

Evaluation of module-sown companion plants as a method of controlling cabbage root fly

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Abstract – A novel technique for controlling cabbage root fly was tested. Companion plants of either birdsfoot trefoil (*Lotus corniculatus*), red clover (*Trifolium pratense*) or yellow trefoil (*Medicago lupulina*) were sown into modules together with calabrese (*Brassica oleracea* var *Italica*). The presence of companion plants subsequently reduced cabbage root fly egg-laying by up to 48% and reduced root damage considerably. Companion plant species did not affect egg-laying in this trial. Although, financially, this technique compares very favourably with an alternative strategy of applying fleece, further refinement is needed to improve the survival of companion plants on a commercial field scale as they were particularly vulnerable to damage by steerage hoes, which are used commonly in organic systems. ¹

INTRODUCTION

Cabbage root fly (*Delia radicum*) is a serious pest with the potential to cause widespread economic damage to brassica crops (Coaker and Finch, 1971). Currently, the only control method available to organic growers is to cover the crop with fleece to prevent female flies from laying eggs in the crop. This is not only expensive and time-consuming but frequently causes weed management problems. An alternative control method would be very useful to organic growers.

It is now well accepted that growing a crop with another species (undersowing, companion planting, inter-cropping) can decrease pest infestations significantly (O'Donnell and Coaker, 1975; Finch and Edmonds, 1993; Sengonca, Kranz et al. 2002). Finch and Collier (2000) proposed that this is because the presence of a non-host plant species reduces pest colonisation. Insect pests such as cabbage root fly seek out the host crop by making a series of 'appropriate / inappropriate landings'. After initially locating the crop, an insect lands on any green surface. If the insect recognises this as a host plant (an 'appropriate landing') it makes further short flights, landing on additional leaves to assess the overall suitability of the plant. It must make several consecutive 'appropriate landings' to be sufficiently stimulated to lay eggs. If it makes an 'inappropriate landing' on another plant species, such as a companion plant or weed, it must begin the searching process again and may fly away. Consistent with this, there

was a 36-82% reduction in egg-laying by the cabbage root fly when cauliflowers were planted amongst 24 other non-host plant species (Finch, et al., 2003).

However, strategies such as undersowing with clover can result in yield penalties of 30-40% (Finch and Edmonds, 1993) through plant competition. Therefore the alternative technique of sowing companion plants into the modules may ensure that the companion plant is in a location where it disrupts cabbage root fly egg-laying, whilst being at a low enough density to have little effect on yield. The biggest challenge is to identify species that are vigorous enough to deter egg-laying without competing against the crop. Three species of companion plant of differing vigour were evaluated in this study.

METHODS

Calabrese (cv Belstar) was sown into module trays on 4 April 2005. At the same time, two seeds of a single species of companion plant were sown into each module. Three different companion plant species were trialled: birdsfoot trefoil (*Lotus corniculatus*) (BFT), red clover (*Trifolium pratense*) (RC) and yellow trefoil (*Medicago lupulina*) (YT). Calabrese alone was included as a control treatment.

All four treatments were planted on 18 May, in a randomised block design with five replicates, at the field station at Ryton, near Coventry, UK. The trial comprised of twenty plots, each 6 m x 3.6 m (4 rows each of 12 plants). In addition, unreplicated blocks (400 plants) of each treatment were planted on commercial farms in three locations in the UK (Lincolnshire, Herefordshire and Devon).

To monitor egg-laying by the cabbage root fly, felt egg traps (Dixon et al. 2002), were placed around the base of two plant stems in each plot and covered with a thin layer of soil. These were examined twice-weekly and eggs were counted and discarded.

At harvest, ten plants per plot were dug up examined, and placed in one of four damage categories: no damage, slight damage (slight scarring of stem around roots), moderate damage (roots slightly stunted, plant pulls out easily), severe damage (plant stunted, very little root system left, plant very loose or fallen over).

RESULTS AND DISCUSSION

Egg-laying

Most eggs were laid between 14 – 21 July, consistent with peak egg-laying by second generation cabbage root fly in the region (R. Collier, unpublished data). All species of companion plant reduced

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the numbers of eggs laid on each sampling occasion. Overall, companion planting reduced the total numbers of eggs laid between 23 June – 11 August by up to 48% (Table 1). However, differences between companion plant species were not statistically significant.

Table 1. Total number of eggs laid per plant

Control	BFT	RC	YT	LSD (p=0.05)	F-prob
79	56	46	42	21.4	0.013

The reduction in egg laying was less than the maximum reduction of 82% observed by Finch *et al* (2003) when cauliflowers were planted with Fat hen (*Chenopodium album*) plants. However, the effectiveness of companion plants appears to depend on a number of physical characteristics including their height and the amount of additional green surfaces they provide compared to the brassica plant (Finch *et al.*, 2003).

Damage to roots

Root damage assessments showed that companion planting reduced the severity of cabbage root fly damage (χ^2 test, $p < 0.001$). This was consistent with results obtained from a similar trial conducted in 2004 (A. Rosenfeld, unpublished data).

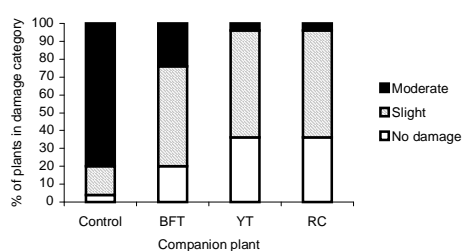


Figure 1 Proportion of plant roots damaged by cabbage root fly

Survival of companion plants

Survival of companion plants was assessed at Ryton and on the three commercial farms to test the applicability of the technique within a commercial system. At Ryton, the yellow trefoil showed the poorest survival rate, although these differences were not statistically significant, owing to a high degree of variability between replicate blocks (Table 2a).

Table 2. Survival of companion plants (%)

a) at Ryton

BFT	RC	YT	LSD (p=0.05)	F-prob
80	89	68	23.9	0.192

b) on commercial farms

Farm	BFT	YT	RC
Hereford	27	9	37
Lincs	41	0	5
Devon	0	0	0

Survival on the commercial farms was much lower than at Ryton with yellow trefoil also showing the lowest rate of survival (Table 2b). The key reason for poor survival was that the companion plants

were buried by soil that was dislodged by steerage hoes during mechanical weed operations. At Ryton, the crop was hand-weeded until the companion plants were large enough to withstand the steerage hoe, but this is not an economically viable option in a commercial crop. For this technique to be viable, the early vigour of the companion plants needs to be improved so that they are sufficiently robust to withstand mechanical weeding operations. This might be done by sowing more vigorous species of companion plant or improving their vigour through, for example, inoculating the companion plant with *Rhizobium* species (Roger White, personal communication).

Financial implications

Organic growers can use fleece as a control measure against cabbage root fly. A typical figure for applying fleece is £530 (€769) / ha including materials and labour. Plant raisers producing module sown companion plants have reported that the increased cost is 25p (€0.37) per tray of 1000 plants costing £8 (€11.76). Assuming a planting density of 35 000 plants / ha, this method of control costs £8.75 (€12.86)/ha, which is considerably cheaper than applying fleece.

CONCLUSIONS

This preliminary trial demonstrates that the technique of sowing companion plants into the modules containing brassica plants can reduce damage by cabbage root fly. It also avoids the problems of weed control normally associated with applying fleece and is considerably cheaper. However, further refinement is needed to improve the survival of the companion plants in a commercial field situation.

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