

Parasitism of raspberry beetle (*Byturus tomentosus* F.) larvae in different cropping techniques of red raspberry

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Abstract. Raspberry beetle (*Byturus tomentosus* F.) is the major pest in raspberry in Estonia and throughout Europe. The parasitism rate of raspberry beetle larvae was studied in different cropping systems and in wild raspberry. In the raspberry plantation two intercropping systems were used: intercropping with 7 herbs and with black currant. The control variant was monocropping. Larvae from wild raspberries were collected from a clear cut area in the neighbourhood of the plantation. In the monocropping area the larval parasitism rate was less than 5%. The intercropping of raspberries with herbs increased the larval parasitism rate (9.4%), while in the intercropping with black currant, it decreased (2.2%). Larvae from wild raspberry were the most parasitized (26.1%). Further investigation is needed to explain species composition of parasitoids in raspberry beetle larvae.

Key words: *Byturus tomentosus*, parasitoids, intercropping

INTRODUCTION

Raspberry beetle (*Byturus tomentosus* F.) is widely spread and major pest of cultivated raspberry throughout Europe (Gordon et al., 1997). Without special treatments, the yield loss may extend to 50% (Tuovinen, 1997). The beetles overwinter in the soil at the base of host plants and emerge in spring, usually before flower buds of raspberry have opened. On emerging from the soil young adult beetles frequently remain on the young foliage. They may feed extensively on the leaves of the growing tips resulting in extensive inter-veinal damage to the leaves. Later on, during flowering, the adults eat large holes in flower buds and pollen. Each adult female raspberry beetle can lay up to 120 eggs, usually as a single egg per flower. The most crucial damage is caused by larvae, which first gnaw the base of the receptacle and then dig galleries on the developing fruit. The result is discoloured or contaminated ripe fruit leading to rejection or down-grading of the crop. Due to their hidden lifestyle, the raspberry beetle larvae are safe from predatory and parasitoid arthropods. In some stadia, the larvae are directly threatened by natural enemies.

Little is known about the parasitoids of raspberry pests. The research in Italy has focused on the natural enemies of strawberry blossom weevil (*Anthonomus rubi* Herbst.) in raspberry and bramble where the most efficient parasitoid was the

Braconid, *Triapsis aciculatus* Ratz., causing up to 68.8% parasitism. Another Braconid, *Bracon immutator* Nees, was less effective and the Pteromalid, *Spilomalus Quadrinota* Walk. also emerged from infested strawberry blossom weevil larvae (Scanabissi & Arzone, 1992). Several species of Hymenopteran parasitoid have been isolated from galled canes (caused by *Lasioptera rubi* Heeger) in Italy but the role of these parasitic wasps in controlling *L. rubi* is unknown (Viggiani & Mazzone, 1978). Some *Apophua* species of ichneumonids attack strawberry leaf-rollers (*Ancyliis comtana* Froelich) while they are hidden inside their leaves (below) (Henderson & Raworth, 1991).

One of the factors which aggravates sustainability problems in agriculture is the use of monocultures, where every plant in a crop is genetically identical. Monocultures lead to vulnerability to stress, whether caused by pathogens, pests, or the weather, and hence to unstable yields. Intercropping with different cultures will provide a chance to reduce accumulation of pests and diseases, dispersing and disguising an odour of each other. On the other hand the intercropping with its diversity is attractive to beneficial organisms (Altieri & Nicholls, 2003). Intercropping has given good results in limiting a number of cabbage (Wiech, 1991) and carrot pests (Uvah & Coacer, 1984; Rämert, 1993). The aim of this work was to determine whether raspberry beetle larvae have parasitoids and whether raspberry growing in different intercropping systems might affect the extent of parasitism compared to wild raspberry.

MATERIALS AND METHODS

The raspberry plantation with different intercropping systems was established in spring 2002 in L. Hanni's organic berry production farm in Viljandi County.

The test variants were:

I – control, raspberry monoculture, 15 x 15 m.

II – raspberry rows alternately with rows of flowering plants, 15 x 10 m. (7 different herbs)

III – raspberry rows alternately with rows of black currant, 15 x 15 m.

IV – wild raspberry, from clear cut area in the neighbourhood of the plantation.

Two raspberry varieties were used in every variant ('Tomo' and 'Novokitaivska') with three replications. The test variants were separated with a vegetable field (width 25 m). The flowering plants were Calendula (*Calendula officinalis*), Fennel (*Foeniculum vulgare* L.), Dill (*Anethum graveolens* L.), Borage (*Borago officinalis*), Chamomile (*Matricaria chamomilla*), Tansy (*Tanaceum sect. Tanaceum*) and Yarrow (*Achillea millefolium*). Dill and Fennel are potentially suitable floral hosts for two eulophid parasitoids, *Edovum puttleri* Grissel and *Pediobius foveolatus* Crawford (Patt et al., 1997). The plantation is surrounded with a 10 m width of thick grass, which was regularly cut down. Nearby the plantation there is a forest with clear cut area, natural grassland and a little body of water. Thick grass, consisting mostly of Gramineae and clover, and including some weeds like quackgrass (*Elymus repens* L.) and dandelion (*Taraxacum officinale*) was growing between rows. No chemical treatments or mineral fertilisation were used on the plantation. Weeds were mechanically controlled two times in the vegetation period. In spring, decayed manure was spread on the raspberry rows, about 5 kg per rowmeter, and cut grass was used as a mulch.

To determine whether raspberry beetle larvae have parasitoids, and if raspberry growing in different intercropping systems and in the wild might affect the extent of pest parasitism, the raspberry beetle larvae were collected in 2005 during the ripening period of raspberry (July 11 – Aug. 17) in four different variants with three replications. The larvae were deep-frozen in distilled water. After thawing, the larvae were coloured and were dissected under a microscope at about 25 x magnification. The larvae of parasitoids appeared after the adipose tissue and haemolymph of pest larvae were coloured. The parasitism rate of raspberry beetle larvae was calculated and the results were elaborated; statistical analysis of variance and differences were compared using LSD test at $P = 0.05$.

RESULTS AND DISCUSSION

The total number of collected raspberry beetle larvae was 978: 243 larvae from raspberry monocropping variant, 440 larvae from intercropping variant with flowering plants, 180 larvae from intercropping variant with black currant and 115 larvae from wild raspberry.

Inside one parasitized raspberry beetle larvae 1–6 parasitoid larvae were found. Larvae from wild raspberry were the most parasitized (26.1%) (Fig. 1). In the intercropping conditions the most parasitized were larvae from the variant with flowering plants (9.4%). The intercropping of raspberries with herbs increased the larval parasitism rate; it decreased (2.2%) in the intercropping with black currant. In the monocropping (control) conditions the parasitism rate was 4.4%.

Raspberry growing in intercropping systems with herbs promoted the parasitism rate of the pest, and consequently also the presence of parasitoids. Wild flower strips have been sown as special field margins to promote beneficial insects, including pollinators, predators and parasitoids as well as soil organisms, all of which help by providing “ecological services” to crop plants. Intercropping with flowering herbaceous plants increases parasitoid survival, fecundity and retention and pest suppression in agro-ecosystems (Patt et al., 1997).

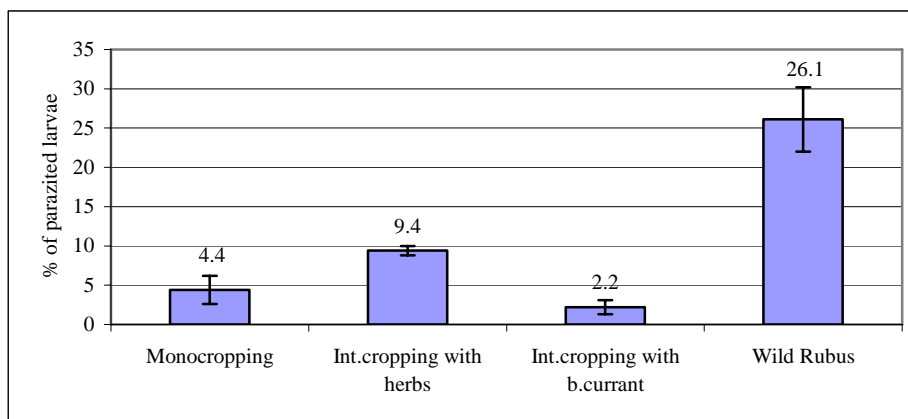


Fig 1. Parasitism rate of raspberry beetle larvae (%) in wild raspberry and its effect in different growing technologies ($LSD_{05} = 4.5$).

CONCLUSIONS

The results of present studies confirmed that raspberry beetle larvae have parasitoids. The parasitism rate was highest in wild raspberries, and higher in raspberries grown intercropping with flowering herbaceous plants than in monoculture or intercropping with black currants.

Control of raspberry beetle especially in organic fields will benefit from the maintenance of useful entomofauna. Further investigation is needed to explain species composition of parasitoids in raspberry beetle larvae.

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