

***Festulolium–Epichloë* symbiosis: suppressing stubby root nematodes and delivering nematotoxic plant metabolites**

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This study investigated the potential of utilising cool season grasses naturally associated with *Epichloë* endophytic fungi for the management of plant-parasitic stubby root nematodes (*Trichodorus* spp. and *Paratrichodorus* spp.). Stubby root nematodes are economically important in East England where they cause docking disorder in sugar beet which causes up to 50% root yield reduction. The lack of chemical nematicides for the management of stubby root nematodes due to environmental concerns warrants the development of more eco-friendly measures. *Epichloë* fungal endophytes are known to confer protection from herbivory to their cool-season grass hosts, via the production of alkaloidal compounds. Several *Epichloë* species are known to produce loline alkaloids, a group of compounds known for their insecticidal and insect-deterrent properties. Lolines have also been reported to inhibit nematode mobility, egg hatching and mortality. In this study, *Festulolium loliaceum* and its associated endophyte *Epichloë uncinata*, known for its production of loline alkaloids, were investigated for their efficacy in suppressing stubby root nematodes. In a field experiment in Docking, Norfolk, England, endophyte-infected grasses significantly reduced the reproduction of stubby root nematodes by seven times compared to endophyte-free grass associations. Laboratory experiments using extracts from shoots and roots of *F.*

loliaceum plants showed that both endophyte-infected and endophyte-free plants could immobilise nematodes. Age, source of extract and extract concentration had a significant effect on the nematocidal activity. Extracts from younger grasses were more potent compared to older grasses, where shoot extracts from 8-week-old endophyte-infected grass plants had six times lower LD50 values compared to 20-week-old grass plants. A contrasting effect was found for grass root extracts where roots from older plants were more potent than extracts from roots from younger plants, and had lower potency compared to shoot extracts. Further laboratory experiments showed that artificial wounding of endophyte-infected *F. loliaceum* plants elevated the loline alkaloids in the regrowth tissue within the first 11 days. Nematicidal activity of extracts from this regrowth tissue was significantly greater as compared to extracts from unwounded grass tissue. Overall, the results from this study suggest that endophyte-infected grasses could serve as a potential cultural management strategy for stubby root nematodes in a sugar beet crop rotation system. It is also evident that stubby root nematodes are sensitive to loline alkaloids produced from the grass-endophyte symbiosis used in this study, and this system could be optimised in the future to support nematode suppression under field conditions.