Functional Response of an Aphid Parasitoid Aphelinus asychis in the Laboratory

Young Woong Byeon1, Midori Tuda2, Jeong-Hwan Kim1 and Man-Young Choi1

1Crop Protection Division, National Academy of Agricultural Science (NAAS), Rural Development Administration, (RDA), Suwon, South Korea
2Institute of Biological Control, Faculty of Agriculture, Kyushu University, Fukuoka, Japan

Abstract

The functional response of an aphid parasitoid, Aphelinus asychis on the green peach aphid, Myzus persicae, were investigated in Petri dish (9cm × 4cm) and net cage (120 × 120 × 70cm) for 24 h at 25°C and a 16L:8D photoperiod.

In Petri dish experiment, 2–2.5 day-old aphids were introduced on eggplant leaf-disc (7cm diameter) for parasitoid oviposition with different host densities (5, 10, 20, 30, 50, and 80 Myzus persicae). Among the three types of functional response, type III best described the parasitoid response to the host densities in A. asychis, according to the Bayesian information criterion (BIC). In net cage experiment, functional response of A. asychis was investigated on 5 × 5 eggplants in the net cage. After Myzus persicae were inoculated uniformly at the densities of 1, 3, 6, 9 and 12 (per plant) on upper, middle and lower leaves of each 25 eggplants, one mated A. asychis female was introduced on the central eggplant. Each aphid density was duplicated three times. A. asychis showed a type II functional response different from that estimated on the eggplant leaf-disc arena.

Materials and methods

Functional Response Study: Petri Dish Test

Mated female

Eggplant leaf disks

2.5 day-old M. persicae

Oviposition of A. asychis for 24 h

Maintained in an incubator

25°C

photoperiod 16L:8D h

50−70% RH

No. mummies were counted

M. persicae densities were 5, 10, 20, 30, and 50 aphids (12 replicates)

Functional Response Study: Net Cage Test

Net cage in environmental chamber

Release point of parasitoid

<net cage: 120 × 120 × 70cm>

Eggplant

Inoculation of 2-4 day-old M. persicae on each eggplant (1, 3, 6, 9, and 12 aphids / eggplant)

No. mummies, aphids & dead aphids / lower, middle and upper leaves / plant / 3 days

Functional Response Study: Petri Dish Test

Diel data fitting to three models

Hassell et al., 1977

Type I: N_s = N_0 [1 − \exp (−aT)]

Type II: N_s = N_0 [1 − \exp (−aT (t + bT^2))]

Type III: N_s = N_0 [1 − \exp (−aT X (t + bT^2 + cT^3))]

Functional selection model

Selection of functional response model

Small BIC (Bayesian Information Criterion) value for choosing the better fit functional response model

BIC = n log (BSE(n)) + p log(n)

(\* BIC: a criterion for model selection among a class of parametric models with different numbers of parameters)

Results

Equations BIC value

Type I 63.42

Type II 46.40

Type III 44.76

Fig. 1. Functional response of A. asychis to M. persicae (A) on 6th day & (B) on 15th day after parasitoid introduction: Net cage

Equations BIC value

Type I 8.748

Type II 8.748

Type III 9.447

Fig. 2. Functional response of A. asychis to M. persicae (A) on 6th day & (B) on 15th day after parasitoid introduction: Net cage

Discussion

Type III response suggests that direct density dependence up to some threshold host density, which may contribute to stability if average densities fall below this threshold (Hassell, 1977) and has been reported in some natural enemies, including A. colemani and Lysiphlebus testaceipes Cresson against S. graminum (Jones et al., 2003), Ibalia leucospoides Horchenwarth against Chromaphis juglandicola Kaltenbach (Valeria and Corley, 2005), Trioxys pallidus Haliday against Sirex noctilio Fabricius (Rakhshani et al., 2004).

Type II response indicates (Hassell et al., 1977) that asymptotic curve that decelerates constantly as prey numbers increase due to the time it takes the predator to manipulate its host and has been reported in several biological control agents, including parasitoids and predators.

The functional response determined in this study showed the type different from that estimated in the Petri dish test.

References


