丽蚜小蜂两个品系寄生行为及对不同寄主植物上烟粉虱的选择性

张世泽[1,2],郭建英[1],万方浩[1*],张 帆[3]

(1. 农业部生物防治重点开放实验室,中国农业科学院农业环境与可持续发展研究所,北京 100081;
2. 西北农林科技大学植物保护学院,陕西,杨凌 712100; 3. 北京市农林科学院植环所,北京 100089)

摘要:对丽蚜小蜂两个品系(分别来自北京和美国)寄生烟粉虱的行为和在番茄、黄瓜、甘蓝、茄子及棉花烟粉虱上的发育历期和寄生率进行了研究。结果表明,丽蚜小蜂通过寄主定位、寄主检查、产卵、清扫和梳理等过程对烟粉虱进行寄生,北京品系平均产卵寄生时间为 5.0 min,美国品系为 4.2 min,品系间差异显著。北京品系在棉花烟粉虱上发育历期最短,为 17.4 d,甘蓝烟粉虱上发育历期最长,为 20.0 d;美国品系在棉花烟粉虱上发育历期最短,为 16.3 d,在其余 4 种寄主植物烟粉虱上发育历期较长(17.3～17.9 d)。2 个品系的寄生率均表现为番茄烟粉虱上最高,分别为 37.3%和 39.0%;棉花次之,分别为 32.2%和 35.5%;黄瓜上最低,分别为 30.2%和 29.6%。在寄主植物选择性试验中,2 个品系亦表现为寄生番茄烟粉虱时寄生率最高,美国品系为 62.7%,北京品系为 56.3%,寄生黄瓜烟粉虱时寄生率最低,分别为 30.8%和 29.0%。

关键词:丽蚜小蜂;烟粉虱;寄生行为;寄主植物;发育历期;寄生率

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Parasitic behavior and selectivity of *Encarsia formosa* (Hymenoptera: Aphelinidae) towards *Bemisia tabaci* (Homoptera: Aley-rodidae) on different host plants

ZHANG Shi-Ze[1,2], GUO Jian-Ying[1], WAN Fang-Hao[1], ZHANG Fan[3] (1. *Key-Lab of Biological Control, Ministry of Agriculture; Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Beijing* 100081, *China*; 2. *College of Plant Protection, Northwest Sci-Tech University of Agriculture and Forestry, Yangling Shaanxi* 712100, *China*; 3. *Institute of Plant and Environment Protection, Beijing Academy of Agriculture and Forestry Sciences, Beijing* 100089, *China*). ***Acta Ecologica Sinica*, 2005, 25(10): 2595～2600.**

Abstract: The cotton whitefly, *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) is a polyphagous species that attacks field crops, vegetables and ornamental crops throughout the tropics, subtropics and temperate zones. *B. tabaci* causes direct damage through feeding, plus indirect damage through disease transmission, and honeydew production on which sooty mold grows. In China, *B. tabaci* has been considered as a sporadic pest of cotton until 2000 when its B-biotype has become an important pest in northern China.

The aphelinid parasitoid, *Encarsia formosa* Gahan (Hymenoptera: Aphelinidae) is a well-known biological control agent of greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood) (Homoptera: Aleyrodidae). Applications of *E. formosa* to control *B. tabaci* has also shown promise. Control efficiency of parasitoids depends on the geographical strain, host plant

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作者简介:张世泽(1972～),男,陕西人,博士,主要从事害虫生物防治和综合治理研究. E-mail: shizezhang@sina.com

* **通讯作者** Author for correspondence. E-mail: wanfh@cjac.org.cn

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Biography: ZHANG Shi-Ze, Ph. D., Lecturer, mainly engaged in biological control of insect pest and insect pest management. E-mail: shizezhang@sina.com

species and characteristics, and environment conditions. In this study, the parasitic behavior, host plant selectivity and development of *E. formosa* on major host plants of *B. tabaci* were studied.

E. formosa is native to China, and since 1978, there have been numerous introductions from different European countries. We used two strains reared on *B. tabaci* kept on tomato plants, an American one and one collected locally, called the Beijing strain. The American strain of *E. formosa* was introduced from the USA (Texas) in 2001 and kept on *B. tabaci* on tomato plants in the laboratory. The precise origin of the Beijing strain is not known. The stock cultures were kept in a climate chamber (20～30 C, 16L∶8D) for several generations before the experiments.

The parasitic behavior of native *E. formosa* female on whiteflies on tomato was observed for 2 h in a 12cm diameter Petri-dish under a dissection microscope. For each *E. formosa* strain, there were 20 females observed in a climate room at 23～25 C, RH 60%～80%, light intensity 4000lx. *E. formosa* readily parasitized *B. tabaci*. The average oviposition period of one egg was 5.0min and 4.2min for the Beijing and USA strains, respectively.

To test the host plant suitability of *E. formosa* on *B. tabaci*, five plant species (tomato, cucumber, cabbage, eggplant and cotton) were included. For each plant species, young seedlings about 10～15cm in height were checked and four intact mature leaves were left on the stem Each seedling was put into a cage of 72cm×72cm×72cm. Adult whiteflies were introduced into the cage to oviposit for 24～48h, after which they were removed. All the seedlings were kept isolated in the cage until the desired instars appeared. The seedlings were checked and the nymphs were counted. Each leaf was exposed to *E. formosa* females confined within clip-on leaf cages (Φ=2cm). The parasitoid oviposition took place in a climate cabinet at 25 C for 12h and thereafter the parasitoids and the cages were removed. The seedlings were placed in temperature cabinets (day:night temparature (25±1) C∶(18±1) C, 14L∶10D, *RH* 70%～80%). For each *E. formosa*, there were 8 plants per plant species observed. The seedlings were examined daily until parasitoid adults emerged. The development time, parasitisation rate and the number of emerged adults were recorded. For the Beijing strain, the average development time from egg to adult was the shortest on cotton (17.4±0.7) d, all values given indicate mean(SD), and the longest on cabbage ((20.0±0.9)d). The American strain also developed fastest on cotton ((16.3±1.3)d) and longer on the other host plants ((17.3～17.9)d). The parasitisation rate was the highest on tomato: 37.3%±3.2% for the Beijing strain and 39.0%±3.8% for the American strain, respectively. The parasitisation rate was the lowest on cucumber: 30.2%±6.5% for the Beijing strain and 29.6%±4.6% for the American strain.

Host plant preference was tested on the same five plant species. The plant seedlings were prepared to leave 3 to 5 young leaves on each stem with around 40 *B. tabaci* nymphs per centimeter on the leaves. In the cage of 72cm×72cm×72cm, five host plant seedlings were placed randomly in a circle, with one seedling per plant species. The adults of *E. formosa* were introduced at a rate of 1 parasitoid to 20 whitefly nymphs and kept in the cage during the experiment. The plants were kept in a climate chamber (23～25 C, 16L∶8D, *RH* 60%～80%), and were inspected 10 days later. There were 3 cages for each *E. formosa* strain. The parasitisation rate was highest on tomato (56.3% for the Beijing strain and 62.7% for the American strain) and the lowest on cucumber (30.8% and 29.0% for the respective strains).

Key words: *Encarsia formosa*; *Bemisia tabaci*; parasitic behavior; host plant; development time; parasitisation rate

烟粉虱[*Bemisia tabaci* (Gennadius)]是世界范围内棉花、蔬菜及花卉等经济作物的重要害虫之一,比温室白粉虱[*Trialeurodes vaporariorum* (Westwood)]具有更广的寄主范围[1]、更强的抗药性[2]和更强的传播植物病毒病的能力[3],对粮食和经济作物造成严重损失[4]。20 世纪 80 年代以来,随着世界贸易的迅速发展,已成为全球性的严重问题[1]。我国 1949 年已有烟粉虱发生的记载,但由于种群数量低,发生轻微而未引起人们的重视[5],但近年来烟粉虱在我国部分地区暴发成灾,引起严重的经济损失[6,7],且有逐年加重危害与蔓延的趋势,对我国蔬菜和花卉生产构成严重威胁。

利用丽蚜小蜂(*Encarsia formosa* Gahan)控制温室白粉虱已取得极大成功[8]。由于温室白粉虱和烟粉虱为同科昆虫,而且往往混合发生,开展了利用丽蚜小蜂防治烟粉虱的研究。Stenseth 采用每周每株植物释放 3 头以下丽蚜小蜂控制烟粉虱,取得了很好的效果[9],Hoddle 等研究了丽蚜小蜂不同释放速率控制烟粉虱的效果,结果表明低释放速率(<3 头/(株·周))的控制效果优于高释放速率(>3 头/(株·周))[10,11]。Rabou 以 5～8 头/株/周的速率释放丽蚜小蜂控制大田作物上的烟粉虱,其寄生率最高可达 83%,取得了很好的控制效果[12]。国内张世泽等对丽蚜小蜂两个品系寄生烟粉虱若虫的适宜性及温度对丽蚜小蜂生长发育的影响进行了研究[13,14]。寄生蜂控制寄主的效果不仅与寄生蜂的种类(地理种群)有关,而且与寄主植物的种类、形态

特征和环境因素等也密切相关[15]。因此,本研究在进行丽蚜小蜂品系比较生态学研究的过程中,选取了 5 种常见的、经济重要性较大的烟粉虱寄主植物作为研究对象,以为深入研究寄主植物-烟粉虱-丽蚜小蜂三者之间的关系奠定基础并为丽蚜小蜂的有效利用提供参考依据。

1　材料和方法

1.1　供试植物

番茄(*Lycospersicum esculentum* Mill.),佳粉 15 号品种;黄瓜(*Cucumis sativas* L.),北京 401 品种;甘蓝(*Brassica oleracea* var. *acephala* L.),中甘 11 号品种;茄子(*Solanum melongena* L.),北京七叶茄品种;棉花(*Gossypium hirsutum* L.),99B 品种。前 4 种蔬菜种子购自北京蔬菜研究中心,棉花种子购自河北冀岱棉花技术有限公司。

1.2　供试虫源

丽蚜小蜂北京品系为采自北京地区温室大棚的种群(1978 年我国从英国引进丽蚜小蜂,此后相继从荷兰、以色列等国引进丽蚜小蜂并大量释放,引进之前北京亦存在丽蚜小蜂自然种群;此文北京品系与前文[13]一致);美国品系由中国农业科学院生物防治研究所 2001 年从美国引进,室内饲养。将采自北京郊区棉田和西葫芦作物的烟粉虱(经鉴定为 B 型烟粉虱)接种在室内盆栽(20cm×17cm)的番茄植株上(株高 15～20cm),在 20～30 C 温室内连续培养多代备用。两个品系的丽蚜小蜂分别接种在寄生于番茄植株上的高龄粉虱若虫上,温室内相同条件下饲养备用。

1.3　丽蚜小蜂寄生行为观察

选取番茄叶片作为烟粉虱的寄主植物,采集带有烟粉虱 3～4 龄若虫的叶片,放入培养皿(Φ=12cm)中,接入小蜂后用保鲜膜封口,在解剖镜下观察小蜂寻找寄主、穿刺、产卵以及休息、整理的过程。记录产卵时间(即产卵姿态持续的时间),产卵姿态的划分参照 Lenteren 等[17]的方法。每品系观察 20 头丽蚜小蜂,每头丽蚜小蜂观察 2h。观察寄生行为时所用解剖镜的冷光源位置保持一致,观测在室温 23～25 C,*RH* 60%～80%,光照时间 16L∶8D,光照强度约为 4000lx 下进行。

1.4　丽蚜小蜂在不同寄主植物烟粉虱上的发育和存活

营养钵种植番茄、黄瓜、甘蓝、茄子和棉花 5 种植物,当幼苗长到 10～15cm 高时,选取长势一致的幼苗若干株,每株选取完整、成熟的叶片 4 片,用毛笔将叶片背面的虫卵、异物扫净,用大网罩(72cm×72cm×72cm)罩好,接入烟粉虱成虫产卵 24～48 h,然后用 DDVP 熏蒸 12h,以确保无粉虱成虫残留。接虫量为 40 粒卵/cm^2,多余的卵及杂物用毛笔去除。将着卵幼苗置于干净纱笼内培养。待粉虱发育至适宜龄期时计数若虫数后,用接虫笼(Φ=2cm)以小蜂(羽化时间不超过 24h)和粉虱若虫 1∶20 的比例接蜂 12h((25±1) C、16L∶8D、*RH* 70%～80%)后去掉小蜂,然后置于 D(昼)(25±1) C/N(夜)(18±1) C, 14L∶10D,*RH* 70%～80%,光照强度>7000 lx 的人工气候箱内令其发育。番茄用离体叶片,其余用整株植物。每种寄主植物观察 8 株植物。观察记录丽蚜小蜂的发育历期、寄生数量、羽化数等。

1.5　丽蚜小蜂对不同寄主植物上烟粉虱的选择性

分别挑选长势一致、具有 3～4 龄粉虱若虫的番茄、黄瓜、甘蓝、茄子和棉花植株各一株,每株挑选 3～5 片粉虱若虫分布较均匀(约 40 头/cm^2)的叶片后去掉其余叶片,计数各植株上的若虫数后,将 5 种植物置于同一纱笼(72cm×72cm×72cm)内,以小蜂和粉虱若虫 1∶20 的比例接入小蜂,10d 后检查各植株上烟粉虱褐蛹的数量,确定寄生率。每小蜂品系重复 3～5 次。试验在室温 23～25 C,*RH* 60%～80%,光照时间 16L∶8D,光照强度约为 4000 lx 下进行。

1.6　数据分析

对寄生率数据进行反正弦数据转换(arcsine transformation),然后与发育历期和产卵时间的数据进行正态分布检验(Kolmogorov-Smirnov test)。经检验,这些数据均呈正态分布(数据略)。发育历期的数据因平均值与标准差呈正相关(数据略),因此进行了对数转换(log transformation)。此后,对发育历期和寄生率的差异显著性分析采用单因子方差分析(ANOVA-Duncan's test),对品系间产卵时间的比较采用独立样本 t 检验。以上数据分析用统计软件 SPSS10.0 进行。

2　结果与分析

2.1　丽蚜小蜂寄生行为

丽蚜小蜂可以寄生烟粉虱 1～4 龄若虫,但较嗜好 3、4 龄若虫[13]。当进入到寄主所在的生境后,不断地来回爬行,并用触角试探,寻找合适的寄主产卵,其寄生行为主要包括寄主定位、处理寄主和产卵后行为等几个过程(图 1)。

(1)寄主定位　包括图中的飞行、着落、触角敲打、变换位置等过程。丽蚜小蜂通过飞行、着落到叶片后,在叶面爬行的过程中不停地用触角敲打探测叶片,快速变换位置,直至找到寄主,如找不到寄主,则飞行离去。小蜂在该过程中不能辨别叶片的正面和背面。

(2)处理寄主　丽蚜小蜂找到寄主后并不立即产卵,而是先处理寄主,判断寄主的发育阶段、寄主大小是否适合或是否已被寄生。处理寄主时,丽蚜小蜂先用触角敲打粉虱若虫,围绕寄主检查几圈,认为若虫龄期等条件都适合时,就准备产卵;若发现寄

主的龄期、大小等条件不适合，则放弃该寄主，通过变换位置重新寻找新的目标。如果认为合适，小蜂就跳到若虫背上，将产卵器刺入若虫腹部，开始产卵。

(3)产卵后行为　包括图中的整姿、静止等过程。丽蚜小蜂产完卵后，将产卵器抽出，尾部翘起，用 1 对后足不停地清扫和梳理产卵器，同时也清扫翅外缘，而 1 对前足则不停梳理触角和口器。梳理完毕后，并不马上离去，而是围绕已产卵寄生的若虫爬行几圈，最后飞去。丽蚜小蜂完成 1 次产卵后，或者继续寻找下一个寄主，或者在叶脉处休息停留片刻，然后飞走，准备寻找下一个寄主。

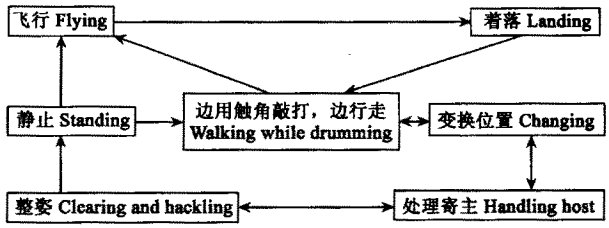

图 1　丽蚜小蜂寄生行为

Fig. 1　Parasitic behavior of *Encarsia formosa*

丽蚜小蜂除了产卵寄生外，还可取食粉虱若虫。取食时先用产卵器刺破若虫体壁，然后吸食寄主体液。被取食的粉虱若虫体色变成黄褐色，体躯干瘪缩小(体液被吸干)，最终死去。

丽蚜小蜂 2 个品系寻找和产卵寄生的过程基本一样，但其产卵时间(即产卵姿势持续的时间)不同。本试验在丽蚜小蜂美国品系产卵寄生过程中观察到 89 个产卵姿势，其中 8 个姿势产卵时间短于 2min，北京品系 87 个产卵姿势，其中 14 个姿势产卵时间短于 2min。丽蚜小蜂美国品系平均产卵时间为(4.2±0.3)(Mean±SD)min，北京品系平均产卵时间为(5.0±0.4)(Mean±SD)min，两者比较差异显著($t=4.966$, $df=153$, $p<0.001$)。

2.2　丽蚜小蜂品系在不同寄主植物烟粉虱上的发育和存活

丽蚜小蜂美国品系产卵寄生烟粉虱若虫后，幼虫期发育历期以寄生番茄烟粉虱最短，为 8.2d，寄生甘蓝烟粉虱的最长，为 10.3d；蛹发育历期在棉花烟粉虱上最短，为 7.1d，在番茄烟粉虱上最长，为 9.3d。美国品系在不同寄主植物烟粉虱若虫体内由卵至蛹期、蛹至羽化期的发育历期差异显著($F=6.094$, 12.726; $df=4,39$; $p=0.001$, <0.001)；但从产卵寄生至成虫羽化的发育历期以在棉花烟粉虱体内最短，为 16.3d，在其余寄主植物上则差异不显著(表 1)。

美国品系在 5 种寄主植物烟粉虱上的寄生率以番茄上最高，为 39.0%，黄瓜上最低，为 29.6%，寄主植物间寄生率差异显著($F=4.359$; $df=4,39$; $p=0.006$)。在不同寄主植物上美国品系发育历期由长到短排列顺序为甘蓝/黄瓜/茄子/棉花，番茄介于棉花和甘蓝之间；寄生率由高到低的顺序为番茄/棉花/甘蓝/黄瓜，茄子介于黄瓜和甘蓝之间(表 1)。综上所述，番茄和棉花上的烟粉虱为丽蚜小蜂美国品系的适宜寄主，黄瓜烟粉虱则较不适宜。

表 1　丽蚜小蜂美国品系在不同寄主植物烟粉虱上的发育历期和寄生率

Table 1　Development time and parasitic rate of the American strain of *Encarsia formosa* on hosts feeding on different host plants

寄主植物 Host plant	卵-蛹(d) Egg-Pupa	蛹-羽化(d) Pupa-Eclosion	卵-羽化(d) Egg-Eclosion	寄生率(%) Parasitic rate
棉花 Cotton	9.2±0.9 a	7.1±0.6 a	16.3±1.3 a	35.5±5.2 a
甘蓝 Cabbage	10.3±1.1 b	7.6±0.7 a	17.9±1.5 b	35.4±5.2 a
茄子 Eggplant	9.1±0.7 a	8.5±0.5 b	17.6±1.0 b	33.8±4.2 ab
黄瓜 Cucumber	9.2±0.7 a	8.6±0.8 b	17.8±0.7 b	29.6±4.6 b
番茄 Tomato	8.2±0.7 c	9.3±0.8 b	17.3±1.1 ab	39.0±3.8 a

* 表中数据为平均值±标准偏差，每列数据中具相同字母的表示在 5%水平无显著差异 The data in the table represented means ±SD of the eight plants observed, and the means in each column followed by the same letter were not significantly different at 0.05 level when tested by Duncan's multiple range test; The data of parasitisation rate were arcsine transformed and the data for development were log transformed before the ANOVA test; 下同 the same below

丽蚜小蜂北京品系产卵寄生烟粉虱若虫后，幼虫期发育历期以寄生棉花烟粉虱最短，为 9.3d，寄生甘蓝烟粉虱的最长，为 11.3d；蛹发育历期在黄瓜烟粉虱上最短，为 8.6d，在番茄烟粉虱上最长，为 9.5d。北京品系在不同寄主植物烟粉虱若虫体内由卵至蛹期的发育历期差异显著($F=13.256$; $df=4,39$; $p<0.001$)，而蛹至羽化期的发育历期无显著差异($F=1.916$; $df=4,39$; $p=0.129$)；但从产卵寄生至成虫羽化的发育历期以在棉花烟粉虱体内最短，为 17.4d，甘蓝烟粉虱上发育历期最长，为 20.0d，差异显著($F=5.941$; $df=4,39$; $p=0.001$)，在其余寄主植物上则差异不明显(表 2)。

北京品系在 5 种寄主植物烟粉虱上的寄生率以番茄上最高，为 37.3%，黄瓜上最低，为 30.2%，寄主植物间寄生率差异不显著($F=1.944$; $df=4,39$; $p=0.129$)。在不同寄主植物上北京品系发育历期由长到短排列顺序为甘蓝/黄瓜/茄子/番茄>棉花；寄生率由高到低的顺序为番茄/甘蓝/茄子/棉花/黄瓜(表 2)。综上所述，番茄和棉花上的烟粉虱为丽蚜小蜂北京品系的适宜寄主，黄瓜烟粉虱则较不适宜。

表 2　丽蚜小蜂北京品系在不同寄主植物烟粉虱上的发育历期和寄生率

Table 2　Development time and parasitic rate of the Beijing strain of *Encarsia formosa* on hosts feeding on different host plants

寄主植物 Host plant	卵-蛹(d) Egg-Pupa	蛹-羽化(d) Pupa-Eclosion	卵-羽化(d) Egg-Eclosion	寄生率(%) Parasitic rate
棉花 Cotton	9.3±0.4 a	8.1±0.5 a	17.4±0.7 a	32.2±6.6 ab
甘蓝 Cabbage	11.3±0.7 b	8.8±0.7 ab	20.0±0.9 b	33.4±4.9 ab
茄子 Eggplant	10.1±0.8 c	9.2±1.3 ab	19.3±1.4 b	32.9±5.3 ab
黄瓜 Cucumber	11.1±0.6 b	8.6±1.5 ab	19.7±1.2 b	30.2±6.5 a
番茄 Tomato	9.7±0.8 ac	9.5±1.2 b	19.2±1.5 b	37.3±3.2 b

丽蚜小蜂 2 个品系寄生不同寄主植物上烟粉虱的发育历期(卵至成虫羽化)和寄生率均差异显著($F=8.123$, 5.588; $df=4,70$; $p<0.000$, $=0.001$),品系间发育历期差异显著($F=45.223$; $df=1,70$; $p<0.001$),而寄生率无显著差异($F=2.063$; $df=1,70$; $p=0.155$)。寄主植物与品系间均无交互效应($F=0.454$, 0.314; $df=4,70$; $p=0.769$, 0.868),表明丽蚜小蜂寄生烟粉虱的发育历期主要由小蜂品系和寄主植物决定,与两者之间的交互作用关系不大,而不同寄主植物烟粉虱寄生率则主要决定于寄主植物,亦与两者之间的交互作用关系不大。

2.3　丽蚜小蜂品系对不同寄主植物烟粉虱的选择性

丽蚜小蜂品系在 5 种寄主植物烟粉虱上的寄生率见表 3。由表 3 可以看出,在寄主植物选择性实验中,2 个品系都表现为寄生番茄烟粉虱时寄生率较高,美国品系为 62.7%,北京品系为 56.3%,寄生黄瓜烟粉虱时寄生率最低,分别为 30.8%和 29.0%,寄主植物间差异显著(美国品系:$F=57.699$; $df=4,14$; $p<0.001$; 北京品系:$F=21.855$; $df=4,14$; $p<0.001$)。品系间寄生率差异显著($F=8.774$; $df=1,20$; $p=0.007$)。寄主植物与品系间不存在交互效应($F=0.569$; $df=4,20$; $p=0.688$)。该结果与寄主植物非选择性实验结果相一致,均表现为丽蚜小蜂较喜欢寄生番茄和棉花烟粉虱,对茄子和黄瓜烟粉虱则较不喜欢寄生。

表 3　丽蚜小蜂品系在 5 种寄主植物烟粉虱上寄生率(%)比较

Table 3　Parasitic rates of the American and Beijing strains of *Encarsia formosa* on five host plants

品系 Strains	棉花 Cotton	甘蓝 Cabbage	茄子 Eggplant	黄瓜 Cucumber	番茄 Tomato
美国品系 The American strain	50.6±1.8 a	37.9±2.4 b	34.3±3.5 bc	30.8±3.6 c	62.7±2.8 d
北京品系 The Beijing strain	48.0±2.9 a	31.3±4.0 b	31.6±4.4 b	29.0±5.2 b	56.3±5.0 a

* 表中数据为平均值±标准差,每行数据中具相同字母的表示在 5%水平无显著差异 The data in the table represented means ±SD of the three cages observed, and the means in each row followed by the same letter were not significantly different at 0.05 level when tested by Duncan's multiple range test; The data were arcsine transformed before the ANOVA test

3　讨论

3.1　丽蚜小蜂通过飞行、着落和行走等方式寻找寄主[15],Roermund 等对丽蚜小蜂在寄生番茄温室白粉虱时的行走速度、停留时间和寄主处理时间做了定量研究[16],但丽蚜小蜂寻找、寄生寄主行为的详细过程未见报道。本文对丽蚜小蜂寻找寄主、处理寄主、清扫和梳理等过程首次做了较详细观察报道,有助于更好地理解寄生蜂-寄主系统的演化关系。Lenteren 等报道丽蚜小蜂成功产卵寄生粉虱若虫的产卵持续时间应超过 2min[17],本试验过程中解剖也发现当丽蚜小蜂产卵持续时间少于 2min 时,成功产卵寄生的几率非常低,故为便于比较,本试验亦认为短于 2min 的产卵时间为无效产卵,因此两品系的平均产卵持续时间分别为 4.2min 和 5min,而 Enkegaard 报道丽蚜小蜂成功寄生圣诞红烟粉虱若虫需要 4min[18]。产卵姿势和持续时间的差异可能与丽蚜小蜂品系、烟粉虱的地理种群有关。

3.2　寄生蜂寄生效率的高低不但与寄生蜂的种类、品系有关,还与寄主植物的种类、形态学特征及挥发性化学物质等密切相关[15]。本文试验结果表明,丽蚜小蜂在番茄和棉花烟粉虱上发育历期短、寄生率高,在黄瓜和茄子上发育历期延长、寄生率降低,其原因除与丽蚜小蜂品系有关外[13],与寄主植物的营养成份、叶片绒毛密度和粉虱分泌蜜露也密切相关[19]。本文研究结果表明丽蚜小蜂控制棉花和番茄烟粉虱效果较好,而棉花和番茄又是烟粉虱最喜嗜食的寄主[20,21],因此利用丽蚜小蜂控制棉花和番茄烟粉虱不但具有现实性,而且对烟粉虱种群的综合治理也有一定的指导意义。

3.3　试验结果表明丽蚜小蜂在不同寄主植物上烟粉虱若虫体内由卵至蛹期、蛹至羽化期的发育历期趋势表现不一致,而林克剑等在研究寄主植物对烟粉虱生长发育和种群增殖时亦发现寄主植物对烟粉虱不同生命阶段的影响机制大不相同[22],因此寄主植物如何通过影响烟粉虱的生长发育阶段,从而间接影响丽蚜小蜂的生长发育,其原因有待进一步研究。

3.4　本试验结果表明在人工繁殖丽蚜小蜂时,应优先考虑选用棉花或番茄作为寄主植物,以降低成本并获得较大效益。此外,在寄主植物选择试验中,番茄和棉花烟粉虱寄生率远高于非选择性试验的寄生率,这是否与接种用的丽蚜小蜂长期在番茄烟粉虱上饲养,可能对番茄烟粉虱产生生理依赖性有关尚需进一步研究。

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