

卵形捕植蟎對銀葉粉蝨的功能反應與數量反應

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摘要

卵形捕植蟎後若蟎及雌蟎對銀葉粉蝨之捕食能力，受銀葉粉蝨食餌不同齡期密度之影響，其捕食力對食餌密度的功能反應均呈Holling第Ⅱ型之捕食反應模式。粉蝨一齡若蟲密度為28隻/4 cm²時，雌捕植蟎每日捕食量達其捕食高原，於此食餌密度下，卵形捕植蟎每日（24小時）之最大捕食量為5.88隻/雌（a: 0.6286；Th: 0.1723）。雌蟎的產卵量隨二齡銀葉粉蝨若蟲密度之增加亦呈Holling第Ⅱ型之關係，當粉蝨密度達24~32隻/4 cm²時，卵形捕植蟎每日每雌產卵量達最高（1.0~1.5卵/雌/日）。卵形捕植蟎對銀葉粉蝨供飼密度之功能反應與數量反應，受不同食餌齡期顯著影響；研究顯示卵形捕植蟎偏好掠食銀葉粉蝨之一齡及二齡若蟲，並為較適宜的食餌源，卵形捕植蟎捕食粉蝨的功能反應及數量反應，可供為田間防治銀葉粉蝨最佳釋放比例之基本參考資料。

關鍵詞：卵形捕植蟎*Amblyseius ovalis*、銀葉粉蝨*Bemisia argentifolii*、功能反應 functional response、數量反應 numerical response

前言

銀葉粉蝨*Bemisia argentifolii*為熱帶及亞熱帶地區蔬菜、花卉、糧作及特作之主要害蟲，其主要天敵有寄生性天敵*Encarsia spp.*、*Eretmocerus spp.*及瓢蟲（*Serangium spp.*、*Delphastus spp.*、*Nephaspis spp.*）、草蛉（*Chrysoperla spp.*）等捕食性天敵，均對銀葉粉蝨之族群具抑制作用；此外，Kapadia and Puri與Landa et al.曾分別報導捕食性椿象*Deraeocoris sp.*、真菌（*Paecilomyces sp.*、*Verticillium sp.*、*Beauveria sp.*）與煙草粉蝨*Bemisia tabaci*之相互關係。Brodsgarrd and Hansen與Houten et al.曾分別評估*Neoseiulus (Amblyseius) cucumeris*及*Amblyseius barkeri*等捕植蟎防治蔥薊馬*Thrips tabaci*與西方花薊馬*Franklinella occidentalis*之效果，部份學者亦報導*A. swirski*、*A. limonicus*及*Typhlodromus occidentalis*捕食煙草粉蝨之行為及其發育結果，然有關捕植蟎與銀葉粉蝨之相互關係及捕食之特性等研究則付之闕如。

卵形捕植蟎 *Amblyseius ovalis* 分佈於東南亞、台灣及中國東南地區，為台灣地區重要且深具利用價值的捕食性蟎類。學者曾就卵形捕植蟎取食數種葉蟎、花粉與人工食餌之生物學有所報導，也曾就卵形捕植蟎對二點葉蟎 *Tetranychus urticae* 之功能反應加以探討。由於卵形捕植蟎與其他種類害蟲相互關係尚未見報導，本研究除瞭解卵形捕植蟎捕食銀葉粉蝨之偏好性，並就其對銀葉粉蝨之功能反應及數量反應特性加以探討，以闡明其二者之相互關係。

內容

透明玻璃瓶（直徑3 cm、高度8 cm）內置5 cm高之脫脂棉，注水至6 cm高後，移置一顆已催芽的胡瓜種子至玻璃瓶內之棉花上。待植株第一對本葉完全開展後，將子葉及一片本葉剪除，僅保留一片本葉（葉面積約8~12 cm²），每日添灌花寶2號®1000倍溶液，供瓜葉正常生長。自粉蝨族群移入8~12隻2~3日齡銀葉粉蝨雌蟲，經24小時後將雌蟲移除，令葉片上之子代發育至特定齡期（卵或一、二齡若蟲）。此著生於玻璃瓶內棉花介質上之胡瓜株及粉蝨，以下稱為試驗供試株。

取前述之試驗供試株，自葉柄及葉片主脈向兩側修剪該胡瓜本葉為4 cm² (2 cm x 2 cm)，製成捕食反應株。於12X解剖顯微鏡挑除多餘的銀葉粉蝨卵，令捕食反應株分別留存2、4、8、16、24、28、32、36、48、64個卵。再移入一隻經24小時飢餓處理之3日齡雌性後若蟎後，將該供試株移置植物生長室，每一處理共40重複，於移入捕植蟎24小時後記錄捕植蟎對粉蝨卵之捕食量。測試食餌種類包括銀葉粉蝨的不同若蟲期（一至四齡），而測定的卵形捕植蟎齡別則為後若蟎與雌成蟎。

依相同方法、步驟及重複測試數，但測定及記錄2~3日齡卵形捕植蟎雌成蟎之產卵量。

卵形捕植蟎捕食銀葉粉蝨之功能反應

卵形捕植蟎雌性後若蟎對銀葉粉蝨之捕食能力，顯然受銀葉粉蝨食餌密度之影響，對各銀葉粉蝨食餌（卵及一至三齡）均呈Holling第II型之捕食模式，其攻擊成功率（a）及處理時間（Th）分別為a: 0.1212, 0.3260, 0.0709, 0.0141及Th: 0.8233, 0.3846, 1.3022, 4.0361（圖一）。當一齡若蟲密度為24隻/4 cm²時，後若蟎一日捕食量達捕食高原（Predation plateau），24小時內之最大捕食量為2.60隻/雌若蟎（圖一）。卵形捕植蟎後若蟎對粉蝨之四齡若蟲則不捕食。

研究顯示卵形捕植蟎後若蟎及雌成蟎對銀葉粉蝨卵及各齡期之捕食模式屬

Holling第Ⅱ型反應，即捕食者對粉蝨之捕食量隨粉蝨密度的上升而增加至一捕食高原，且捕食高原因粉蝨食餌齡期而改變（圖一、二）。當粉蝨一齡若蟲密度為24~28隻/4cm²時，卵形捕植蟎之後若蟎及雌蟎可達到捕食高原，其24小時之最大捕食量分別為2.60隻/日及5.88隻/日（圖一、二），此與Takafuji and Chant (1976)及Eveleigh and Chant (1981)報導智利捕植蟎*P. persimilis*或Shih *et al.* (1993)報導卵形捕植蟎之捕食高原高低受食餌齡別影響之結果相似。

Shih *et al.* (1993)及Shih and Wang (2001)報導卵形捕植蟎後若蟎及雌蟎對二點葉蟎各齡期之捕食高原受捕食者本身之不同齡期、性別而左右。但當食餌密度降低（載台面積增加）時，捕植蟎對葉蟎的捕食高原則隨之下降，且捕食模式將由第Ⅱ型轉為第Ⅲ型（Takafuji and Deguchi, 1980；Wang and Shih, 2001）。卵形捕植蟎對銀葉粉蝨之捕食能力及處理時間，顯然因銀葉粉蝨食餌密度、齡期與卵形捕植蟎之齡期（後若蟎、雌蟎）而影響。而卵形捕植蟎對銀葉粉蝨四齡若蟲不具捕食之行為，顯然符合Dean and Schuster (1995)報導食餌體型影響捕食者捕食能力之論點。

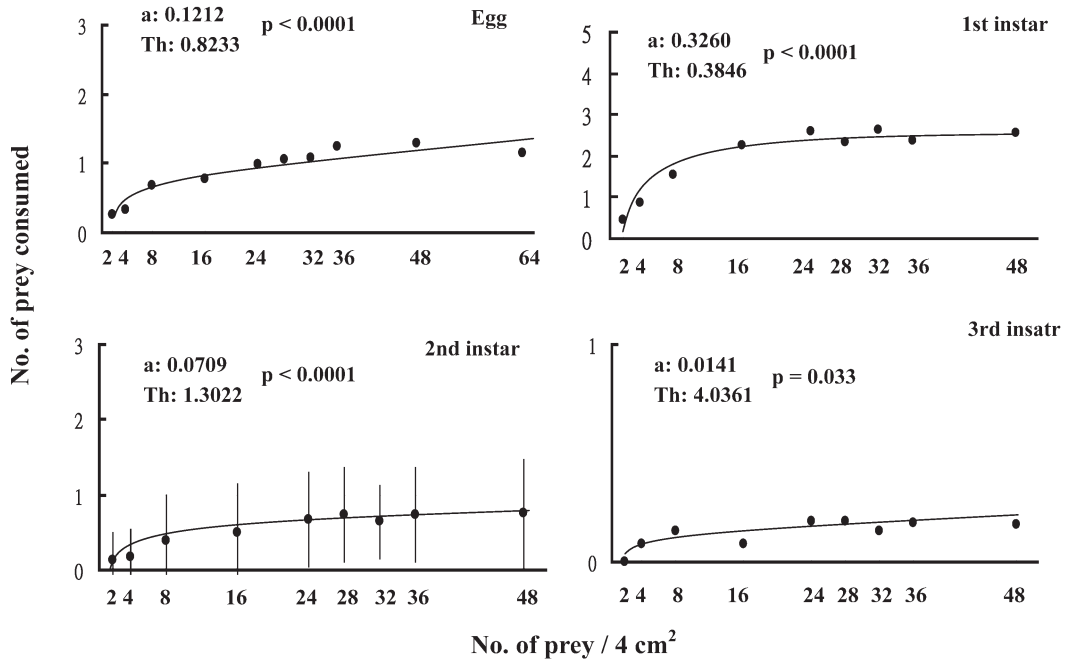
卵形捕植蟎捕食銀葉粉蝨之數量反應

卵形捕植蟎的產卵量與胡瓜葉片上銀葉粉蝨之一齡若蟲密度呈Holling第Ⅲ型（Sigmoid-型）之關係，當粉蝨密度達24~32隻/4 cm²時，卵形捕植蟎達其最高產卵量（1.38~1.42卵/雌）（圖三）。雌蟎產卵量與粉蝨二齡若蟲密度則為Holling第Ⅱ型之關係，當粉蝨密度達16~24隻/4 cm²時，卵形捕植蟎具最高產卵量（1.40~1.42卵/雌）（圖三）。於粉蝨卵或三、四齡若蟲食餌條件下，雌蟎之產卵量較少，且單日每雌平均產卵量與粉蝨食餌密度之相關性較不明顯。

卵形捕植蟎對銀葉粉蝨之數量反應顯然依粉蝨食餌密度及食餌齡期而改變（圖三）。此結果與Shih and Wang (2001)報導卵形捕植蟎之產卵量受其二點葉蟎密度及齡期顯著影響之結論相同。總之，本研究與Shih and Wang (2001)之結果，顯示卵形捕植蟎之生殖力受食餌密度及齡期影響。

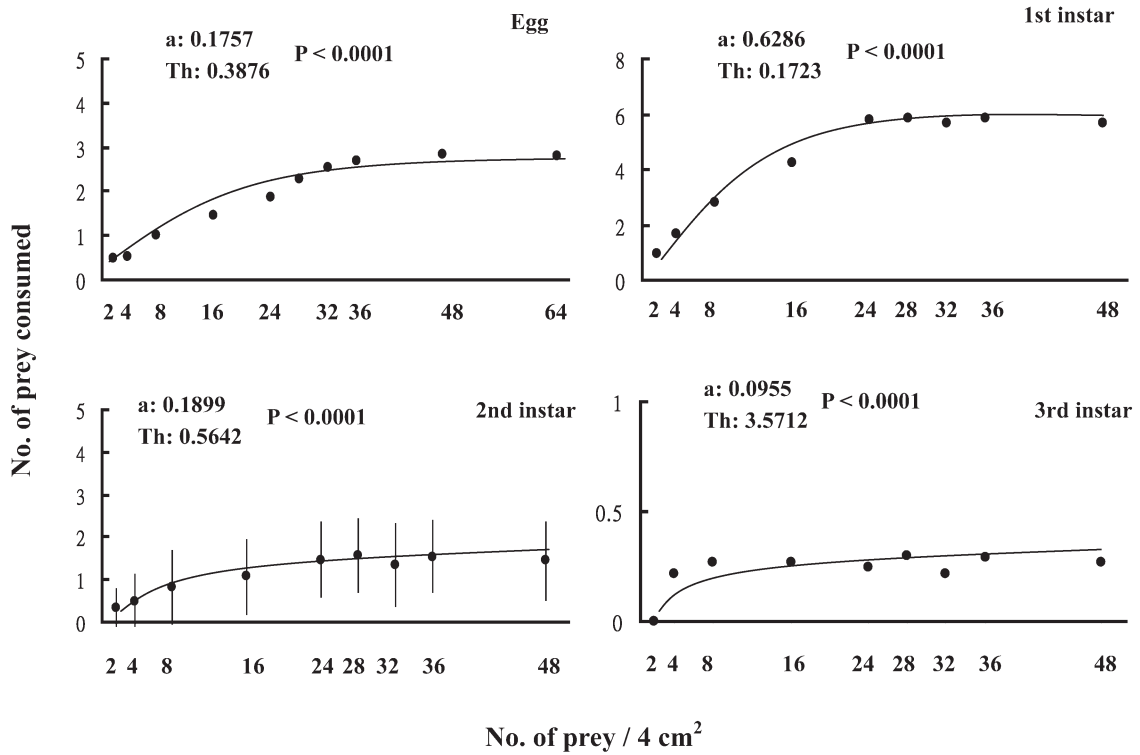
結語

學者曾報導煙草粉蝨卵對*E. hibisci*及*E. scutalis*具偏好性及適宜性，但二齡若蟲則否。相較本試驗之結果，卵形捕植蟎對銀葉粉蝨的親和力、嗜好性及捕食作用力顯然較*E. hibisci*及*E. scutalis*為高；推測除不同種的捕食者（*A. ovalis*、*Euseius hibisci*、*E. scutalis*）其營養需求各異外，粉蝨之不同生物型（biotype A = *Bemisia tabaci*及biotype B = *B. argentifolii*）或不同寄主植物（胡瓜、棉花）應為影響此等結果之原因。設若銀葉粉蝨卵對卵形捕植蟎具某程度上的不利影響，而卵形捕植蟎又偏好捕食銀葉粉蝨之一、二齡若蟲之特性，此捕食者與食餌在生態演化的過程中，顯然已發展出齡別差異性的關係。



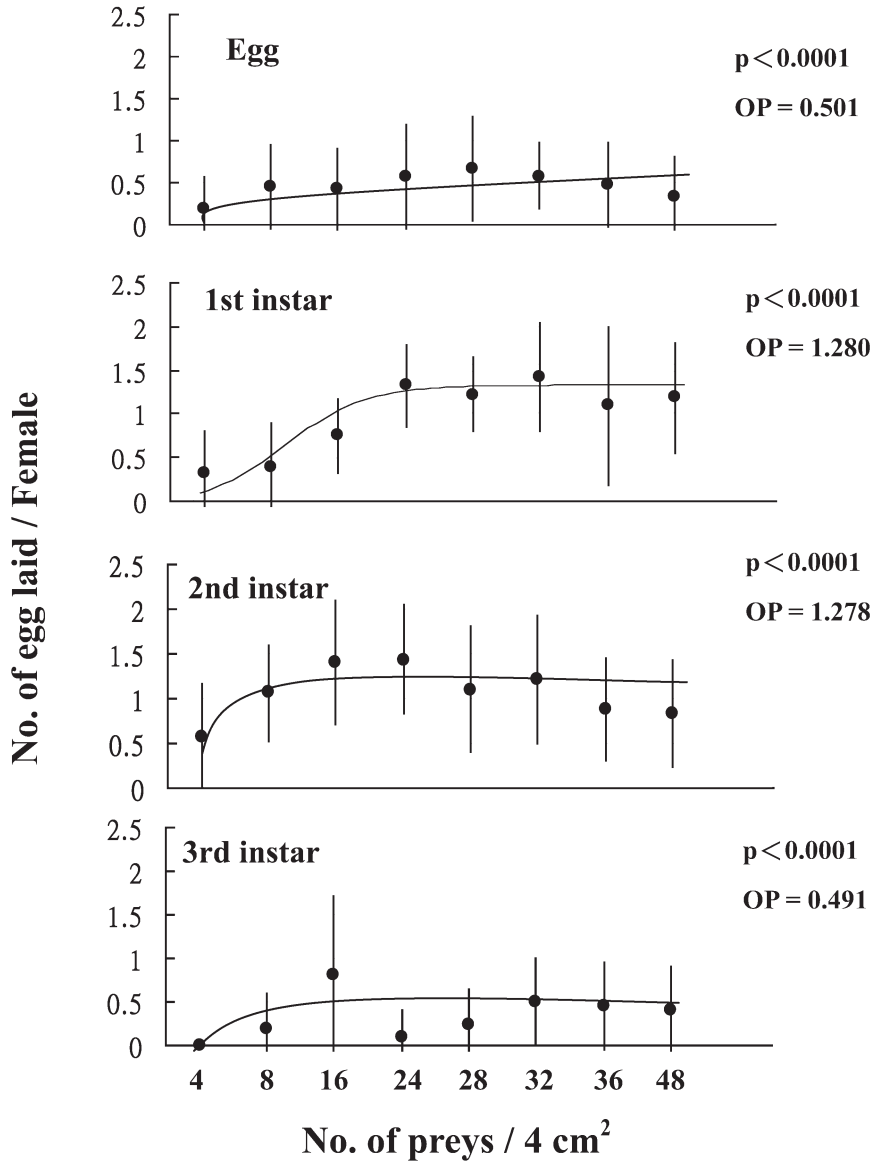
圖一、卵形捕植蟎後若蟎於24小時內對不同密度及齡期銀葉粉蝨之捕食量。

Fig. 1. Consumption of *A. ovalis* deutonymphs to different densities and stages of *B. argentifolii* in 24 hrs.



圖二、卵形捕植蝨雌蝨於24小時內對不同密度及齡期銀葉粉蝨之捕食量。

Fig. 2. Consumption of *A. ovalis* females to different densities and stages of *B. argentifolii* in 24 hrs.



圖三、卵形捕植蟎於不同密度及齡期銀葉粉蝨食餌下24小時內之產卵量。

Fig. 3. Oviposition of *A. ovalis* feeding on different densities and stages of *B. argentifolii* in 24 hrs. (OP: oviposition potential)

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