

Seasonal Pupation, Adult Emergence and Mating of Black Soldier Fly, *Hermetia illucens* (Diptera: Stratiomyidae) in Artificial Rearing System

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(Received 05 November 2010; Accepted 02 December 2010)

The black soldier fly, *Hermetia illucens*, has a worldwide distribution in the tropics and warm temperate regions and is active in the Korea from May through October. This species colonize a wide variety of decomposing vegetable and animal matter and oviposits in a variety of decomposing materials. In this study, how the black soldier fly pupation, adult emergence and mating rate changed with season at the artificial rearing system was investigated. The black soldier fly larvae and pupae were reared under laboratory condition (27°C, 60% R.H.). In this study, under the laboratory condition, pupation and adult emergence were not influenced by season, but the data shows definitely different mating numbers throughout whole year. The time of the day is changed with seasons and it influence to mating on artificial rearing. To culture the black soldier fly throughout the year in Korea needs a more deep study under the artificial rearing system.

Key words: *Hermitia illucens*, Pupation, Emergence, Mating of black soldier fly

Introduction

The black soldier fly, *Hermetia illucens* (L.), is distributed throughout the tropics and warm temperate regions (James, 1935; McCallan, 1974). The insect was mainly found in the vicinity of and in cattle sheds, manure sheds, living waste dump grounds, and food waste dump grounds (Kim, 1997).

The black soldier fly is economically important in animal feed. Soldier fly prepupae can be used as feed for a variety of animals, including fish (Bondari and Sheppard, 1981) and swine (Newton *et al.*, 1977). Prepupae, when dried, have an estimated value comparable to menhaden fish meal. If used live, as specialty feed, or marketed to exploit its other unique qualities (i.e., essential fatty acids and chitin), the value of the product might be higher (Sheppard *et al.*, 1994). Additionally, a system has already been developed for self-harvesting the larvae by directing their search for pupation sites into collection bins (Sheppard *et al.*, 1994). In natural, black soldier fly colonize in warm temperate region and active in the Korea from May through October. Information on black soldier fly rearing which is affected by seasonal factors in Korea is limited. To produce black soldier fly throughout the year in Korea needs artificial rearing system. In this study, how the black soldier fly pupation, adult emergence and mating rate changed by seasonal condition at the artificial rearing system was investigated.

Materials and Methods

Source of flies

Black soldier flies were obtained from a colony maintained year-round in an outdoor glasshouse at National Academy of Agricultural Science, RDA, Suwon. Eggs from the colony were collected in egg traps made of wooden square bar. Eggs were held in a laboratory and placed in a plastic box (W×D×H = 60×40×15 cm, food waste) at 27°C and 60% R.H.

Pupation and adult emergence of black soldier fly

To determine pupation of black soldier fly, hatched 1000 larvae were reared at plastic box (W×D×H = 60×40×15 cm) covered with net (200 mesh) and used colony maintenance method (Kim, 1997). The 1000 prepupae of black soldier fly

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Table 1. Black soldier fly, seasonal pupation and emergence rates under laboratory condition (27°C, 60% R.H), 2008. November - 2009.October.

Months	N = 1000 per month (Mean ± SD)	
	Pupation (%)	Emergence (%)
Jan	99.8 ± 0.31	99.3 ± 1.42
Feb	98.9 ± 0.91	-
Mar	-	97.7 ± 2.13
Apr	98.7 ± 1.61	98.4 ± 1.04
May	97.5 ± 2.31	-
Jun	-	99.8 ± 0.31
Jul	99.5 ± 0.51	99.8 ± 0.33
Aug	99.8 ± 0.53	-
Sep	-	99.7 ± 0.31
Oct	99.3 ± 0.71	99.9 ± 0.03
Nov	99.7 ± 0.51	-
Dec	-	99.9 ± 0.07

-, Data not collected in the study.

were placed on the sawdust including 20% moisture in the plastic box (W×D×H = 30×20×35 cm) and observed the adult emergence. Larvae and Pupae were reared at 27°C 60% R.H in the laboratory. The experiment was replicated three times from 2008. November to 2009.October.

Seasonal mating of black soldier fly

For observe the seasonal mating differences of black soldier fly, approximately 10000 adults in our colony were

typically managed in a 200 mesh screen cage in the glasshouse (W×D×H = 2×2×4 m). Adult held here were watered by misting water on the cage netting. Rearing temperature was maintained at 27°C. The observation of mating behavior was carried out 5 days a week in January to October 2009 and every 2 hours 10 AM to 4 PM. There was no statistical analysis because this experiment was conducted to investigate only a number of mating of the black soldier fly based on time a day and season a year.

Results and Discussion

Pupation and adult emergence of black soldier fly

The black soldier fly have been ecologically studied several fields of animal feed and decomposing organic matter. Also, development data can be used in forensic studies to estimate the period of insect activity (PIA) (Lord *et al.*, 1994; Pujol-Luz *et al.*, 2008; Tomberlin *et al.*, 2005). Studies of black soldier fly have been carried out at tropical and warm-season temperate areas. In natural, black soldier fly in Korea develops from late of May to October (Kim *et al.*, 2008). We examined the differences of pupation and adult emergence rate under the artificial rearing system with seasonal changes. Under the laboratory condition, the rate of hatching was nearly 100% (data not shown). Also, pupation and adult emergence were not influenced by seasons (Table 1). There was no significant difference among the months. This result suggested that seasons are not influence the produce larvae and pupae in the artificial rearing system.

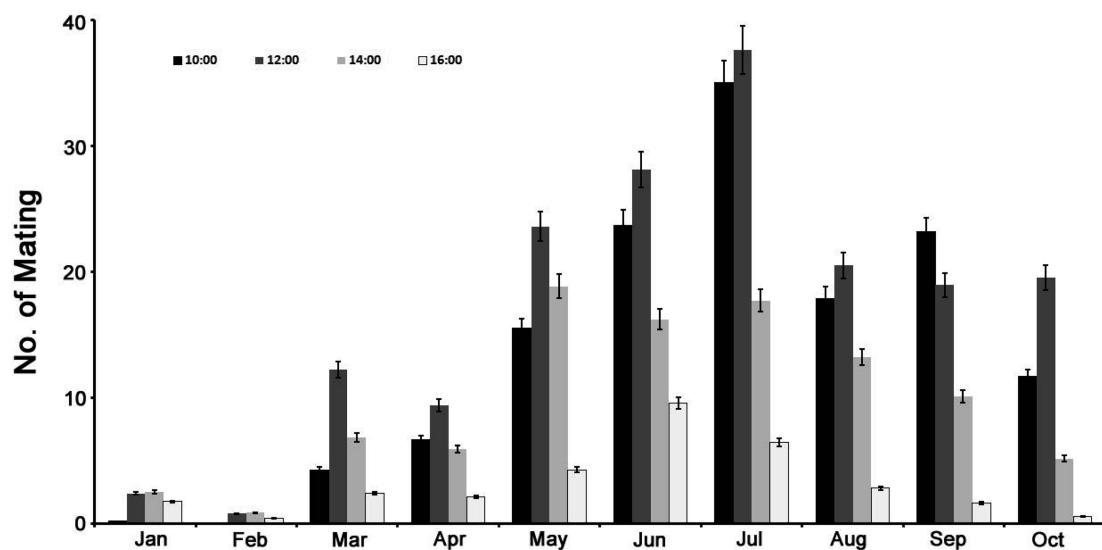


Fig. 1. Comparison of seasonal and hour recording of black soldier fly mating number. Observation from January to October 2009 and every 2 hours from 10 AM to 4 PM. Rearing 10000 adults in 200 mesh screen cage in the glasshouse (W×D×H = 2×2×4 m). Error bars represent the standard deviation.

Seasonal mating number of black soldier fly

The black soldier fly is a tropical and warm-season temperate species (Sheppard *et al.*, 1994), in accordance with its high survivorship to the adult at 27 and 30°C (Tomberlin *et al.*, 2009). Smaller adults and a shorter adult lifespan are associated with increasing temperature (Tomberlin *et al.*, 2009). Time of day and light intensity significantly correlated with mating while time of day, temperature, and humidity significantly correlated with oviposition (Tomberlin and Sheppard, 2002). Light intensity positively regressed with number of black soldier flies mating but not oviposition (Tomberlin and Sheppard, 2002). In this study, our result was similar with previous other studies. Mating behavior was mediated by seasons. As season changes on black soldier fly had different numbers of mating (Fig. 1). Also the date shows, daily mating number was depending on times each day (Fig. 1). From this result, we suspect the turning of seasons in Korea plays an important role as change intensity of sunlight. To use black soldier fly for mass feed, it need to develop whole year. Such information would be useful in improving current black soldier fly rearing methods in Korea. Therefore, additional research in a more controlled setting is needed to improve mating rate throughout the seasons.

Acknowledgements

We are grateful to Kyung Su Ahn, Suen Gi Hwang, In Im Kim, Keum Sook Go and Sung Mook for their valuable help in rearing the black soldier fly. This work was supported by a grant from RDA (PJ0068932010).

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