Pheromones use in smart-autoinoculation systems using insects as vectors of plant pathogens in weed biocontrol

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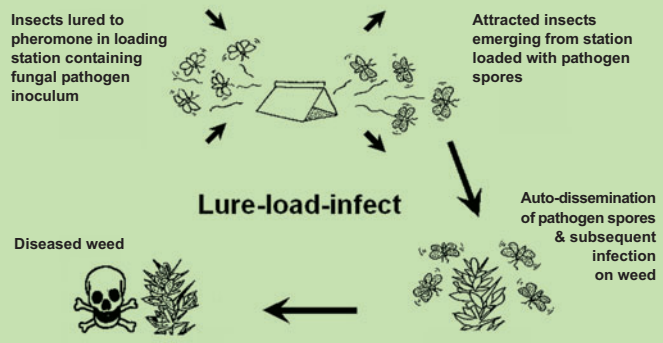
Introduction

- New Zealand currently has over important 250 weed species
- Gorse *(Ulex europaeus)*, broom *(Cytisus scoparius)* and thistle *(Cirsium spp.)*
- Ecologically sound weed management technologies such as biological control are being developed to achieve sustainability
- Weed biocontrol is traditionally centred on the use of insects and microbial pathogens
- Potential to combine the use of insects and fungal pathogens to achieve a synergistic effect in further improving control



Insect attractants and pheromones

- Insect attractants are an important tool in New Zealand for maintaining biosecurity to protect against pest incursions
- Insect pheromones have also been developed and successfully used in a number of New Zealand horticultural crops for monitoring or direct control strategies
- Synthetic pheromones have been used in NZ for delimiting the Asian gypsy moth *(Lymantria dispar)*, the fall webworm *(Hyphantria cunea)*, the guava moth *(Coscinoptycha improbana)* and the gum leaf skeletoniser *(Uraba lugens)*
- Sex attractants have now begun to demonstrate value for monitoring and detection of weed biocontrol agents' establishment - gorse pod moth[1] *(Cydia succedana)* and gorse soft shoot moth[2] *(Agonopterix ulicetella)*

Insects as vectors of plant pathogens

- Insects are known to transmit and establish plant infections by many fungi
- Insect-fungal pathogen-weed tripartite interactions are currently being investigated
- Several insect-fungal pathogen synergisms have been identified

Weed biocontrol insects with known attractants and pheromones present in New Zealand

Target Weed	Insect
1. Gorse *(Ulex europaeus)*	Gorse pod moth *(Cydia succedana)* Gorse soft shoot moth *(Agonopterix ulicetella)* Light brown apple moth *(Epiphyas postvittana)*
2. Californian thistle *(Cirsium arvense)*	Californian thistle gall fly *(Urophora cardui)*
3. Scotch thistle *(C. vulgare)*	Scotch thistle gall fly *(Urophora stylata)*
4. Nodding thistle *(Carduus nutans)*	Nodding thistle gall fly *(Urophora solstitialis*)* *Pheromone known to exist for *U. cardui & U. stylata*
5. Broom *(Cytisus scoparius)*	Broom twig miner *(Leucoptera spartifolliella*)* *Pheromones known to exist for two congenerics- *L. malifoliella and L. scitella*
6. Ragwort *(Senecio jacobaea)*	Cinnabar moth *(Tyria jacobaeae)*
7. Hemlock *(Conium maculatum)*	Hemlock moth *(Agonopterix alstromeriana)*
8. Hawkweed *(Hieracium spp.)*	Hieracium plume moth *(Oxyptilus pilosellae*)* *Attractants known to exist for one congeneric, O. *tristis*

Can a system be developed using insects as deliberate vectors of fungal pathogen for weed control?

Smart-autoinoculation systems

- Insects to be used as deliberate vectors of plant pathogens, development of components of a model system including choice of target, vector and pathogen
- Attractant-based systems to bring insects to the pathogen inoculum thereafter infecting the susceptible weed hosts **("lure-load-infect")**
- Several introduced weed biocontrol insects with known attractants and pheromones are now already present in New Zealand
- Compilation of world database containing known insect attractants and pheromones, including insects as weed biocontrol agents[3]
- Potential fungal pathogens - *Fusarium, Chodrostereum and Sclerotinia* to infect weeds like gorse, broom and thistle
- Pathogen vectoring capability of insect

Conclusions

- Potential value from identifying positive insect-weed fungal pathogen interactions and incorporating insect attractants for weed biocontrol
- Success in novel "lure-load-infect" strategy requires thorough evaluation of interactions between each tripartite component including risk of non-target impacts and practical functionality

Acknowledgements

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References

1. SUCKLING, D.M., HILL, R., GOURLAY, H., and WITZGALL, P. 1999. Sex attractant-based monitoring of a biological control agent of gorse. *Biocontrol Sci. Technol.* 9:99-104.
2. SUCKLING, D.M., GIBB, A.R., GOURLAY, H., CONANT, P., HIRAYAMA, C., LEEN, R., and SZÖCS, G. 2000. Sex attractant for the gorse biocontrol agent *Agonopterix ulicetella* (Oecophoridae). *New Zealand Plant Prot.* 53:66-70.
3. EL-SAYED, A.M. 2004. The Pherobase: A database of insect pheromones and semiochemicals. <http://www.pherobase.com/>

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