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拟澳洲赤眼蜂和短管赤眼蜂在米蛾卵上的种间竞争*

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Interspecific competition between *Trichogramma confusum* and *T. pretiosum* on *Corcyra cephaloica* factitious eggs. HE Yurong[1], LÜ Lihua[2], CHEN Kewei[1] ([1]*Laboratory of Insect Ecology, South China Agricultural University, Guangzhou* 510642, *China*; [2]*Plant Protection Research Institute, Guangdong Academy of Agricultural Sciences, Guangzhou* 510640, *China*). -*Chin. J. Appl. Ecol.*, 2004, 15(12): 2401～2404.

By means of single and mixed inoculation, this paper studied the interspecific competition between *T. confusum* and *T. pretiosum* on the factitious eggs of *Corcyra cephaloica* under different parasitoid densities, host densities and inoculated spaces. The results showed that for both singly and mixed inoculated groups, the parasitism increased with parasitoid density but decreased with host density, whereas the percentage of female progeny dropped with parasitoid density but enhanced with host density. No significant effect was observed on adult emergence for all parasitoid and host density treatments. In mixed inoculated group, the proportion of *T. pretiosum* in the progeny decreased with parasitoid density but increased with host density, and was more than 50% in all treatments, indicating that *T. pretiosum* had a stronger competitive ability than *T. confusum*. In the spaces ranging from 4 cm^3 to 102 cm^3, the parasitism decreased gradually in both singly and mixed inoculated groups. The percentage of female progeny and adult emergence had no significant difference among different inoculated spaces. In mixed inoculated group, the proportion of *T. pretiosum* in the progeny was more than 50% in all treatments except space 102 cm^3, but decreased with space, which suggested that *T. confusum* could improve their competitive ability through increasing their search areas and looking for more hosts.

Key words *Trichogramma confusum*, *T. pretiosum*, *Corcyra cephaloica*, Interspecific competition.
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1 引 言

小菜蛾(*Plutella xylostella*)是十字花科蔬菜的一种重要害虫.20世纪70年代以来,化学杀虫剂的大量使用和抗性的产生,使小菜蛾成为南亚、东南亚和中国南方蔬菜生产中最为严重的害虫[8,22].因此,寻求安全有效的生物防治措施是防治小菜蛾的必要途径[23].赤眼蜂(*Trichogramma*)是一类多食性的卵寄生蜂,近百年来已被成功地用于防治为害多种作物及森林的害虫[21],但研究和利用赤眼蜂防治小菜蛾只有10来年的历史[12,23].通过在室内外对寄生于小菜蛾的赤眼蜂蜂种和品系的筛选,拟澳洲赤眼蜂(*Trichogramma confusum*)和短管赤眼蜂(*T. pretiosum*)被认为是防治小菜蛾的优良蜂种[2,6,12,26,29].

种间竞争在很大程度上可引起群落结构大小和稳定性的变化,甚至导致害虫天敌引种工作的失败[20].因此,在生物防治领域,寄生蜂间相互竞争的研究一直较受重视[1,10,17～19,25,28].拟澳洲赤眼蜂是我国南方寄生小菜蛾的本地优势蜂种[5,9],而短管赤眼蜂是美国用于防治棉铃虫的优势蜂种[11],在我国属于外来引入天敌.不同的赤眼蜂蜂种之间存在着相互竞争现象[15,25],在引入外地的优良蜂种时,应对其与本地种之间的种间竞争进行研究,预测其可能引起的环境风险[16].在我国,郭明昉[4]曾就稻螟赤眼蜂(*T. japanicum*)、拟澳洲赤眼蜂和松毛虫赤眼蜂(*T. dendrolimi*)对寄主的辨别能力和种间竞争进行过研究,发现稻螟赤眼蜂可寄生被其它两种赤眼蜂寄生过的寄主卵,竞争能力最强.朱耀沂等[3,13]比较了螟黄赤眼蜂(*T. chilonis*)和玉米螟赤眼蜂(*T. ostrinae*)在不同接蜂密度、不同寄主卵密度、不同接蜂空间和不同温度条件下的种间竞争,探讨两种蜂在室内繁殖的最适宜条件.以上研究所用的材料均为本地的赤眼蜂种,而对本地赤眼蜂种与外来赤眼蜂种之间竞争的研究却未见报道.本试验拟通过研究本地寄生于小菜蛾的拟澳洲赤眼蜂和引入的短管赤眼蜂在中间寄主米蛾卵上的种间竞争,评价两种赤眼蜂对寄主资源的利用能力,探讨两种蜂在室内保种和繁殖的适宜条件.

2 材料与方法

2.1 供试材料

拟澳洲赤眼蜂采自我国广东省,短管赤眼蜂来自美国,均在室内用米蛾(*Corcyra cephaloica*)卵连续繁殖20代以上.繁蜂用米蛾卵系本室用面粉饲养米蛾所产的当天卵,接蜂前用30 W的紫外光灯照射1 h杀死胚胎,繁蜂温度为28 ℃.

2.2 研究方法

2.2.1 不同蜂密度条件下种间竞争 粘有100粒米蛾卵的

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卵卡，放入直径 1 cm、长 5 cm 的指形管中，接蜂前用小毛笔在指形管壁内轻轻涂上 30% 的蜂蜜水供给赤眼蜂补充营养，每管单独接入已充分交配的拟澳洲赤眼蜂、短管赤眼蜂雌蜂 2、4、6、8 和 10 头或混合接入每种蜂 1、2、3、4 和 5 头雌蜂，放入 28 ℃全黑暗的温箱中让其寄生．1 d 后将雌蜂引出，待寄生卵发育羽化、子代蜂死亡后检查卵寄生率、子代成蜂羽化率、雌性百分率．由于两种蜂在体色上非常相似，不易区分，而两种赤眼蜂 28 ℃条件下，在米蛾卵上繁殖的雌性百分率为 80%～85%，且具有相似的逐日产雌分配[7]，即两种赤眼蜂雄蜂比例大致相等．因此，将混合接蜂处理中所有的子代雄蜂解剖，以雄性外生殖器来确定蜂的种类，并以此代表子代中两种蜂的比例．

2.2.2 不同卵密度条件下的种间竞争　将粘有 20、40、60、80、100 粒当天产米蛾卵的卵卡，放入直径 1 cm、长 5 cm 的指形管中，接蜂前用小毛笔在管壁内轻轻涂上 30% 的蜂蜜水供给赤眼蜂补充营养，每管单独接入已充分交配的拟澳洲赤眼蜂、短管赤眼蜂雌蜂 2 头或混合接入已充分交配的每种蜂的雌蜂 1 头，放入 28 ℃全黑暗的温箱中让其寄生，1 d 后将雌蜂引出，结果检查同 2.2.1．

2.2.3 不同空间条件下的种间竞争　在高和直径分别为 5 cm×1 cm (4 cm^3)、6 cm×1.3 cm (8 cm^3)、7 cm×2 cm (22 cm^3)、8 cm×2.9 cm (53 cm^3)和 9 cm×3.8 cm (102 cm^3)的玻璃管内放入粘有 100 粒当天产米卵的卵卡，接蜂前用小毛笔在管壁内轻轻涂上 30% 的蜂蜜水以供给赤眼蜂补充营养，每管单独接入已充分交配的拟澳洲赤眼蜂、短管赤眼蜂雌蜂 2 头或混合接入已充分交配的每种蜂的雌蜂 1 头，放入 28 ℃全黑暗的温箱中让其寄生，1 d 后将雌蜂引出，结果检查同 2.2.1．

每种处理 10 管，试验重复 3 次．试验结果采用 DPS 软件进行 Duncan's 多重比较[24]．

3 结果与分析

3.1 不同蜂密度条件下的种间竞争

由图 1 可见，两蜂无论是单独接蜂还是混合接蜂，对米蛾卵的寄生率基本随赤眼蜂密度的增加而增加，但短管赤眼蜂单独接蜂时，其寄生率在各种蜂密度条件下都低于拟澳洲赤眼蜂单独接蜂和混合接蜂．后代雌蜂百分率随蜂密度的增加而减少，而羽化率则变化不大．混合接蜂后代中，短管赤眼蜂的百分率随蜂密度的增加而减少，但无论何种接蜂密度，均超过 50%，说明短管赤眼蜂较拟澳洲赤眼蜂的竞争能力强，但随蜂密度的增加，拟澳洲赤眼蜂的竞争能力逐渐加强，从另一方面说明了短管赤眼蜂成蜂之间存在相互干扰作用，当蜂过多时，相互间的干扰作用降低了竞争能力．

3.2 不同卵密度条件下的种间竞争

图 2 表明，两蜂无论是单独接蜂还是混合接蜂，对米蛾卵的寄生率基本随寄主卵量的增加而逐渐下降，后代雌蜂百分率则随卵量的增加而增加，而羽化率变化不大．混合接蜂后代雄蜂中短管赤眼蜂的百分率随卵量的增加而增加，但无论何种卵量，均超过了 50%，说明短管赤眼蜂较拟澳洲赤眼蜂的竞争能力强，并随寄主卵量的增加，这种竞争能力逐渐加强，从另一方面说明了短管赤眼蜂成蜂之间存在相互干扰作用．当寄主卵量较少时，成蜂之间的相互干扰作用导致其竞争能力降低．

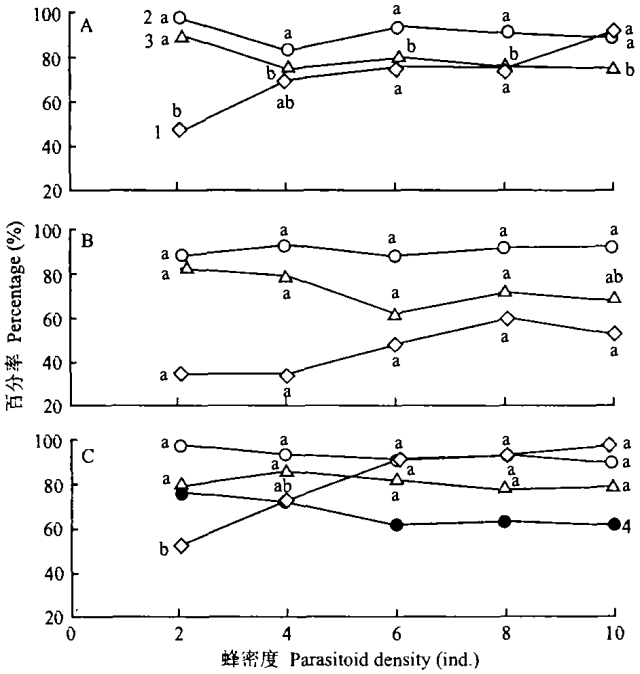

图 1 蜂密度对拟澳洲赤眼蜂和短管赤眼蜂竞争能力的影响

Fig. 1 Interspecies competition of *T. confusum* and *T. pretiosum* under different parasitoid densities.

A: 拟澳洲赤眼蜂单独接蜂 *T. confusum* only; B: 短管赤眼蜂单独接蜂 *T. pretiosum* only; C: 拟澳洲赤眼蜂和短管赤眼蜂混合接蜂 *T. confusum* and *T. pretiosum* both. 1) 寄生率 Parasitism, 2) 羽化率 Emergency, 3) 子代雌蜂率 Female proportion in progeny, 4) 子代中短管赤眼蜂比例 *T. pretiosum* proportion in progeny. 小写字母为 Duncan's 多重比较结果，同一条线中不同字母表示差异显著 The same letters in a line are not significantly different from each other ($P < 0.05$; DMRT method). 下同 The same below.

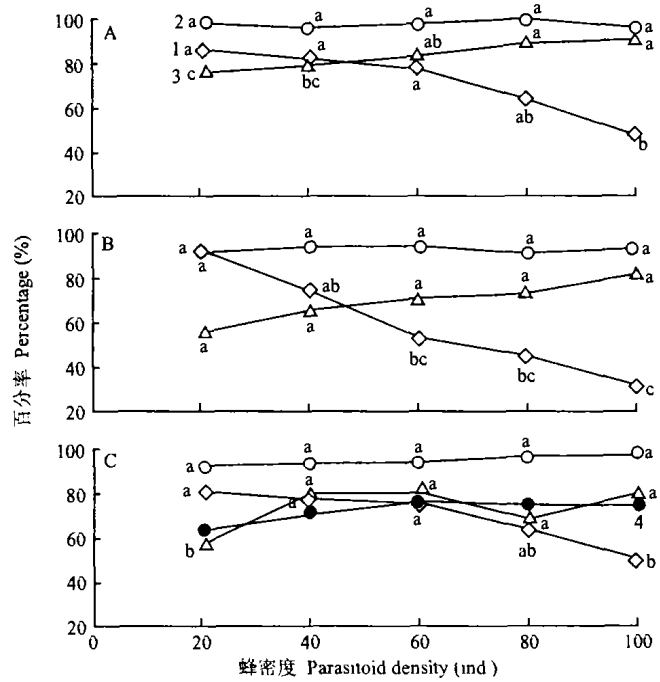

图 2 寄主卵密度对拟澳洲赤眼蜂和短管赤眼蜂竞争能力的影响

Fig. 2 Interspecies competition of *T. confusum* and *T. pretiosum* under different host densities.

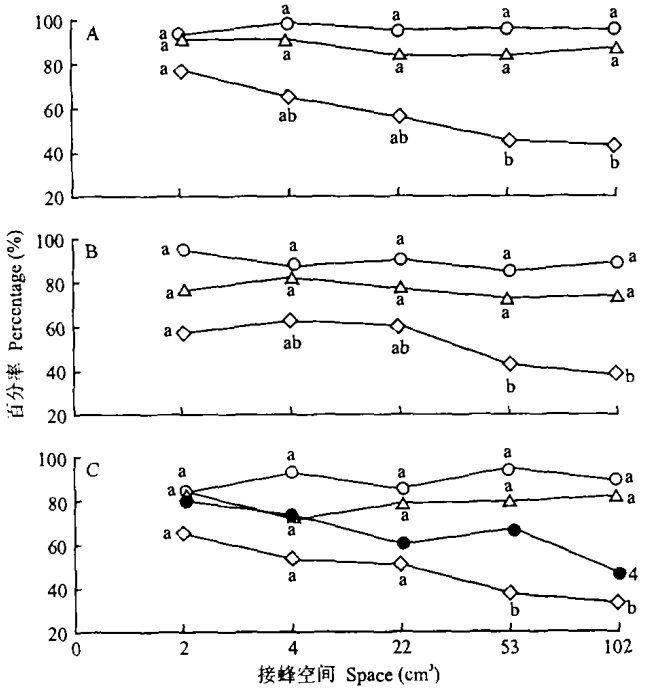

图 3　接蜂空间对拟澳洲赤眼蜂和短管赤眼蜂竞争能力的影响

Fig.3 Interspecies competition of *T. confusum* and *T. pretiosum* under different spaces.

3.3　不同空间条件下的种间竞争

图 3 结果表明,无论是单独接蜂还是混合接蜂,两蜂对米蛾卵的寄生率基本随接蜂所处空间的增加而明显下降,羽化率和后代雌蜂百分率则变化不大.混合接蜂后代雄蜂中短管赤眼蜂的百分率随接蜂空间的增加而降低,除 102 cm^3 空间外,其它处理均超过了 50%,说明尽管短管赤眼蜂较拟澳洲赤眼蜂的竞争能力强,但拟澳洲赤眼蜂具有较强的扩散能力,当与短管赤眼蜂发生竞争时,能通过在空间中的扩散寻找更多的寄主卵来提高其竞争能力.

4　讨　　论

两种赤眼蜂在米蛾卵上的竞争结果表明,不同蜂密度、寄主卵密度和接蜂空间条件下,短管赤眼蜂比拟澳洲赤眼蜂具有更强的竞争能力,但其竞争能力随蜂密度和接蜂空间的增加逐渐减弱.即短管赤眼蜂成蜂之间存在相互干扰作用,当蜂密度过多或寄主卵量过少时,相互间的干扰作用降低了其竞争能力.而拟澳洲赤眼蜂具有较强的扩散能力,能通过在空间中的扩散寻找更多的寄主卵来提高其竞争能力.由于两种蜂在体积、体色等方面几乎没有多大差别,凭肉眼不易区分,往往需通过对雄性外生殖器的解剖才能将其准确区别开,在室内繁蜂时,如果在拟澳洲赤眼蜂中混入了短管赤眼蜂,繁殖一定代数后很容易将拟澳洲赤眼蜂淘汰掉,因此在室内繁蜂时应注意蜂种隔离.

拟澳洲赤眼蜂是我国应用较多的赤眼蜂种之一,已被成功地用于防治甘蓝夜蛾(*Mamestra berassicae*)、甘蔗螟虫(*Diatroea* spp.)、棉铃虫(*Heliothis armigera*)等害虫[14].我国赤眼蜂的人工繁殖技术处于世界领先地位,拟澳洲赤眼蜂可以用米蛾卵、柞蚕卵以及人工卵进行繁殖[27],并进行工厂化生产.人工释放拟澳洲赤眼蜂作为防治小菜蛾的一种生物措施,由于产品可以工厂化生产,并有充足的来源,因此具有广阔的应用前景.短管赤眼蜂是美国防治棉铃虫的优势蜂种[11],生活能力较强,寄主范围也较广,其竞争能力较拟澳洲赤眼蜂强.其大量释放有可能对本地的优势种拟澳洲赤眼蜂产生排斥作用,具有一定的环境风险.因此,对短管赤眼蜂的大面积应用应慎重.

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