生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	信息素將線蟲變成殺蟲機器 (Pheromones Turn Nematodes Into Pest-killing Machines)
生物系統 LIVING SYSTEM	線蟲 (Nematodes)
功能類別 FUNCTIONS	#生物性控制族群、蟲害、病害 #Biological control of populations, pests, diseases #保護免受生物威脅 #Protect from living threats
作用機制標題	線蟲應用信息素，將它們變成最終的天然殺蟲劑，大大增加對昆蟲的破壞。 Applying pheromones to nematodes turns them into the ultimate natural pesticide, drastically increasing destruction of insects.
生物系統/作用機制示意圖 (確認版權、註明出處；畫質)	 

作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)

介紹

蛔蟲會讓你神經質嗎？如果是這樣，那是可以理解的。它們沒有眼睛，令人不安地蠕動，許多最著名的物種都是寄生蟲。不過，有充分的理由來檢查這種對蠕動生物的態度。

策略

一些線蟲物種已經演化到以攻擊人類認為是"害蟲"的昆蟲（象鼻蟲、蛀蟲、甲蟲和飛蛾，僅舉幾例），因為它們會破壞我們的莊稼。農民已開始將它們用作天然殺蟲劑——一種更環保的化學品替代品。

現在的研究顯示稱為蛔苷 (*ascarosides*) 的信息素在觸發其生命週期的關鍵擴散階段中發揮著關鍵作用，當被稱為"感染幼蟲"（infective juveniles, IJs）的年輕線蟲會在土壤中不斷搜索，直到遇到它們可以感染的昆蟲。

當科學家將蛔苷應用於 IJ 時，更多的年輕線蟲開始向目標宿主移動，更成功地入侵宿主，並更成功地殺死宿主。

一旦進入，IJs 就會釋放殺死宿主的細菌。然後，當它們長大成人並繁殖時，它們會以身體為食——有時會持續多代。最後，當宿主的每一根可食用碎片都被消耗完時，化學和環境因素的結合帶來了擴散階段，將 IJ 釋放到土壤中以尋找新的宿主並重新開始循環。

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潛力

科學家們認為，線蟲在被施用於農作物之前可能會接觸這些信息素，從而將害蟲殺滅效果提高 78%。Pheronym 公司已經在生產用於商業用途的線蟲信息素，有助於開展一條更環保的農業系統之路。

Introduction

Do roundworms make you squeamish? If so, it's understandable. They have no eyes, they wriggle unnervingly, and many of the best known species are parasites. There is good reason, though, to check this attitude toward the squirmy creatures.

The Strategy

A few nematode species have evolved to target insects (weevils, borers, beetles, and moths, just to name a few) that humans deem "pests" because they destroy our crops. Farmers have begun employing them as a natural pesticide—a more environmentally-friendly alternative to chemicals. Studies have now shown that pheromones called *ascarosides* play a key role in triggering the critical dispersal phase of their life cycles, when young nematodes known as "infective juveniles" (IJs) will search through soil until encountering an insect they can infect.

When scientists applied ascarosides to IJs, more of the young nematodes began moving toward their target host, more successfully invaded the host, and more successfully killed the host. Once inside, the IJs release bacteria that kill the host. They then feed on the body as they grow into adults and reproduce—sometimes for multiple generations. Finally, when every edible shred of the host has been consumed, a combination of chemical and environmental cues brings on the dispersal phase, releasing IJs into the soil to search for a new host and begin the cycle anew.
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The Potential

Scientists suggest that nematodes could be exposed to these pheromones before being applied to crops for up to 78% more pest-killing efficacy. The company Pheronym is already producing nematode pheromones for commercial use, helping to pave the way toward a more eco-friendly agriculture system.

文獻引用 (REFERENCES)

我們發現與分別用受感染的屍體浸漬液和水、陽性和陰性對照處理的 IJ 相比，信息素提取物誘導更多的小捲蛾斯氏線蟲 (*Steinernema carpocapsae*) 和 *Steinernema feeliae* IJ 向底部的麵包蟲 (*Tenebrio molitor*) 的幼蟲 (larvae) 移動。此外信息素提取物處理的 *S. carpocapsae* IJs 入侵麵包蟲幼蟲的數量高於對照。用信息素提取物和浸漬（陽性對照）預處理的 *S. feeliae*IJs 感染麵包蟲的速度相同，但入侵優於用水處理的 IJs。與土柱試驗一致，在溫室試驗中，與用水處理的 IJ 相比，用信息素提取物處理的 *S. carpocapsae* 和 *S. feeliae* IJ 在殺死兩種經濟上重要的昆蟲幼蟲山核桃象鼻蟲 (*Curculio caryae*) 和黑水虻 (*Hermetia illucens*) 的幼蟲方面表現更好。我們展示了信息素介導的生物控製劑行為操縱，以增強害蟲控制潛力。可以想像，可以在田野應用之前，先將線蟲暴露於有增強功效的信息素中。

We found that pheromone extracts induced higher numbers of Steinernema carpocapsaeand Steinernema feltiaeIJs to move towards T. molitorlarvae in the bottom of the column compared to IJs treated with infected cadaver macerate and water, positive and negative controls, respectively. Furthermore, the number of S. carpocapsaeIJs that invaded T. molitorlarvae was higher for the pheromone extract treatment than the controls. S. feltiaeIJs that were pretreated with pheromone extracts and macerate (positive control) infected T. molitorat the same rate but invasion was superior to IJs that were treated with water. Consistent with the soil column tests, both S. carpocapsaeand S. feltiaeIJs treated with pheromone extracts performed better in killing larvae of two economically important insect larvae, pecan weevil, Curculio caryae, and black soldier fly, Hermetia illucens, in greenhouse tests compared to IJs treated with water. We demonstrated pheromone-mediated behavioral manipulation of a biological control agent to enhance pest control potential. Conceivably, nematodes can be exposed to efficacy-enhancing pheromones prior to field application.

參考文獻清單與連結 (REFERENCE LIST) **Harvard 或 APA 格式**

https://zh.wikipedia.org/wiki/%E7%BA%BF%E8%99%AB%E5%8A%A8%E7%89%A9%E9%97%A8

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***自然*| Borgonie, G, García-Moyano A, Litthauer D, Bert W, Bester A, van Heerden E, Möller C, Erasmus M, 和 Onstott TC**

生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

https://asknature.org/innovation/natural-pest-control-inspired-by-nematode communication/

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AskNature 原文連結

https://asknature.org/strategy/pheromones-turn-nematodes-into-pest-killing-machines/

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