs were used in this test and the male that died during experiment was not replaced.

2.3 Data record

Data were recorded as follows; number of immature and mature eggs, total eggs produced, age of female, duration of oviposition.

3. Results and Discussion

3.1 Adult reproduction

The female *B. latifrons* reproductive system is shown in Figure 1. The females began to produce eggs on the 8th day after emergence. The number of total eggs, immature eggs and mature eggs varied from 23.80-69.10, 1.45-24.85, and 8.30-51.60 eggs, respectively. The mature eggs rate was higher than immature eggs rate. However, the numbers of mature eggs followed a similar trend to that of immature eggs. The highest number of immature eggs (24.85 eggs) and mature eggs (51.60 eggs) occurred on the 32th and 14th day, respectively (Figure 2). The pre-oviposition period was 9 days with the oviposition period of 45 days. The number of eggs laid by female *B. latifrons* was variable, with females laying between 1-130 eggs with the mean (±SD) total eggs laid of 41.30±36.60 eggs per female. The 10th day was the first day of egg laying. Mean eggs laid per day was highest on the 48th day age (10 eggs). The mean egg load fluctuated over

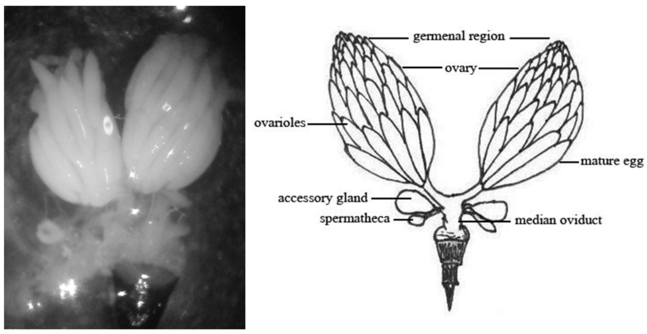

Figure 1. Reproductive system of mature female chili fruit fly, *Bactrocera latifrons*.

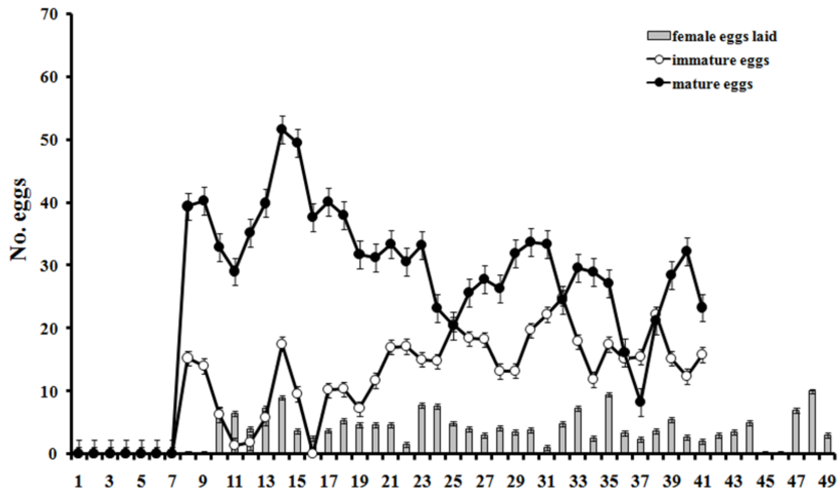

Figure 2. Number of eggs per ovary and mean eggs laid per female, *Bactrocera latifrons*. Bars are SE.

time. The number of eggs laid was less than the potential reproductive capacity. Egg production was 12.45±9.56 fold greater than egg laying (Figure 2).

The results showed the oviposition egg laying of female *B. latifrons* was low in number of eggs compared with other *Bactrocera* species; *Bactrocera dorsalis* (1,428.2 eggs) and *Bactrocera cucurbitae* (880.6 eggs) (Vagas and Nichida, 1985). Results of this study suggest that the general oviposition pattern of female *B. latifrons* is to lay a small number of eggs over a long time period. This is characteristic of species with a long life span and a relatively low fecundity as k-selected species. Generally, k-species allocate more energy to efficient use of environmental resources than to maximization of the reproductive rate (r-selected species) (MacArthur and Wilson, 1967). According to this study *B. latifrons* is considered to be a k-species. These species, like *B. latifrons*, are well adapted to tropical environments (Landahl and Root, 1969). *B. latifrons* is widely distributed throughout tropical habitats of Sri Lanka, India, Malaysia, Laos, Thailand, and Taiwan (Naraynan and Batra, 1960). In addition, the fly was reared under 25±2°C and 65±5% RH condition. This condition should cause a low laying number, as the optimum temperature for fruit fly species, on the basis of fecundity, was apparently 29:18°C (max:min). Pre-oviposition periods and reproductive values at fluctuating temperature were more favorable than at constant temperature (24°C) (Vargas *et al.*, 2000). Furthermore, mating of insects affects the reproductive performance, fecundity or fertility of females (Jimenez and Wang, 2003; Rutledge and Keena, 2012). Multiple mating resulted in an increased lifetime production of feasible offspring for females (Arnqvist and Nilsson, 2000). Previously, nine studies report higher egg production or egg fertility in non-virgins in comparison with virgins or in multiple mated females compared with single mated females (Cavalloro and Delrio, 1970a; Cavalloro and Delrio, 1970b; Prokopy and Bush, 1973; Delrio and Cavalloro, 1979). In the butterfly, *Pieris napi*, monogamous females display lower lifetime fecundity and lay eggs at a lower rate than do polygamous females (Wiklund *et al.*, 1993; Wedell *et al.*, 2002). In contrast, one study reported lower egg production in twice mated compared with once mated females (Myers *et al.*, 1976). Neilson (1975) found that mated apple maggot females lay eggs not significantly more than virgins.

In this experiment, we focused only on fecundity and oviposition of females and did not observe mating of this fly. Thus, nothing is known about the impact of mating on female chili fruit fly fecundity and fertility. This factor may influence the number of eggs laid unrelated to the potential reproductive capacity. Chapman *et al.* (1998) noted that the data on the effect of virginity and of mating on fecundity in seven species of Tephritid fruit flies are ambiguous. Therefore, further research is required to elucidate the effect of multiple mating on egg production. This research may not help to shed light on the generalization and evolution of mating effect but may supply novel routes for pest control.

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References

Arnqvist, G. and Nilsson, T. 2000. The evolution of polyandry: multiple mating and female fitness in insects. Animal Behaviour. 60, 145-164.

Cavalloro, R. and Delrio, G. 1970a. Studi sulla radiosterilizzazionedi *Ceratitis capitata* Wiedemann e sul comportamento dell'insetto normale e sterile. Redia. 52, 511-547.

Cavalloro, R. and Delrio, G. 1970b. Rilievi sul comportamento sessuale di *Dacus oleae* Gmelin (Dipter: Trypetidae) in laboratorio. Redia. 52, 201-230.

Chapman, T., Miyatake, T., Smith, H. K. and Partridge. 1998. Interaction of mating, egg production and death rates in females of the Mediterranean fruit fly, *Ceratitis capitata*. Proceedings of the Royal Society of London B. 265, 1879-1894.

Delrio, G. and Cavalloro, R. 1979. Influenza dell'accoppiamento sulla recettivia sessuale e sull'ovideposizione in feminine di *Ceratitis capitata* Wiedemann. Entomologica. 15, 127-143.

Jimenez-Perez, A. and Wang, Q. 2003. Effect of mating delay on the reproductive performance of *Cnephasia jactatana* (Lepidoptera: Tortricidae). Journal of Economic Entomology. 96(3), 592-598

Landahl, J. T. and Root, R.B. 1969. Differences in the life tables of tropical and temperate milkweed bugs, genus *Oncopeltus* (Hemiptera: Lygaeidae). Ecology. Ecological Society of America. 50(4), 734-737.

MacArthur, R.H. and Wilson, E.O. 1967. The theory of island biogeography, Princeton University Press, Princeton, N.J. 203 p.

McQuate G.T., Keum, Y.S, Sylva, C.D., Li, Q.X. and Jang, E.B. 2004. Active ingredients in cade oil that synergize attractiveness of apha-ionol to male *Bactrocera latifrons* (Diptera:Tephritidae). Journal of Economic Entomology. 97, 862-870.

Naraynan, E.S. and Batra, H.N. 1960. Fruit flies and their control, Indian Council of Agricultural Research, New Delhi, India, pp 1-68.

Neilson, W. T. A. 1975. Fecundity of virgin and mated apple maggot (Diptera: Tephritidae) females confined with apple and black ceresin wax domes. The Canada Entomologist. 107(8), 909-911.

Myers, H. S., Barry, B. D., Burnside, J. A. and Rhode, R. H. 1976. Sperm precedence in female apple maggots alternately mated to normal and irradiated males. Annals of the Entomological Society of America. 69, 39-41.

Prokopy, R. J. and Bush, G. L. 1973. Oviposition by grouped and isolated apple maggot flies. Annals of the Entomological Society of America. 66, 1197-1200.

Raghu, S., Halcoop, P. and Drew, R. A. I. 2003. Apodeme and ovarian development as predictors of physiological status in *Bactrocera cacuminata* (Hering) (Diptera: Tephritidae). Australian Journal of Entomology. 42, 281-286.

Rutledge, C. E. and Keena, M. A. 2012. Mating frequency and fecundity in the emerald ash borer *Agrilus planipennis* (Coleoptera: Buprestidae). Annals of the Entomological Society of America. 105 (1), 66-72.

Vagas, R.I. and Nichida, T. 1985. Life history and demographic parameters of *Dacus latifrons* (Diptera: Tephritidae). Journal of Economic Entomology. 78, 1242-1244.

Vargas, I. R., Mitchell, S., Hsu, H.L. and Walsh, W.A. 1993. Evaluation of mass-rearing procedures for *Bactrocera latifrons* (Diptera:Tephritidae). Journal of Economic Entomology. 86, 1157-1161.

Vargas, R. I., Walsh, W.A., Kanehisa, D., Stark, J. D. and Nishida, T. 2000. Comparative demography of three hawaiian fruit flies (Diptera: Tephritidae) at alternating temperatures. Annals of the Entomological Society of America. 93, 75-81.

Vijaysegaran, S. and Osman, M.S. 1991. Fruit flies in peninsular malaysia: their economic importance and control strategies. In: Kawasaki, K., Iwahashi, K.O., Kaneshiro, K. Biology and control of fruit flies. Ginowan, Okinawa, Japan, pp. 105-115.

Wang, X. J. 1996. The fruit fly (Diptera: Tephritidae) of the East Asian region. Acta. Zootaxonomica. Sinica 21.

Wedell, N., Wiklund, C. and Cook, P. A. 2002. Monandry and polyandry as alternative lifestyles in a butterfly. Behavioral Ecology. 13, 450-455.

Wiklund, C., Kaitala, A. Lindfors, V. and Abenius, J. 1993. Polyandry and its effect on female reproduction in the green-veined white butterfly (*Pieris napi* L.). Behavioral Ecology and Sociobiology. 33, 25-33.

White, I. M. and Elson-Harris, M.M. 1994. Fruit flies of economic significance: their identification and bionomics, CAB International,Wallingford, U.K.

White, I. M. and Elson-Harris, M.M. 1997. Fruit flies of economic significance: their identification and bionomics, CAB International,Wallingford, U.K.