Agronomy Research **7**(Special issue I), 451–456, 2009

Effect of cultivar on oviposition preference of the cabbage moth, *Mamestra brassicae* L. (Lepidoptera: Noctuidae)

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Abstract. The oviposition preference of the cabbage moth, *Mamestra brassicae* L. (Lepidoptera: Noctuidae) was investigated on white cabbage cultivars under field conditions in two vegetation periods. Significantly less eggs were laid on cultivar ‘Golden Acre’. There were no differences in the number of eggs found on the cultivar ‘Lennox’, ‘Krautman’, ‘Krautkaiser’ and ‘Turquoise’. The cultivar ‘Parel’ showed different results during experimental period. The data on cabbage moth oviposition preferences can be used in sustainable plant protection strategies in organic farming.

Key words: *Mamestra brassicae*, oviposition, white cabbage cultivars

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata*) is an important vegetable crop grown extensively in temperate regions throughout the world. One of the major limitations in cabbage production is damage due to insect pests. The most important among them is a highly polyphagous generalist cabbage moth, *Mamestra brassicae* L. (Lepidoptera: Noctuidae) (Popova, 1993). Bretherton et al. (1979) reported that *M. brassicae* is particularly associated with cruciferous crops. *M. brassicae* hibernates as diapausing pupa in soil. The adults emerge in June, and the eggs are deposited in clusters on the underside of the leaves. Larvae in the instars I–IV feed mainly freely exposed on the outermost leaves. From instar V the display a negative phototaxis (Omino et al., 1973), and move into the crown of the plant. When the larvae are fully grown in August and September, they enter the soil where they pupate in earth at a depth of 3–5 cm (Rygg & Kjos, 1975). One *M. brassicae* female is able to produce about 1000 eggs in the laboratory, giving a potential for a population increase of 300% in each generation. Fortunately, there is a high mortality in early immature stages (Johansen, 1997). The occurrence of cabbage moth in Estonia is variable. During the last years, the population levels in general have been low, but with sporadic, local outbreaks.

Commonly, in conventional farming, lepidopterous pests of cruciferous crops have been controlled by the use of insecticides. However, this is not the most desirable mean of control because cruciferous crops are used for human and animal consumption, which is why insecticides are prohibited in organic farming. Although cultural control could be effective in preventing or reducing the damage, losses caused by lepidopterous pests could be reduced by growing more resistant plants. Decreasing cultivars attractiveness to oviposition could be an important mechanism by which a plant can limit damage inflicted upon it by the cabbage moth. The first step is to identify resistant cultivars. Studies on *Pieris rapae* L. (Lepidoptera: Pieridae) performance showed differences in susceptibility among white cabbage (*B. oleracea* var. *capitata* f. *alba*) cultivars (Poelman et al., 2008). Based on these results: two cabbage cultivars were with relatively poor *P. rapae* performance ('Rivera' and 'Lennox') and two with relatively good performance of this herbivore ('Badger Shipper' and 'Christmas Drumhead') (Poelman et al., 2008).

It is generally known that various plant qualities influence host plant selection in herbivorous insects, but plant chemistry can be especially important. For example, secondary plant metabolites are used by several insects for recognition of their host plants (Chew, 1988; Städler, 1992). The typical mechanism of host location among butterflies is the use of plant odours for longer-range detection and evaluation of potential host plants, followed by contact chemoreception for selection of oviposition sites (Schoonhoven et al., 1998). In case of cabbage moths, it has been found that they mainly select oviposition site by odour cue, whereas the search process is, to some extent, influenced by visual cues (Rojas et al., 2000). Plant age also affects the feeding response of lepidopterous pests in *Brassica* crops because glucosinolates are more accumulated in young plants and the concentration declines with plant age (Dickson & Eckenrode, 1980; Hoy & Shelton, 1987; Velasco et al., 2007). Glucosinolates have been found to reduce the acceptance of brassicaceous plants by generalist butterflies (Mithen et al., 1995).

Female moths, having a large number of antennal sensilla for detection of plant odorants, use odour cues to locate the host plants. Once landed, the female cabbage moth, before laying clusters of 50–300 eggs under the leaves, drums on the plant with legs and also touches the plant surface with their antennae, proboscis and ovipositor (Rojas & Wyatt, 1999; Rojas et al., 2000).

A field study was conducted to determine if some cultivars of white cabbage were more attractive to oviposition than others.

MATERIALS AND METHODS

The experiment was conducted at the Estonian University of Life Sciences in Tartu, Estonia, in 2005 and 2008. Seeds of six cultivars of white cabbage, early cultivars 'Parel' and 'Golden Acre' ('Golden Acre' was tested only in 2008), mid-season cultivars 'Lennox' and 'Krautman', late cultivars 'Turquoise' and 'Krautkaiser', were assessed under field conditions in two vegetation periods. Cabbage plants were transplanted in tree replications, the size of the experimental plot was 2 x 2 m^2, and each plot had 9 plants. Cabbage moth eggs and caterpillars were counted and removed once a week from all plants in a plot to avoid repeated counting. Observations lasted from July to September in 2005 and 2008. According to the meteorological data of the weatherstation of the Institute of Environmental Physics of the University of Tartu, the mean temperatures in Tartu from June till September 2005 and 2008 were 15.3°C, 19.5°C, 16.7°C, 13.6°C and 15.1°C, 17.2°C, 16.1°C, 10.4°C, respectively.

Mean relative humidity in Tartu from June till September 2005 and 2008 were 74.0%, 73.1%, 83.5%, 85.5% and 61.7%, 69.1%, 77.8%, 86.0%, respectively. Data were presented as mean ± standard error. Statistical comparisons were performed with one-way ANOVA followed by Tukey test. All means were considered significantly different at the $P < 0.05$ level.

RESULTS AND DISCUSSION

In the oviposition choice test six cultivars were used to study cabbage moth–white cabbage cultivars interaction. Significant differences in the mean numbers of eggs and caterpillars were found between the cultivars in 2005 and 2008 ($P < 0.05$). 'Golden Acre' and 'Parel' had deterrent effect on cabbage moth oviposition. 'Golden Acre' was even less attractive to oviposition than 'Parel', though the difference between them was not reliable ($P > 0.05$). Early cultivar 'Golden Acre' differed significantly from mid-season and late cultivars ($F_{5,138} = 2.94$, $P < 0.05$) (Fig. 2). The cultivar 'Parel' showed different results during experimental years. There were statistical differences among 'Parel' and 'Turquoise' ($F_{4,10} = 1.37$, $P = 0.04$) in 2005 (Fig. 1), and between 'Parel' and 'Krautkaiser' ($F_{5,138} = 2.94$, $P = 0.02$) in 2008 (Fig. 2). The difference in the mean numbers of mid-season cultivars 'Lennox' and 'Krautman', and late cultivars 'Turquoise' and 'Krautkaiser', were not statistically reliable in both years ($P > 0.05$), but still the cultivar 'Lennox' was the least preferred choice among them (Figs 1–2). It was noticed that cultivar 'Lennox' leaves had thicker wax layer than other cultivars.

Knowledge on cabbage moth susceptibility of white cabbage cultivars will enable growers to employ the most appropriate control tactics for a particular cultivar. In current test we found that there was no varietal preference for oviposition by cabbage moths for tested mid-season and late cultivars. It implies that, from the perspective of susceptibility to oviposition, there is no clear advantage in choosing any one of these cultivars over another. It is possible, however, that some cultivars may be more resistant to larval attack than others, but this was not tested. Clear repellent effect to oviposition was found on cultivar 'Golden Acre', the early medium sized yellowish-green cabbage. Generally almost all phytophagous insects have demonstrated colour preference for green or shades thereof (Hern et al., 1996). Myers (1985) also found that *P. rapae* females laid more eggs on greener plants approached by them from a distance. Visual cues are often imprecise about plant species identity but contain strong directional information, whereas olfactory information may provide specific information about species identity, but more vague information about the distance from and direction to the odour source (Hambäck et al., 2008). Leaf morphology and leaf colour as well as certain phytochemicals as glucosinolates, flavonoids, plant volatiles, waxes, or a combination of these factors, can modify the feeding behaviour of larvae and oviposition of adult insects (Onyilagha et al., 2004). In brassicaceous plants, the secondary chemicals, glucosinolates (Fahey et al., 2001), and their breakdown products are well known to effectively decrease performance of generalist herbivores (Chew, 1988; Olsson & Jonasson, 1994; Traw & Dawson, 2002; Agrawal & Kurashige, 2003). Temperature and humidity conditions during cabbage moth flight in both experimental years were similar and did not cause differences in abundance.

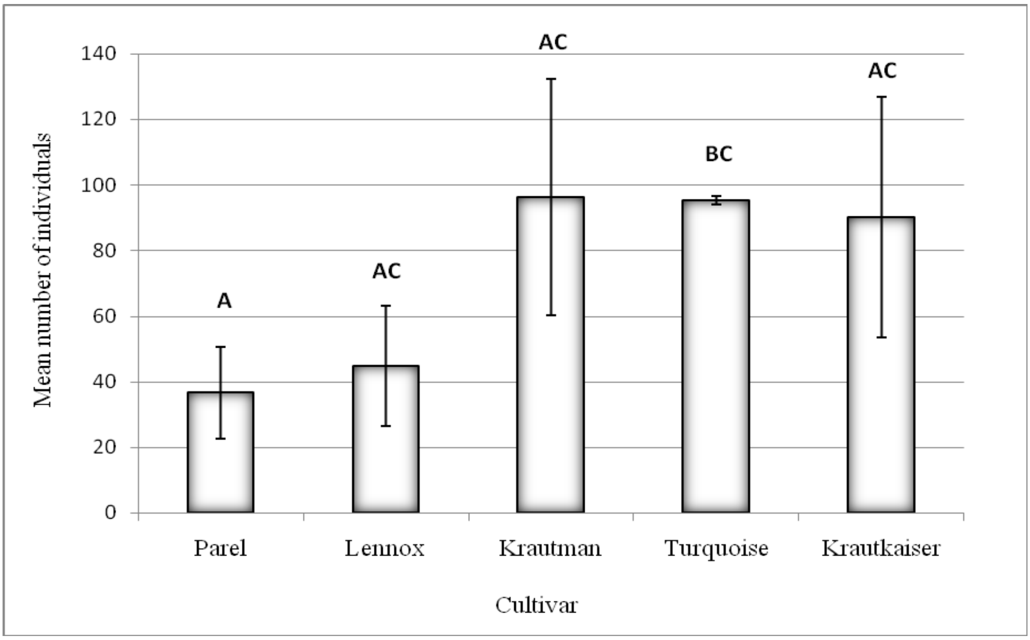

Fig. 1. Number of individuals of cabbage moth (*Mamestra brassicae* L.) on different cabbage cultivars in 2005 (mean ± SE). Means followed by the same letter are not significantly different ($P < 0.05$).

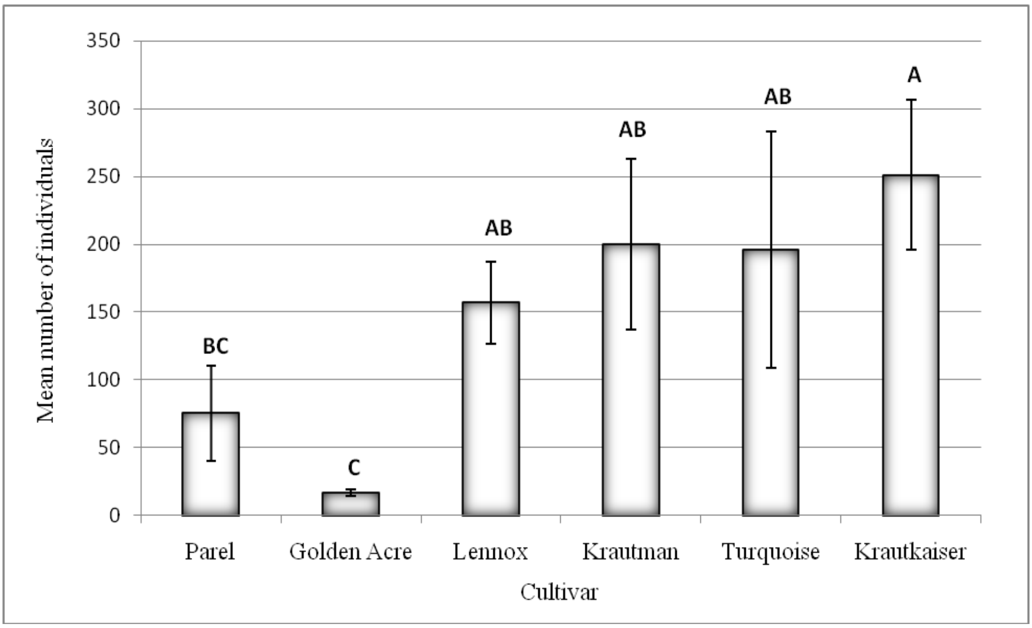

Fig. 2. Number of individuals of cabbage moth (*Mamestra brassicae* L.) on different cabbage cultivars in 2008 (mean ± SE). Means followed by the same letter are not significantly different ($P < 0.05$).

CONCLUSIONS

Cabbage moth was more attracted to mid-season and late white cabbage cultivars ‘Lennox’, ‘Krautman’, ‘Turquoise’ and ‘Krautkaiser’ than early cultivars ‘Golden Acre’ and ‘Parel’. Early cultivars ‘Golden Acre’ and ‘Parel’ had deterrent effect on cabbage moth oviposition. There were no statistically reliable differences between early cultivars. ‘Parel’ showed different results during experimental years. Statistical difference was found among ‘Parel’ and ‘Turquoise’, ‘Parel’ and ‘Krautkaiser’. Knowledge about cabbage moth cultivars oviposition preferences is valuable information for farmers in implementing sustainable plant protection strategies.

ACKNOWLEDGEMENTS. This research was supported by the Estonian Science Foundation (grants no 7130, 6722 and 6781), and Estonian Ministry of Education and Research targeted financing projects no. SF170057s09, SF0170014s08 and SF0170021s08.

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