*Agronomy Research* **4**(Special issue), 447–450, 2006

# The impact of field edges on the incidence of *Meligethes aeneus* Fab. larvae and their parasitisation in spring and winter oilseed rape

E. Veromann, A. Luik and R. Kevväi

Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, Kreutzwaldi St. 64, EE51014 Tartu, Estonia; e-mail: *eve.veromann@loodusfoto.ee*

**Abstract.** The occurrence of *Meligethes aeneus* larvae and their parasitism rate was studied at the edges and in the centres of commercial spring and winter oilseed rape fields in Estonia. Insecticides were used in spring oilseed rape but not in winter oilseed rape fields. Significantly more larvae were found at the field edges than in centres of both crops, but they were more abundant in winter oilseed rape. The larval parasitism rate was significantly greater at field edges than in centres only in winter rape; in spring oilseed rape parasitism was more evenly distributed. But there were no differences in pollen beetle parasitisation rates between crops.

**Key words:** spring and winter oilseed rape, *Meligethes aeneus*, larval parasitism

## INTRODUCTION

Oilseed rape (*Brassica napus* L.) is one of the most widely grown crops in Europe. In Estonia, the growing area has increased twenty times over the last decade, with 50,400 hectares grown in 2004 (Statistics Board, 2005). Oilseed rape is attacked by many different insect pests (Alford et al., 2003). The pollen beetle, *Meligethes aeneus* Fab. (Coleoptera, Nitidulidae) is the major pest throughout Europe in both winter and spring oilseed rape, but is usually more abundant in the spring crop (Alford et al., 2003). In Estonia, *M. aeneus* is the most numerous crucifer-specialist insect and the only one to reach pest status in the spring oilseed rape crop (Veromann, et el., 2006b). The management of oilseed rape pests relies on chemical pesticides, which also kill the pests' natural enemies. Routine application of pesticides may lead to development of resistance to pyrethroids in *M. aeneus* (Hansen, 2003). Parasitoids have great potential for controlling the abundance of pollen beetles in oilseed rape fields (Nilsson, 2003), but they are vulnerable to insecticides. Therefore it is important to find alternative strategies to decrease insecticide use and increase the impact of biological control agents. The importance of spatial distribution of pests is well known (Free & Williams, 1979; Ferguson et al., 2003a,b), but little work has been done in this field in Estonia. The aim of this pilot study was to compare the distribution of *M.aeneus* larvae and their parasitism at the edges and in the centres of commercial winter and spring oilseed rape fields.

## MATERIALS AND METHODS

The study compared the abundance of *M. aeneus* larvae and parasitized larvae in the field edges with those in field centres. Samples were taken from three commercially grown crops of winter (Tamme field 1 – 35 ha, Tamme field 2 – 35 ha, Luunja 40 ha) and three of spring oilseed rape (Nõo – 40 ha, Männiku – 60 ha, Tõrvandi – 65 ha) in Tartu County in 2005. No insecticide was applied to the winter crops, but it was used in spring oilseed rape (Fastac 0.2 l/ha at plants growth stage (BBCH) 62–63 (Meier, 2001)). Pest infestation was determined at the crop edges and the crop centres, in both locations, studying 25 randomly chosen plants (BBCH 66–67). All *M. aeneus* larvae were collected from oilseed rape flowers. For the estimation of parasitisation levels, second instar larvae of *M. aeneus* were dissected in the laboratory.

Statistical analysis was carried out using the SAS GENMOD procedure. Comparisons of the number of larvae and parasitized larvae at the edges and centres of fields were made by using generalized linear models, applying the Poisson distribution and the log link function. The scale parameter was estimated by Pearson's chi-square divided by the degrees of freedom if the model was overdispersed.

## RESULTS AND DISCUSSION

During the study, 3020 larvae of *M. aeneus* were collected. Infestation by pollen beetle larvae was greater in winter than in spring oilseed rape plants (respectively 2030 and 990 larvae) ($\chi^2 = 19.29$; $df = 1$; $P < 0.0001$). In Estonia, there is not yet a serious pest problem with winter oilseed rape (Veromann et al., 2006a), therefore farmers usually do not treat it with insecticides. The cold spring in 2005 delayed winter rape growth by about two weeks, thus pollen beetles could find belated buds suitable for laying eggs. Winter and spring oilseed rape plants have different architecture: winter rape plants are well branched, stronger and taller than spring rape plants. In addition, because of a longer vegetation period, they are better able to compensate for damage. Therefore, the greater number of *M. aeneus* larvae per plant in winter than in spring rape (mean numbers respectively, 13.53±20.29 and 6.6±9.21) does not correctly reflect the serious nature of injury. Williams and Free (1979) showed that attacks in early growth stages cause more damage than during later growth stages. From collected larvae, 1147 from winter and 565 from spring rape were second instar larvae and were dissected to search for endoparasitoids. In total, 116 parasitised larvae were found, 88 from winter and 28 from larvae collected from spring oilseed rape. But there were no differences in parasitisation rates between crops.

Free & Williams (1978) found that larvae of *M. aeneus* were quite evenly distributed over the crop but our study showed that larvae were more numerous at the edges than at the centres of all winter rape ($P < 0.0001$) and spring rape fields ($P = 0.05$) (Fig. 1). The mean number of collected *M. aeneus* larvae per winter oilseed rape plant at the edges was 17.72 (±11.72) and at the centres 2.53(±2.27); in spring oilseed rape, respectively 4.46(±3.75) and 3.26(±2.85). At the centres of fields, there was no difference in the number of larvae between crops ($\chi^2 = 2.78$; $df = 1$; $P = 0.096$) but there were significantly more larvae of *M. aeneus* per plant at the edges of the winter rape fields than at the edges of the spring rape fields ($\chi^2$ = 39.35; *df* = 1; *P* < 0.0001). Consequently, overall insecticide treatment in spring rape fields, applied just before or during the larval period, decreased the number of larvae at the edge and at the centre of the crop, either by killing them directly or by killing the mature adults. Similarly, there were significantly more parasitised larvae of *M. aeneus* per plant at the margins of oilseed rape fields than at the centres of the fields ($\chi^2$ = 10.10; *df* = 1; *P* < 0.0015), but in spring rape fields there was no difference between areas (Fig. 2). Thus, insecticide applied to spring crops killed parasitoids more evenly than their host, whereas there were differences between the edges and centres in the number of *M. aeneus* larvae.

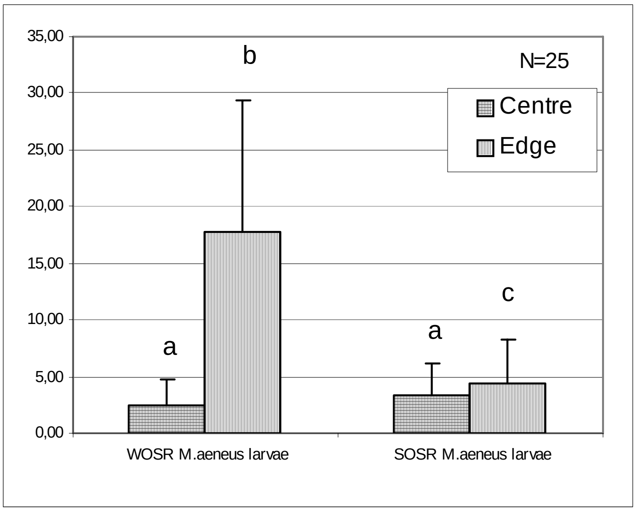


**Fig. 1.** Mean number of *M. aeneus* larvae per oilseed rape plant in spring (SOSR) and winter oilseed rape (WOSR) fields in Estonia, 2005 (letters indicate significant difference between areas and crops, whiskers: SE of means).

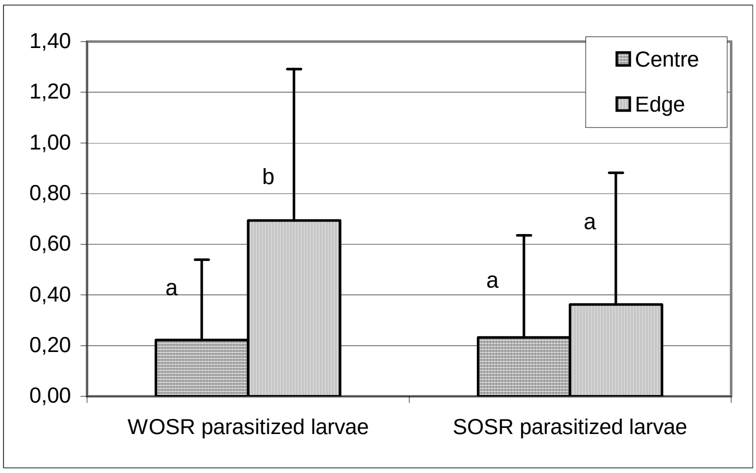


**Fig. 2.** Mean number of parasitized *M. aeneus* larvae per oilseed rape plant in spring (SOSR) and winter oilseed rape (WOSR) fields in Estonia, 2005 (letters indicate significant difference between areas and crops, whiskers: SE of means).

A better understanding of spatial distribution of pests and their parasitisation rates would help control the abundance of the pollen beetle population, with reduced insecticide use. Potentially, insecticides could be applied only in the field edges, reducing the amounts used and increasing the impact on beneficial insects (Ferguson et al., 2000).

## CONCLUSIONS

The greater number of *M. aeneus* larvae at the edges of crops suggests that insecticide treatment of crop borders alone may decrease pollen beetle population while maintaining parasitoids in field centres. In Estonia, there is still no need for insecticide treatment against *M.aeneus* in winter oilseed rape, because they are poorly synchronized with phenological development of the winter crop.

ACKNOWLEDGEMENTS. We thank Marge and Madis Ajaots, Pilsu Farm, for crop husbandry. This study was supported by the EU Framework 5 project MASTER: Integrated pest management strategies incorporating bio-control for European oilseed rape pests (QLK5-CT-2001-01447), Ministry of Agriculture of Estonia and Estonian Science Foundation grants Nr 5736 and 4993.

## REFERENCES

Alford, D. V., Nilsson, C. & Ulber, B. 2003. Insect pests of oilseed rape crops. In Alford, D.V. (ed.): *Biocontrol of Oilseed Rape Pests*. Blackwell Science. Oxford, UK, 355 pp.

Ferguson, A.W., Klukowski, Z., Walczak, B., Perry, J.N., Mugglestone, M.A., Clark, S.J. & Williams, I.H. 2000. The spatial-temporal distribution of adult *Ceutorhynchus assimilis* in a crop of winter oilseed rape in relation to the distribution of their larvae and that of the parasitoid *Trichomalus perfectus*. *Entomologia Experimentalis et Applicata* **95**, 161–171.

Ferguson, A.W., Campbell, J. M., Warner, D.J., Watts, N.P., Schmidt, J.E.U. & Williams, I.H. 2003a. Spatio-temporal distributions of *Meligethes aeneus* and its parasitoids in an oilseed rape crop and their significance for crop protection. *11$^{th}$ International Rapeseed Congress, 6-10 July 2003*, Copenhagen, Denmark, pp. 1057–1059.

Ferguson, A.W., Klukowski, Z., Walczak, B., Clark, S.J., Mugglestone, M.A., Perry, J.N. & Williams, I.H. 2003b. Spatial distribution of pest insects in oilseed rape: implications for integrated pest management. *Agriculture, Ecosystems and Environment* **95**, 509–521.

Free, J.B. & Williams, 1979. The distribution of insect pests on crops of oilseed rape (*Brassica napus* L.) and the damage they cause. *J. Agric. Sci. Camb*. **92**, 139–149.

Hansen, L.M. 2003. Insecticide-resistant pollen beetles (*Meligethes aeneus* F) found in Danish oilseed rape (*Brassica napus* L.) fields. *Pest Management Science* **59**(9), 1057–1059.

Meier, U. (ed.) 2001. Growth stages of mono- and dicotyledonous plants. 2$^{nd}$ ed. Updated 23 November 2005. Cited 12 April 2006.http://www.bba.de/veroeff/bbch/bbcheng.pdf

Nilsson, C. 2003. Parasitoids of Pollen Beetles. In Alford, D.V. (ed.): *Biocontrol of Oilseed Rape Pests*. Blackwell Science, Oxford, UK, pp. 73–85.

Statistics Board 2005: Cited 17 Apr. 2006. Updated 3 Apr. 2006. http://pub.stat.ee.

Veromann, E., Luik, A., Metspalu, L., & Williams, I. 2006a. Key pests and their parasitoids on spring and winter oilseed rape in Estonia. *Entomol. Fennica* **17** (in press).

Veromann, E., Tarang, T., Kevväi, R., Luik, A. & Williams, I.H. 2006b. Insect pest and their natural enemies on spring oilseed rape in Estonia: impact of cropping systems. *Agricultural and Food Sci.* **15**, 1–12.

Williams, I. H. & Free, J.B. 1979. Compensation of oilseed rape *Brassica napus* L. plants after damages to their buds and pods. *J. Agric. Sci. Camb*. **92**, 53–59.