Investigating potential transfer of endophyte-grass toxins to horticultural crops

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Introduction

- Associations between Pooideae grasses and *Epichloë* fungal endophytes are utilised in agriculture and recreation areas for the benefits the associations provide in pasture persistence and performance.
- This includes the wild-life deterrent grass-endophyte product Avanex® Unique Endophyte Technology[1] which is used in amenity areas, sports grounds and airports for the deterrent effects the endophyte alkaloids have on insect, bird and small mammalian pests.
- Mammalian toxins produced by grass-endophyte associations have been detected in soil supporting tall fescue pastures[2] with suggestions that these compounds could remain within the soil matrix for an extended time.
- As changes in land use can occur, there is the potential for arable and horticultural crops to be grown in soil previously supporting grass-endophyte associations, thereby potentially absorbing endophyte alkaloids. Therefore, it is necessary to undertake scientific evaluations to provide assurances that soil is 'safe', especially if the subsequent crop is for animal or human consumption.

Aim

■ To investigate whether food crops could absorb endophyte alkaloids from soil that had been exposed to Avanex® Unique Endophyte Technology.

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Avanex® Unique Endophyte Technology is a registered trademark of PGG Wrightson Seeds Limited.

References

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Methods

Soil

■ Soil samples were taken from under two established areas growing either

tall fescue (*Lolium arundinacea*) cv 'Jackal' with *Epichloë coenophiala* strain AR601 (**TF E+**)

or

perennial ryegrass (*Lolium perenne*) cv. 'Colosseum' with *Epichloë festucae* var. *lolii* strain AR95 (**PRG E+**).

■ The three control soil samples:

tall fescue with no endophyte (**TF E-**)

perennial ryegrass with no endophyte (**PRG E-**)

bare soil where no plants were grown for three years.

Alkaloid analyses

■ Plant material was analysed by HPLC and GC-FID for lolitrem B, ergovaline, peramine and total lolines using published protocols[3, 4].

■ Initial analyses were conducted on bulks of replicates from individual treatments, with some experiments selected for analysis of individual replicates.

Plants

■ Barley, carrot, lettuce, and silverbeet were raised from seed and grown in a glasshouse in pots containing soils as detailed.

■ Seed potatoes were planted into large gauze-bottomed pots containing soil of the corresponding treatments, and placed outside on a sand pad.

■ All plants received water and nutrients as required until the plants reached maturity, at which time the plants were harvested and the plant tissue of interest analysed for endophyte alkaloids.

■ Haricot beans were harvested from a crop grown at Lincoln on an area that had grown Jackal AR601 for the preceeding three years.

Common name	Species	Plant tissue analysed	Plants raised in	Replication
Lettuce	*Lactuca sativa*	Leaf	Pots	n = 10
Potato	*Solanum tuberosum*	Tuber	Pots	n = 10
Carrot	*Daucus carota* subsp. *sativus*	Taproot	Pots	n = 10
Silverbeet	*Beta vulgaris* subsp. *cicla*	Leaf	Pots	n = 10
Barley	*Hordeum vulgare*	Grain	Pots	n = 10
Haricot bean	*Phaseolus vulgaris*	Bean	Field	n = 6

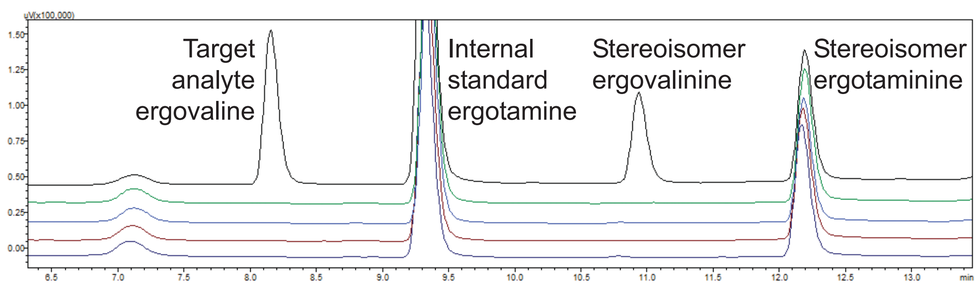
Experimental setup for potatoes

Results

■ There was no evidence for the presence of lolitrem B, ergovaline, peramine or the lolines in crops grown in soil that had previously supported endophyte-infected pasture.

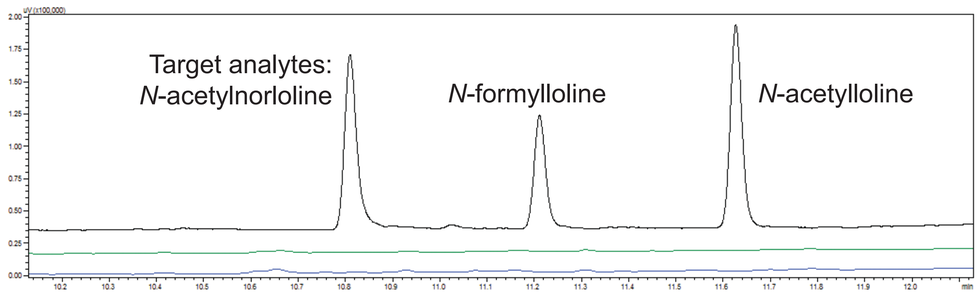
Ergovaline chromatograms

Ergovaline HPLC chromatogram of silverbeet leaves grown in
Jackal AR601 soil (green),
tall fescue E- soil (blue),
Colosseum AR95 soil (brown),
Colosseum E- soil (dark blue).
Reference standard (black).



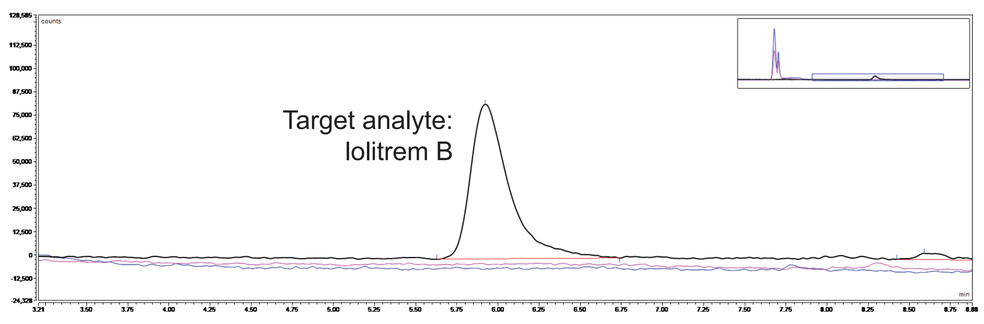
Lolines chromatograms

Lolines GC-FID chromatogram of carrot grown in
Jackal AR601 soil (green),
endophyte free soil (blue).
Reference standard (black).



Lolitrem B chromatograms

Lolitrem B HPLC chromatogram of barley grown in
Colosseum soil (blue),
nil soil (pink).
Reference standard (black).



Discussion

■ There is no evidence to support the contamination of crops with ergovaline, lolitrem B, lolines, or peramine from soils that have grown endophyte-infected pasture. This indicates that the rotation between pasture seed production and cropping will not lead to endophyte alkaloids getting into the animal or human food chains.

■ It should also be noted that no attempt was made to determine the levels of endophyte alkaloids present in the soils. This work was undertaken to establish whether crops grown on soil previously used to grow endophyte-infected pasture grasses had detectable levels of endophyte alkaloids and toxins.

■ There are three possible explanations for the absence of detection of endophyte toxins in the crops; absence of endophyte alkaloids in the soil matrices, inability of the crop plants to effectively absorb detectable quantities of the endophyte alkaloids, modification/degradation of the alkaloids once absorbed by the crop plants.

Future work should establish the level and range of endophyte alkaloids in soil through a survey across a range of locations under a range of land uses.