New Project Summary Report for CP 115: Enhancing the soil food web to control soil dwelling pests of field vegetables (Teagasc Walsh Fellowship)

Project Number	31101150
Title	Enhancing the soil food web to control soil dwelling pests of field vegetables (Teagasc Walsh Fellowship)
Short Title	CP 115
Lead Contractor	Scottish Rural University College
Other Contractors	TEAGASC
Start & End Dates	01 October 2013 - 30 September 2016
Project Budget	£67,650
AHDB Contribution	£0 (in-kind support only)

The Problem

Management practices to increase soil organic matter (OM) levels are widely recognised as improving soil structure – leading to enhanced soil water regulation and ease of tillage (Grosbellet et al., 2011). Other advantages relating to enhanced pest management as a result of the increased complexity of the biological soil food web are becoming evident. The food web is essentially the inter-connectedness of organisms from different tropic groups (i.e. de Ruiter et al., 1993) and soils with long and complex food webs, with more trophic links and more abundant predatory fauna, effectively suppress plant pathogenic organisms (Sanchez-Moreno and Ferris., 2007; Djigal et al., 2012; Ferris et al., 2012). The advantages of increased soil biological complexity for general ecosystem function are well documented (Loreau et al., 2002) but more specific studies are now showing that increased trophic diversity in the soil can help protect against foliar pests (Huang et al., 2012). In this project we hypothesise that an enhanced soil food web can reduce the incidence of the root pests and diseases – which we will test with cabbage root fly (Delia radicum) (CabRF), carrot root fly (Chamaepsila rosae, CarRF) and club root (Plasmodiophora brassicae).

The control of CabRF is currently highly dependent on the routine use of pesticides. In 2003, for example, c. 9 tonnes of the organophosphorus pesticide chlorpyrifos were used for CabRF control on brassicas in the UK (DEFRA 2010) and so management strategies to reduce this usage would make commercial and environmental sense. In the soil, CabRF larvae are attracted to host roots by chemical clues (Ross and Anderson, 1992) and they are also susceptible to natural enemies such as beetle larvae and entomopathogenic fungi and nematodes. We hypothesise that if there is improved control of CabRF infection in soil with increased OM, then that will be due to the enhanced soil food web. Probably either because of more complex volatile organic chemical cues resulting from microbial activity (McNeal and Herbert, 2009) disrupting host finding or due to the enhancement of suppressive organisms in the food

web.

Aims and Objectives

1. Extensive literature review on soil factors affecting the target pest species.
2. Establishment of sub-plots with swede at the primary field site.
3. Quantify the soil food web and associated soil parameters in both sites over a two-year period.
4. Detailed laboratory studies of CabRF development in soils with different food web complexity, using soil from both field sites (with probable expansion to include CarRF and club root depending on student development).
5. Develop practical appraisal of integrated control measures.
6. Knowledge transfer to industry.

Approach

The soil food web represents the interactions between organisms of different feeding groups. Evidence suggests that soils with long and complex food webs, with more trophic links and more abundant predatory fauna, can effectively suppress plant pathogenic organisms. We propose to test this hypothesis for the damaging root pests Delia radicum (cabbage root fly, CabRF) at two, established field trials, with ancillary studies on carrot root fly (CarRF, Chamaepsila rosae) and club root disease (Plasmodiophora brassicae). The primary site is used for horticultural crops (carrot, onion, broccoli) and incorporates a fully factorial design of organic and conventional soil treatment with organic and conventional pest management. The secondary site has replicated plots of low and high input arable production. At both sites the soil food web will be quantified over an initial two year period and key soil parameters related to soil organic matter, nutrients and the microbial biomass also determined. The abundance of entomopathogenic fungi, nematodes and beetle larvae will be specifically monitored. The primary site will also be used for field evaluation of CabRF and CarRF abundance and damage. Detailed laboratory experiments will then determine the effects of soil food web complexity on CabRF and club root, growth and development in soils taken from both field sites. Further experimentation and sampling will be for the student to develop as part of their training. Communication of the results and implications to growers and the industry will be an important part of this project.