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Comparisons of Developemental Period, Fecundity and Feeding Amount of Three Phytoseiid Mites (Acari: Phytoseiidae)【Research report】

三種捕植瑠發育期、生殖力與捕食量的比較【研究報告】

Chyi-Chen Ho* and Wen-Hwa Chen
何琦琛*、陳文華

*通訊作者E-mail : phytoseiid, development, fecundity, feeding amount.

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Abstract

Amblyseius womersleyi Shicha is found commonly in Taiwan. It feeds actively on spider mites, and can provide good control of Tetranychus kanzawai Kishida. A. fallacis (Garman) and Phytoseiulus persimilis Athias-Henriot are exotic phytoseiids imported from the United States and/or Australia to Taiwan for the control of T. urticaeKoch. To compare their spier-mite-controlling abilities in controlling Kanzaw spider mite, the developmental rate, and the daily fecundity and feeding amounts of adult female mites of these three species during the first 5 days after eclosion were studied at 28C with a photoperiod of 13:11 (L:D) in an incubator. Developing from egg to adult took less than 5 days for all three mites: approximately 2 days for the egg stage, less than 1 day for the larval stage, and 1 or slightly longer than 1 day for each of the two nymphal stages. Adult female A. womersleyi, A. fallacis, and P. persimilis consumed 32.1, 18.7, and 46.5 spider mite eggs daily; and laid 3.4, 3.3, and 4.6 eggs per day, respectively. A. womersleyi had a developmental rate and daily fecundity similar to those of A. fallacis, but consumed more food. It is worthy to pay more attention to the value of A. womersleyi as a biological control agent.

摘要

溫氏捕植瑠(Amblyseius womersleyi Schicha)普遍發生於臺灣各地，對葉瑠有良好的捕食能力。應用於神澤氏葉瑠(Tetranychus kanzawai Kishida)的生物防治上，有良好的成效。法拉斯捕植瑠(A. fallacis (Garman))及智利捕植瑠(Phytoseiulus persimilis Athias-Henriot)為自美國以及澳洲引進的外來種類，引進目的在防治二點葉瑠(T. urtica Koch)。為比較此3種捕植瑠對神澤氏葉瑠的抑制能力，本試驗以神澤氏葉瑠卵為食，觀察3種捕植瑠的發育速度、產卵量與捕食量。28C、13:11(L:D)光照週期定溫箱中，自卵發育至成瑠需時均不足5日，卵期約2日，幼瑠期短於1日，前、後若瑠期均為1日或略長於1日。溫氏、法拉斯及智利捕植瑠的雌成瑠每日各捕食葉瑠卵32.1、18.7及46.5粒；每日產卵3.4、3.3及4.6粒。溫氏捕植瑠的發育速度及日產卵量與法拉斯捕植瑠相似，但食量較高，值得加強其應用探討。

Key words: phytoseiid, development, fecundity, feeding amount.
關鍵詞: 捕植瑠、發育、繁殖、食量

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三種捕植蟎發育期、生殖力與捕食量的比較

何琦琛* 陳文華 臺灣省農業試驗所應用動物系 臺中縣霧峰鄉中正路189號

摘 要

溫氏捕植蟎(*Amblyseius womersleyi* Schicha)普遍發生於臺灣各地，對葉蟎有良好的捕食能力。應用於神澤氏葉蟎(*Tetranychus kanzawai* Kishida)的生物防治上，有良好的成效。法拉斯捕植蟎(*A. fallacis* (Garman))及智利捕植蟎(*Phytoseiulus persimilis* Athias-Henriot)為自美國以及澳洲引進的外來種類，引進目的在防治二點葉蟎(*T. urtica* Koch)。為比較此3種捕植蟎對神澤氏葉蟎的抑制能力，本試驗以神澤氏葉蟎卵為食，觀察3種捕植蟎的發育速度、產卵量與捕食量。28℃、13:11 (L:D)光照週期定溫箱中，自卵發育至成蟎需時均不足5日，卵期約2日，幼蟎期短於1日，前、後若蟎期均為1日或略長於1日。溫氏、法拉斯及智利捕植蟎的雌成蟎每日各捕食葉蟎卵32.1、18.7及46.5粒；每日產卵3.4、3.3及4.6粒。溫氏捕植蟎的發育速度及日產卵量與法拉斯捕植蟎相似，但食量較高，值得加強其應用探討。

關鍵詞：捕植蟎、發育、繁殖、食量。

前 言

溫氏捕植蟎(*Amblyseius womersleyi* Schicha)為臺灣田野間常見於葉蟎族群中的天敵(Ho *et al.*, 1995)，對葉蟎具有良好的捕食能力(Lo and Ho, 1979; Shih and Shieh, 1979; Ho *et al.*, 1995a)。國內首先利用於防治草莓上的神澤氏葉蟎(*Tetranychus kanzawai* Kishida)，效果良好，但釋放於商業生產草莓園防治二點葉蟎(*T. urtica* Koch)時，未能抑制葉蟎族群(Lo *et al.*, 1984)。羅幹成氏乃於1985年及1989、1990年先後引進法拉斯捕植蟎(*A. fallacis* (Garman))及智利捕植蟎 (*Phytoseiulus persimilis* Athias-Henirot)，大量繁殖後釋放於草莓園防治二點葉蟎，獲有相當良好的效果(Lee and Lo, 1989)；隨後釋放於木瓜上防治赤葉蟎(*T. cinnabarinus* Boisduval)及神澤氏葉蟎，亦卓有成效(Hao *et al.*, 1996)。而溫氏捕植蟎釋放於桑園、茶園防治神澤氏葉蟎，效果良佳(Chen, 1988; Ho and Chen, 1991)。筆者在茶園測試法拉斯捕植蟎及智利捕植蟎的功效時，二者均發揮了抑制葉蟎族群的功能；但釋放捕植蟎的試驗小區及對照區均自然發生溫氏捕植蟎(Ho, 1990)。加之筆者多年田間經驗顯示，無論平地、山地、農作物或野生植物，如發生 *Tetranychus* 屬葉蟎，往往可發現溫氏捕植蟎於其中，亦即此捕植蟎在臺灣

* 抽印本索取及論文聯繫之負責人

極為普遍。筆者因而動念對此三種捕植蟎進行比較，探討其在捕食葉蟎能力上的優劣。由於臺灣農作物上以神澤氏葉蟎最常發生(Ho *et al.*, 1995b; Ho *et al.*, 1997)，勢將為生物防治工作時最常面對的葉蟎，乃選擇此葉蟎做為比較時的食物，本文謹報導三者捕食神澤氏葉蟎時的生活環資料。

材料與方法

將250×190×3 mm的塑膠板置於泡棉上，板的邊緣圍以1 cm寬的棉條。放在塑膠盤中，加水至淹過3/4泡棉，使棉條飽吸水分，以阻隔葉蟎及捕植蟎，不使外逃。以此裝置來飼養三種捕植蟎的母族群，每2～3日添加飼養有神澤氏葉蟎的青皮豆(*Glycine max* L.)苗，供捕植蟎取食，並清除底層乾萎的豆苗。

參照Lo and Ho (1979)的方法，利用直徑約6cm之培養皿，襯舖飽吸水分棉花，上置葉背朝上的青皮豆真葉，做成浮葉供進行試驗。自母族群挑取雌成蟎至浮葉，容其產卵2小時後，將雌蟎挑走，以這些卵粒來進行觀察。卵孵化後，將幼蟎單隻個別挑入一浮葉，供以足量的神澤氏葉蟎卵。每日記錄其發育情形及捕食量，並挑去孵化出的葉蟎幼蟎，補足食物。蛻為成蟎後，立即予以配對，再觀察記錄10隻雌成蟎的捕食量、產卵量至第五天。全部測試在28℃，13:11 (L:D)的定溫箱中進行。

結　果

溫氏捕植蟎、法拉斯捕植蟎及智利捕植蟎捕食青皮豆飼育的神澤氏葉蟎卵，其發育期長分別列於表一、二及三。三種捕植蟎的發育速度極為近似，28℃下均以不到5天的時間完成發育。發育速度極為迅捷，除卵期稍長約為2天外，後胚胎期各齡期均在1天或1天以內，僅法拉斯捕植蟎雌性個體前若蟎及雄性個體後若蟎期達1天餘，而幼蟎期均不足1天，為發育期最快速的一段時間。兩性間的差別極小，以智利捕植蟎而言，兩性發育速度幾乎相同。

雌成蟎在前五日齡中的平均每日產卵量，溫氏捕植蟎與法拉斯捕植蟎相近，各為

表一　溫氏捕植蟎捕食神澤氏葉蟎卵之發育速度(日)

Table 1. Development period (d) of *Amblyseius womersleyi* while feeding on *Tetranychus kanzawai* eggs

Sex	N	Duration (x±SE)				
		Egg	Larva	Protonymph	Deutonymph	Total
F	44	1.99±0.03	0.52±0.0	1.23±0.04	1.18±0.23	4.92±0.24
M	26	2.1 ±0.06	0.60±0.0	1.04±0.05	0.94±0.06	4.67±0.09

表二　法拉斯捕植蟎捕食神澤氏葉蟎卵之發育速度(日)

Table 2. Development period (d) of *Amblyseius fallacis* while feeding on *Tetranychus kanzawai* eggs

Sex	N	Duration (x±SE)				
		Egg	Larva	Protonymph	Deutonymph	Total
F	44	1.58±0.1	0.71±0.1	1.29±0.1	1.00±0.00	4.58±0.12
M	26	2.0 ±0.0	0.5 ±0.29	1.00±0.0	1.25±0.25	4.75±0.25

3.4、3.3粒；智利捕植蟎則較高，達4.6粒。每日捕食量則以智利捕植蟎46.5粒最高，溫氏捕植蟎32.1粒次之，法拉斯捕植蟎18.7粒最低；三種間有顯著的差異(表四)。以之計算它們平均每產一粒卵所消耗的神澤氏葉蟎卵數，則以智利捕植蟎最高，溫氏捕植蟎與之近似，而法拉斯捕植蟎較低。

討　論

McMurtry (1982)以散播能力(dispersal power)、分布與食餌的關係(distribution in relation to prey)、生殖潛能(reproductive potential)、貪食度(voracity)、專食性(specificity)、缺乏食物時的生存能力(survival ability when prey scarce)等六項特徵來評量捕植蟎。在將本地的溫氏捕植蟎與自國外引進的法拉斯捕植蟎、智利捕植蟎比較時，它們都是專食葉蟎的天敵，行動迅速，缺乏食物時均會自相殘殺而維續族群。依據筆者在台灣各地採集的經驗，不論是野生植物或農作物，*Tetranychus*屬葉蟎族群中發現的捕植蟎幾乎均是溫氏捕植蟎。法拉斯捕植蟎是噴藥果園中才較多的，未噴藥園中往往是其它種類較優勢。筆者未知智利捕植蟎是否如此。本試驗中，筆者以發育速率及產卵量對它們的族群增長能力做簡單但快速的比較。

法拉斯捕植蟎及智利捕植蟎乃自美、澳引進者，二種天敵在該地均非以神澤氏葉蟎為食物，為了解是否會影響它們的表現，將國外對此二種捕植蟎的研究結果選取溫度相近、且以葉蟎為食物者，列於表5及表6。25～27℃時以二點葉蟎、歐洲葉蟎或太平洋葉蟎(*T. pacificus* McGregor)為食，法拉斯捕植蟎的發育期在3.5～5.1天間，似乎有發育較本試驗為快的情形；日產卵量3.2或3.5粒，則與本試驗中取食神澤氏葉蟎時相似。智利捕植蟎於25～30℃間以二點葉蟎或太平洋葉蟎為食，其發育期為5～5.4天，日產卵量3.2～3.7粒。發育期與取食神澤氏葉蟎時相似，日產卵量則有不如。這可能因為本試

表三　智利捕植蟎捕食神澤氏葉蟎卵之發育速度(日)

Table 3. Development period (d) of *Phytoseiulus persimilis* while feeding on *Tetranychus kanzawai* eggs

Sex	N	Duration (x±SE)				
		Egg	Larva	Protonymph	Deutonymph	Total
F	44	1.96±0.04	0.60±0.1	1.0±0.0	1.0±0.0	4.56±0.12
M	26	2.00±0.0	0.55±0.1	1.0±0.0	1.0±0.0	4.55±0.16

表四　捕植蟎雌成蟎每日捕食神澤氏葉蟎卵量與產卵量

Table 4. Daily fecundity and daily consumption on *Tetranychus kanzawai* eggs

Phytoseiid	Daily fecundity	Daily food consumption	No. eggs predated/egg produced
A. womersleyi	3.4±0.1	32.1b±1.0	9.4
A. fallacis	3.3±0.2	18.7c±0.6	5.7
P. persimilis	4.6±0.2	45.9a±1.5	10.0

Data in the same column followed by different letters are significantly different by LSD test, $\alpha = 0.05$.

表五　取食葉蟎時，法拉斯捕植蟎一些已報導的發育期長(日)及每日產卵量

Table 5. Some reported developmental period (d) and daily fecundity of *Amblyseius fallacis* that feeding on spider mite

Temp (℃)	Food	Developmental period	Fecundity	Source
26	*T. urticae*	3.5	3.5	Ball, 1980
27	*P. ulmi*	5.1	–	Ahlstrom and Rock, 1973
27	*T.* spp.	4.2	3.2	Smith and Newsom, 1970

表六　取食葉蟎時，智利捕植蟎一些已報導的發育期長(日)、每日產卵量及內在增殖率

Table 6. Some reported developmental period, daily fecundity, and intrinsic rate of increase (r_m) of *Phytoseiulus persimilis* that feeding on spider mite

Temp (℃)	Food	Developmental period	Fecundity	r_m	Source
23	*T. pacificus*	6.1	2.9	–	Amano and Chant, 1977
25	*T. pacificus*	5.4	3.7	0.317	Takafuji and Chant, 1976
25	*T. urticae*	–	–	0.363～0.395	Galazzi and Nicoli, 1996
30	*T. urticae*	5	–	–	Sabelis, 1981

驗只觀察前5日齡，此時期雌性生殖系統的成熟需要額外的養分，同時也正值產卵盛期的緣故。與此兩表的資料比較，本試驗的結果顯示，神澤氏葉蟎也是法拉斯與智利捕植蟎的良好食物，並未對其發育及產卵造成不良影響。

Lo and Ho (1979)、Shih and Shieh (1979)均曾研習溫氏捕植蟎的生命表，前者以二點葉蟎的卵為食，測試了35、30、25、20℃四個溫度的影響；後者以神澤氏葉蟎的卵為食，在24℃下觀察。將Lo and Ho所測25及30℃下的結果及Shih and Shieh的資料與本試驗比較，他們觀察到的發育期略長，30℃時也有5天。如將Lo and Ho四個溫度的數據以內插法推算28℃下雌蟎的發育期，應為5.6天，相差約1天。在未做正式比較前，無法推論此情形是否由食物不同而造成。但其平均每日取食量及每日產卵量均較本試驗所測得之數值為低，連帶每產一卵所需食物量也較低。這情形也如同法拉斯捕植蟎與智利捕植蟎在本試驗中產卵量較高一般，可能係本試驗觀察期較短所致。本試驗之結果顯示台灣本地的溫氏捕植蟎在發育速率上完全不輸引進的二種天敵；但在食量與生殖力上皆遜於智利捕植蟎。Lo and Ho (1979)所測得溫氏捕植蟎在30及25℃下的內在增殖率分別為0.320及0.229，也低於智利捕植蟎在25℃下的0.317或0.363-0.395 (Takafuji and Chant, 1976; Galazzi and Nicoli, 1996)。溫氏捕植蟎與法拉斯捕植蟎相較時，生殖力上二者相當，食量則前者較高。整體而言，似以溫氏捕植蟎較優。法拉斯捕植蟎雖為3種捕植蟎中食量最低者，但它消耗5.7粒葉蟎卵即能產出一卵，低於智利捕植蟎的10粒與溫氏捕植蟎的9.4粒，在將食物轉換利用至生殖上，則為三種捕植蟎中最優者，此點將有利於在低食餌密度時，將種族維續。

法拉斯捕植蟎及智利捕植蟎引進已有10年以上，草莓上先後釋放了數百萬隻(Lee *et al.*, 1989)，木瓜上也釋放了數十萬(Hao *et al.*, 1996)，然而迄今未曾獲得二者已立足之

證據。雖然也可能是因為缺乏有關的後續調查，乃致缺乏有關資訊。優良天敵的特點之一是與防治對象共同發生，溫氏捕植蟎在此一特點上具有極為優良的表現，已在前述及。而其在發育、捕食、產卵上表現亦極優秀。此外，農試所大量繁殖捕植蟎時，豆苗上如被溫氏捕植蟎污染有可能影響法拉斯捕植蟎的生產。以上種種均指出溫氏捕植蟎也是一種優良的捕食性天敵，它在台灣的應用價值，極可能不亞於法拉斯捕植蟎，也可能有與二種引進捕植蟎相輔相成之處，值得研發葉蟎生物防治工作者對溫氏捕植蟎予以進一步的探討。

引用文獻

Ahlstrom, K. R., and G. C. Rock. 1973. Comparative studies on *Neoseiulus fallacis* and *Metaseiulus occidentalis* for azinphosmethyl toxicity and effects of prey and pollen on growth. Ann. Entomol. Soc. Am. 66: 1109-1113.

Amano, H., and D. A. Chant. 1978. Mating behaviour and reproductive mechanisms of two species of predacious mites, *Phytoseiulus persimilis* Athias-Henriot and *Amblyseius andersoni* (Chant)(Acarina: Phytoseiidae). Acarologia 20: 196-213.

Ball, J. C. 1980. Development, Fecundity, and prey consumption of four species of predacious mites (Phytoseiidae) at two constant temperature. Environ. Entomol. 9: 298-303.

Chen, H. T. 1988. Tea mite biological control in fields. Taiwan Tea Res. Bull. 7: 15-25 (in Chinese).

Galazzi, D., and G. Nicoli. 1996. Comparative study of strains of *Phytoseiulus persimilis* Athias-Henriot (Acarina Phytoseiidae). II. Influence of mass-rearing on population growth. Bollettino dell'Istituto di Entomologia "Guido Grandi" della Universita degli Studi di Bologna 50: 243-252.

Hao, H. H., H. L. Wang, W. T. Lee, and K. C. Lo. 1996. Studies on biological control of spider mites on papaya. J. Agric. Res. China 45: 411-421 (in Chinese).

Ho, C. C. 1990. A preliminary study on the biological control of *Tetranychus kanzawai* in tea field by *Amblyseius fallacis* and *Phytoseiulus persimilis* (Acarina: Tetranychidae, Phytoseiidae). J. Agric. Res. China 39: 133-140 (in Chinese).

Ho, C. C., and W. H. Chen. 1991. Biological control of the kanzawa spider mite in mulberry grooves. Taiwan Agric. Bimonthly 27: 82-89 (in Chinese).

Ho, C. C., K. C. Lo, and W. H. Chen. 1995a. Comparative biology, reproductive compatibility, and geographical distribution of *Amblyseius longispinosus* and *A. womersleyi* (Acari: Phytoseiidae). Environ. Entomol. 24: 601-607.

Ho, C. C., K. C. Lo, and W. H. Chen. 1995b. Spider mites injurious to economic plants in Taiwan and the toxicity of twelve acaricides to two major species. J. Agric. Res. China 44: 157-165 (in Chinese).

Ho, C. C., K. C. Lo, and W. H. Chen. 1997. Spider mite (Acari: Tetranychidae)

on various crops in Taiwan. J. Agric. Res. China 46: 333-346 (in Chinese).

Lee, W. T., and K. C. Lo. 1989. Integrated control of two-spotted spider mite on strawberry in Taiwan. Chinese J. Entomol. Special Publ. 3: 125-137 (in Chinese).

Lo, K. C., and C. C. Ho. 1979. Influence of temperature on life history, predation and population parameters of *Amblyseius longispinosus* (Acarina: Phytoseiidae). J. Agric. Res. China 28: 237-250 (in Chinese).

Lo, K. C., H. K. Tseng, and C. C. Ho. 1984. Biological control of spider mites on strawberry in Taiwan (I). J. Agric. Res. China 33: 406-417 (in Chinese).

McMurtry, J. A. 1982. The use of phytoseiids for biological control: progress and future prospects. pp. 23-48 *in* M. A. Hoy ed. Recent advances in knowledge of the phytoseiidae. Agric. Sci. Publ. Univ. California, Berkeley.

Sabelis, M. W. 1981. Biolocial control of two-spotted spider mites using phytoseiid predators. Part I. Modeling the predator-prey interaction at the individual level. Agr. Res. Rept. 910, Pudoc, Wageningen, 242pp.

Shih, C. I. T., and J. N. Shieh. 1979. Biology, life table, predation potential and intrinsic rate of increase of *Amblyseius longispinosus* (Evans). Plant Prot. Bull. 21: 175-183 (in Chinese).

Smith, J. C., and L. D. Newsom. 1970. The biology of *Amblyseius fallacis* (Acarina: Phytoseiidae) at various temperature and photperiod regimes. Ann. Entomol. Soc. Am. 63: 4602.

Takafuji, A., and D. A. Chant. 1976. Comparative studies of two species of predacious phytoseiid mites (Acarina: Phytoseiidae), with special reference to their responses to the density of their prey. Res. Popul. Ecol. 17: 255-310.

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Comparisons of Developemental Period, Fecundity and Feeding Amount of Three Phytoseiid Mites (Acari: Phytoseiidae)

Chyi-Chen Ho* and Wen-Hua Chen Department of Applied Zoology, Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan, R.O.C.

ABSTRACT

Amblyseius womersleyi Shicha is found commonly in Taiwan. It feeds actively on spider mites, and can provide good control of *Tetranychus kanzawai* Kishida. *A. fallacis* (Garman) and *Phytoseiulus persimilis* Athias-Henriot are exotic phytoseiids imported from the United States and/or Australia to Taiwan for the control of *T. urticae* Koch. To compare their spider-mite-controlling abilities in controlling Kanzawa spider mite, the developmental rate, and the daily fecundity and feeding amounts of adult female mites of these three species during the first 5 days after eclosion were studied at 28℃ with a photoperiod of 13:11 (L:D) in an incubator. Developing from egg to adult took less than 5 days for all three mites: approximately 2 days for the egg stage, less than 1 day for the larval stage, and 1 or slightly longer than 1 day for each of the two nymphal stages. Adult female *A. womersleyi, A. fallacis*, and *P. persimilis* consumed 32.1, 18.7, and 46.5 spider mite eggs daily; and laid 3.4, 3.3, and 4.6 eggs per day, respectively. *A. womersleyi* had a developmental rate and daily fecundity similar to those of *A. fallacis*, but consumed more food. It is worthy to pay more attention to the value of *A. womersleyi* as a biological control agent.

Key words: phytoseiid, development, fecundity, feeding amount.

*Correspondence/reprint request address