

薤菜間作對有機茭白田生產及節肢動物組成之影響

林文華^{1,*}、彭冠華²、陳季呈³

¹花蓮區農業改良場助理研究員

²花蓮區農業改良場研究助理

³花蓮區農業改良場研究員

* e-mail: wenhwalin@hdares.gov.tw

摘要

本試驗探討間作薤菜對有機茭白田作物生產及田間節肢動物組成之影響。結果顯示有機間作田節肢動物之種類為 71 種，是無間作田 51 種的 1.4 倍，而捕獲總數前者為 1,588 隻，達後者 1,208 隻之 1.3 倍；而間作田之天敵數量 248 隻，較無間作田 109 隻為高。試驗期間因颱風僅採收 2 次茭白筍，產量較慣常為低，間作處理為 1,472 kg/ha，較無間作田區 1,340 kg/ha 稍高，顯示間作薤菜不影響茭白筍收成；間作之薤菜產量 18,050.1 kg/ha，可大幅提升間作田區作物收量及收益。試驗結果顯示，間作薤菜提高田間節肢動物及天敵的種類及數量，並對有機茭白田之生產具正面效益。

關鍵詞：茭白筍、薤菜、生態功能群、節肢動物、水田

前言

茭白 (*Zizania latifolia* L.) 為禾本科之多年生草本植物，是台灣重要之夏秋季作物。相較於其他蔬菜作物，茭白較不易受病蟲害影響而大幅減產，故為適合有機栽培之作物。其高大的植株與田區長期湛水的種植方式，形成優良的隱蔽處，可吸引眾多物種棲息，但種植單一作物致使棲地單一化，不易有豐富的生物多樣性。間作 (intercropping) 為單一田區種植兩種以上作物，一般而言具有提高田區產值的效果，且透過間作田作物相較為複雜的特點，或可增加田區生物多樣性。本研究於有機茭白筍田間作蕹菜 (*Ipomoea aquatica*)，並與未間作蕹菜之有機茭白筍田進行比較，探討田間節肢動物相及作物產量與產值之差異，評估間作蕹菜在農民收益及生物多樣性增益效果，以期達到生活、生產與生態三贏之目標。

間作蕹菜對有機茭白田節肢動物相之影響

本試驗於田區以掃網方式採集到之節肢動物，參考范 (2016) 將節肢動物分為稻害蟲 (Pest)、雜草食者 (Graminivore)、捕食者 (Predator)、擬寄生者 (Parasitoid)、授粉者 (Pollinator) 及分解者 (Scavenger) 六大功能類群 (Function groups)，並針對影響農作收成的稻害蟲、捕食者、擬寄生者三功能群及捕獲到的所有節肢動物之種類與數量進行探討。結果顯示有機茭白筍間作蕹菜之田間節肢動物種類較為豐富，試驗期間，間作田區出現 71 種節肢動物，較無間作田區 51 種為高；節肢動物總數調查結果亦顯示間作蕹菜田較無間作田為高，間作田區共捕獲 1588 隻，無間作田區僅有之 1,208 隻 (表 1)；在趨勢變化上，間作田與無間作田之節肢動物總數分別於 7 月 21 日與 8 月 4 日達到最大值 (圖 1、圖 2)，顯示間作田區節肢動物增長速度較快，與預期結果相符，由試驗結果可知有機茭白筍間作蕹菜對生物多樣性有正面的影響。國外研究亦指出，間作是維護農田生物多樣性的方法之一 (McLaughlin and Mineau, 1995)，至於如何進行間作模式才能達到最高效益，尚需實務經驗累積。

農民為生產更安全的作物，並期望能提高作物單位售價等因素，而選擇有機耕作，此時天敵防治相形之下更加重要。本試驗間作田較無間作田有較高之天敵種類及捕獲總數，在雜草食者與天敵的數量上達顯著差異，其中寄生性天敵在間作田有 12 種 85 隻，在無間作田僅有 6 種 45 隻；而捕食性天敵分別為 17 種 163 隻及 14 種 64 隻，數量上均達顯著差異 (表 1)。Liang 等發現同屬禾本科的水稻 (*Oryza sativa*) 間作蕹菜，比起單一種植水稻，可以降低紋枯病、稻熱病的發生，並降低田間瘤野螟的族群數量 (Liang *et al.*, 2016)；而本試驗發現，間作田區之天敵總數於 7 月 21 日達到最大值後害蟲種類及總數即開始下降 (圖 2)，推測田間天敵與害蟲具一定的相關性，由試驗結果可推知有機茭白筍間作蕹菜能提升天敵數

量，具應用價值。但間作吸引到的生物是否增強防治效果，及作物的產量如何交互影響，與作物搭配密切相關 (Flint and Robert, 1988)，如何調整不同作物、地理條件及耕作方法，需要進一步的試驗探討。

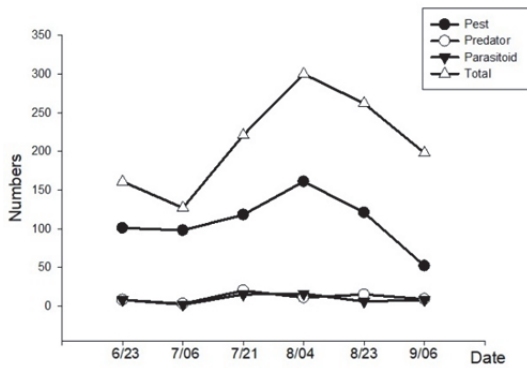
間作薤菜對有機茭白田作物生產之影響

本試驗期望以間作的方式增加農民的收益，調查結果顯示，茭白筍產量間作處理為 1,472 kg/ha，較無間作田區 1,340 kg/ha 稍高，顯示間作薤菜不影響茭白筍收成；含殼單筍重、裸筍單筍重及筍長等特性上，於間作田區與無間作田區間無顯著差異 (表 2)；由於間作薤菜並不影響茭白筍產量與品質，農民更可採收薤菜而獲得額外收益，故間作田區淨收益高於無間作田區 (表 3)。由於本試驗執行年度受颱風侵害因此茭白筍僅採收 2 次，而後續植株嚴重受損致無法採收，造成本試驗茭白筍產量較低，僅約 1,400 kg/ha；而本次試驗觀察到田間薤菜於颱風過後損害並不嚴重，產量 18,050.1 kg/ha，由此更加突顯間作薤菜可降低有機茭白筍受颱風影響致災的風險。國外研究曾指出間作大麥等較高大的作物能避免蘆筍受到風的侵害 (Schultz *et al.*, 1963)，可能因茭白植株高大，於颱風季節可以破風，使間作之薤菜受損較少並快速恢復生長。

結論

以有機間作模式栽培茭白筍可有效增加田間節肢動物種類與數量，且因天敵數量亦增加，較一般有機栽培更具天敵防治的潛力。有機間作栽培不僅符合聯合國愛知生物多樣性目標，並能夠帶給消費者更安全的食物，對於農民而言，則可增加收益並降低風險，頗具生態與生產價值。

a. Species



b. Numbers

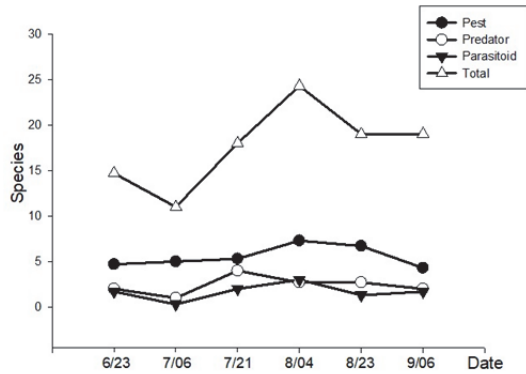
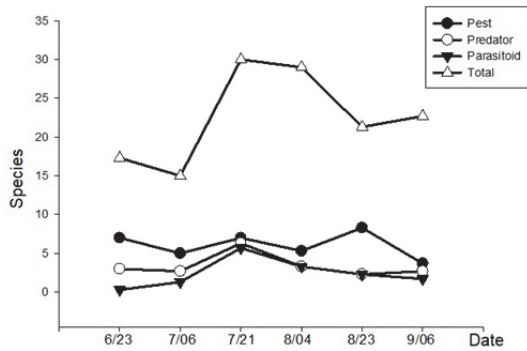


圖 1、有機茭白筍無間作田之節肢動物(a)種類及(b)數量調查

Fig. 1. Investigation of arthropods (a) species and (b) numbers captured in organic water bamboo non-intercropping field.

a. Species



b. Numbers

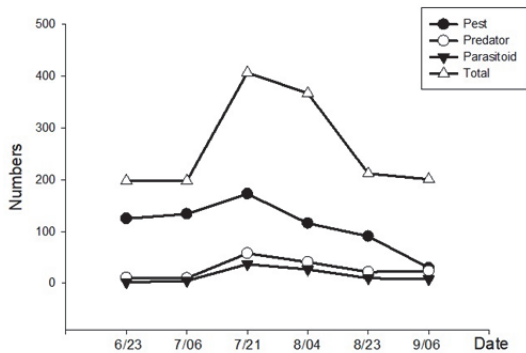


圖 2、有機茭白筍間作蕹菜田之節肢動物(a)種類及(b)數量調查

Fig. 2. Investigation of arthropods (a) species and (b) numbers captured in organic water bamboo and water spinach intercropping field.

表 1、間作薤菜與否於各節肢動物功能群種類及總數之調查

Table 1. Investigation of arthropod species and numbers captured in different function groups affect by intercropping. (單位：隻)

Analysis item	Pattern	Pest	Graminivore	Predator	Parasitoid	Pollinator	Scavenger	Total
Species^z	Intercropping	12	12	17	12	1	17	71
	Non-intercropping	10	7	14	6	1	13	51
Numbers^y	Intercropping	113.8	36 ^{*x}	27.2 [*]	14.2 [*]	0.3	73.2	264.7 ^{**}
	Non-intercropping	102.3	16.3	10.7	7.5	0.2	64	201.3

^z Arthropod species in function groups within experimental period, data were not analyzed by software.

^y The mean of arthropod numbers caught in experimental period, data analyzed by one-way anova.

^x The symbol * and ** means significant difference. * means $p < 0.05$, ** means $p < 0.01$.

表 2、間作薤菜與否對茭白筍產量及品質之影響

Table 2. The effect of intercropping water spinach in field on annual yields, quality of water bamboo.

Field	Annual yield (kg/ha)	Edible shoot wt. with leaf sheath (g)	Edible shoot wt. without leaf sheath (g)	Edible shoot length (cm)
Non-intercropping ^z	1340	45.4 a ^y	32.6 a	15.1 a
Intercropping	1472	49.7 a	34.4 a	15.3 a

^z Trial areas of two treatments were in the same field. All the trial areas had a procedure of weed control by hands several days before water spinach planted.

^y Means within each column followed by the same letters are not significantly different at $P < 0.05$ by Fisher's protected LSD test.

表 3、有機茭白筍間作蕹菜與否之生產效益分析比較

Table 3. Comparison of production benefit of organic water bamboo production with and without intercropping water spinach farming modules.

	Intercropping	Non-intercrop ping	Remarks
Total Profit (N.T.\$ 1,000/ ha)	1812.0	335	
Water bamboo			
Harvest (kg/ha)	1472	1340	
Price (N.T.\$/ kg)	250	250	
Profit (N.T.\$ 1,000/ha)	368.0	335.0	Organic water bamboo: 250 N.T.\$/ kg
Water spinach			
Harvest (kg/ha)	18050.1	0	
Price (N.T.\$/ kg)	80	---	Organic leafy vegetable purchase by Ilan school was 80 N.T.\$/ kg in 2016
Profit (N.T.\$ 1,000/ha)	1444.0	0	
Total Cost (N.T.\$ 1,000/ ha)	179	69	
Organic fertilizer	25	25	Fertilizer : 450 N.T.\$/ 20 kg
Pest control	9	9	Camellia meal: 450 N.T.\$/ 20 kg
Labor			
Nursery of water bamboo	15	15	Wage: 1500 N.T.\$/ day
Harvest of water bamboo	20	20	
Nursery and cottage of water spinach	20	0	
Harvest of water spinach	90	0	
Net profit (N.T.\$ 1,000/ ha)	1633.0	266.0	

主要參考文獻

1. 范美玲 2016 台灣東部水稻田無脊椎動物多樣性與指標物種研究 國立東華大學自然資源與環境學系博士論文

2. Flint M. L. and P. A. Robert. 1988. using crop diversity to manage pest problem: some California example. *Am. J. Alternative Agric.* 3:163-167.
3. Liang K., T. Yang, S. Zhang, J-E Zhang, M. Luo, L. Fu, B. Zhao. 2016. Effect of intercropping rice and water spinach on net yields and pest control: an experiment in southern China. *Intl. J. Agric. Sust.* 14:448-465.
4. McLaughlin A., and P. Mineau. 1995. The Impact of agricultural practices on biodiversity. *Agric. Ecosyst. Environ.*
5. Schultz H. B., A. B. Carlton, and F. Lory. 1963. Interplanting methods for wind erosion protection in San Joaquin asparagus. *Calif. Agric.* 17:4-5.

Effects of Intercropping with *Ipomoea aquatica* on Crop Production and Biotic Component of Arthropods in Organic *Zizania latifolia* Field

Wen-Hwa Lin¹, Guan-Hua Pung² and Chi-Cheng Chen³

¹Hualien District Agricultural Research and Extension Station, Assistant Researcher

²Hualien District Agricultural Research and Extension Station, Research Assistant

³Hualien District Agricultural Research and Extension Station, Researcher

Abstract

The effects of intercropping with water spinach (*Ipomoea aquatica*) on the yield and profit of crops and the biotic component of arthropods in water bamboo (*Zizania latifolia*) field were investigated in this study. There were 71 species of arthropods captured in intercropping field, which was 1.4 times higher than in non-intercropping field (51 species). The number of arthropods captured in intercropping field (1,588) was 1.3 times higher than in non-intercropping field (1,208). The number of nature enemies in intercropping field (248) was higher than in non-intercropping field (109). The yield of water bamboo was 1,472 kg/ha in intercropping field, which were slightly higher than in non-intercropping field (1,340kg/ha). The yield of water spinach was 18,050.1 kg/ha, which could increase the yield and profit of crops in intercropped field. The results indicated that intercropping with water spinach increased arthropods numbers and species in water bamboo field, and it had positive effects on the production and profit of crops.

Keywords: biotic component, water bamboo, water spinach, ecological function group, arthropod, paddy field