Species of the Genus *Meligethes* Occurring in Oil-Seed Crop Fields in the Czech Republic

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Abstract

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Identification of *Meligethes* species and their frequencies in adult samples collected at different localities in Central and South Moravia (Czech Republic, 2009–2011) was based on comparisons of morphometric and colour characters and on differences in male and female genitalia. *M. aeneus*, *M. viridescens*, *M. subaeneus*, *M. atratus,* and *M. coracinus* were recorded throughout the observation period, while *M. nigrescens* was recorded just in 2009 and 2011, *M. carinulatus* and *M. maurus* in 2010 and 2011. *M. aeneus* was the most frequent species of all compared samples (2009–2011). Of the accompanying species, *M. subaeneus* and *M. viridescens* were markedly more frequent in this study. Considering high resistance of *M. aeneus* to esteric pyrethroids, it could be helpful to distinguish among the individual *Meligethes* species occurring in field samples intended for laboratory testing.

Keywords: index of dominance; *Meligethes aeneus*; *Meligethes* spp.; pollen beetle resistance

The pollen beetle (*Meligethes aeneus* Fabricius, 1787; Coleoptera: Nitidulidae) is one of the major pests in European oilseed rape known to be quite destructive once infestation thresholds are exceeded and no chemical control measures are taken (Williams 2004). In the Czech Republic *M. aeneus* causes significant losses in rapeseed crops every year and together with *Ceutorhynchus napi* Gyllenhal, 1837, *Ceutorhynchus pallidactylus* (Marsham, 1802), and *Dasineura brassicae* (Winertz, 1853) is usually controlled by insecticides (Kazda 2007). The importance of *M. aeneus* for oil seed rape in the Czech Republic is quite similar as it is in Germany (Glattkowski *et al*. 2008) and Poland (Wegorek & Zamojska 2008). Not only one but usually more species of the genus *Meligethes* have occurred in winter oilseed rape crops (Thieme *et al*. 2008). Agricultural practice does not distinguish among the individual species which are more or less abundant and often intermittently present in oilseed rape fields in Europe (Cook & Denholm 2008; Richardson 2008; Thieme *et al*. 2008; Tóth *et al*. 2011). With respect to practical control needs it is not necessary to distinguish one from the other. However, with respect to the confirmed resistance of pollen beetles to pyrethroids in Europe (IRAC 2008) it is important to know if the phenomenon concerns only *M. aeneus* or more *Meligethes* species are affected (Thieme *et al*. 2008; Tóth *et al*. 2011).

In many parts of Europe, *M. aeneus* has become resistant to pyrethroid insecticides. For example, in Germany in 2006, beetles that could not be controlled with pyrethroids destroyed 30 000 ha and seriously damaged 200 000 ha of winter oilseed rape. Such resistance is now well established over much of Central and Eastern Europe (IRAC 2008;

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Wegorek *et al*. 2009; Stará *et al*. 2010; Zimmer & Nauen 2011; Seidenglanz *et al*. 2012), as well as Scandinavia (Djurberg & Gustafsson 2007; Hansen 2008).

The occurrence of different species in both winter and spring oilseed rape is not new (Reitter 1871; Kauffmann 1925; Bollow 1950; Fritzsche 1955; Kirk-Spriggs 1996; Marczali & Keszthelyi 2003). From the genus *Meligethes, M. aeneus* is considered to be highly prevalent in European oilseed rape fields (Thieme *et al*. 2008; Tóth *et al*. 2011). The development of this species is closely related to oilseed rape even though its adults also feed on different plant species (Charpentier 1985). Thieme *et al*. (2008) have shown that also *M. viridescens* (Fabricius, 1787), *M. nigrescens* (Stephens, 1830), and *M. coracinus* (Sturm, 1845) accompany *M. aeneus* in oilseed rape crops in Germany and the UK. Billquist (2001) proved the dominance of *M. aeneus* in oilseed rape fields in Scandinavia. However, he also mentioned variable but not negligible frequencies of *M. viridescens* in *Meligethes* samples. In Hungary Marczali and Keszthelyi (2003) monitored *Meligethes* species in oilseed rape with similar results. In relation to pollen beetle resistance to pyrethroids Derron *et al* (2004) reported *M. viridescens* is not resistant and was present in variable frequencies depending on the time and place where the samples were collected.

The aim of the paper was to establish indices of dominance for individual *Meligethes* species occurring in winter oilseed rape crops in the Czech Republic. In comparison, the portions of *Meligethes* species were also expressed in several samples collected in two other oilseed crops which are relatively significant in Czech agriculture – white mustard (*Sinapis alba* L.) and poppy (*Papaver somniferum* L.).

MATERIAL AND METHODS

Samples of *Meligethes* adults from different localities in the Czech Republic were collected from commercial winter oilseed rape (*Brassica napus* L.) fields in 2009–2011. Sweep nets were used for collecting. Samples were taken from the field margins (min. 10 m from field edges; usually 4 different collecting places per field). For the transfer of adults into the transport boxes (aerated containers with several inflorescences as a food

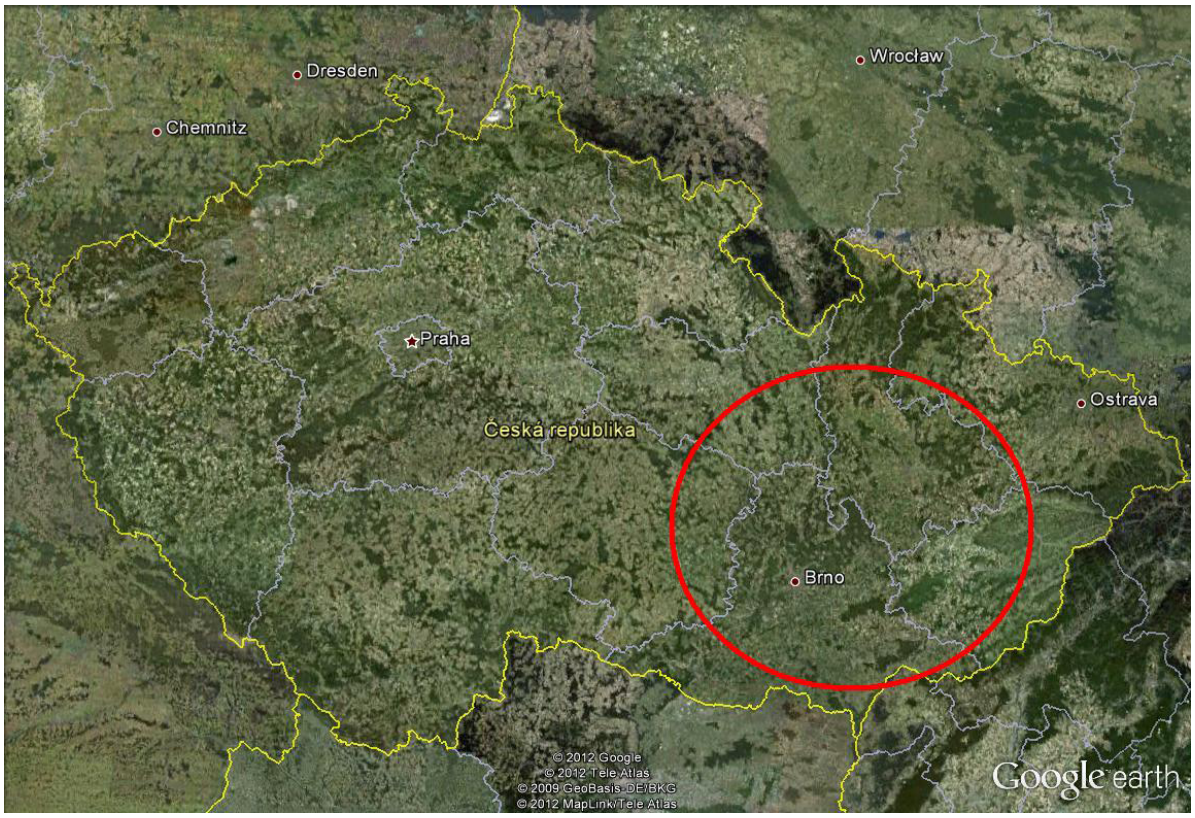

Figure 1. Sampling localities were situated in the region of Central and Southern Moravia in the Czech Republic (total acreage approximately 20 000 km^2)

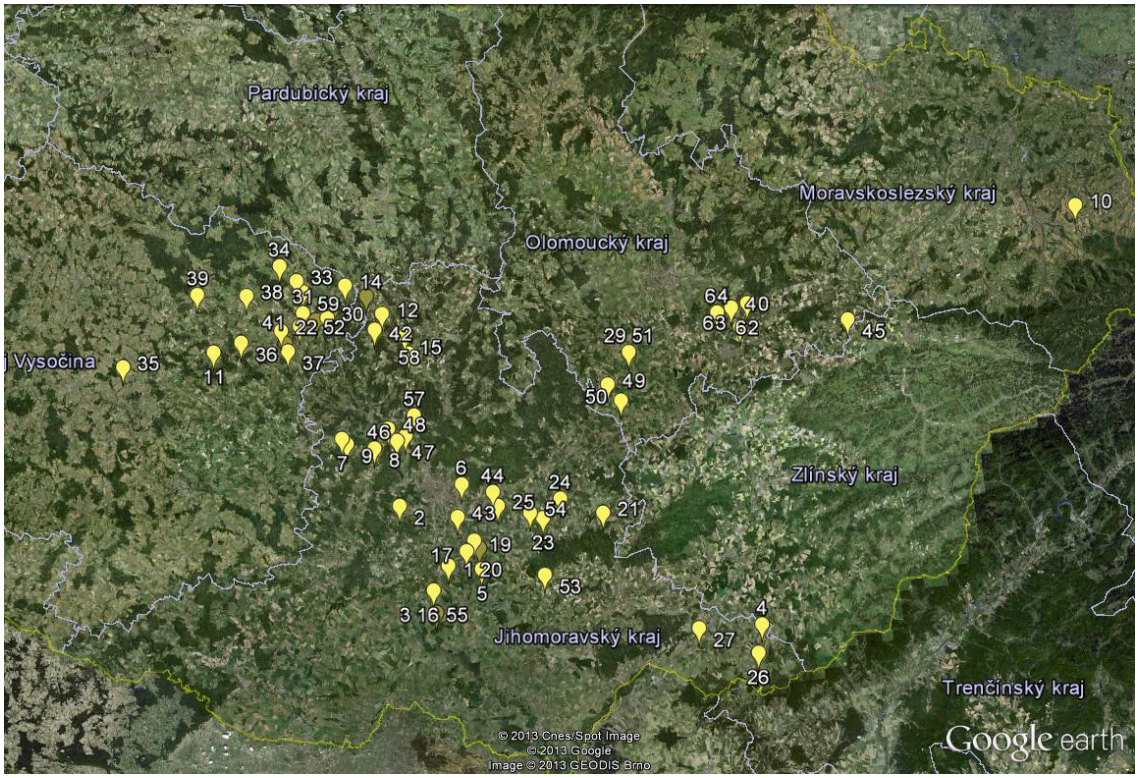

Figure 2. Locations of sampling places (2009–2011) (the locality numbers used on the map correspond with the numbers used in Tables 1–3 – column three)

source) an entomological suction pump (exhaustor) was used. The sampling period began when the green buds appeared on plants (BBCH 55) and finished at the end of flowering (BBCH 69; in some cases BBCH 69–73). The dates of sampling were different for the individual localities. Only one sample per locality was made each year. The sampling localities were mainly situated in the regions of Central and South Moravia (Figures 1 and 2). Minimal distance between adjacent localities was 3 km. In addition, in 2010 and 2011 several samples were also collected from poppy (*Papaver somniferum* L.) and white mustard (*Sinapis alba* L.) in the same region. The complete lists of the localities are given in Tables 1–3.

Approximately 1000 *Meligethes* adults were collected from each field. The adults were also used for testing for susceptibility to insecticides (IRAC 2008). In most cases 200 individuals of them were used for species identification.

Meligethes species were identified using published taxonomic keys (Nunberg 1976; Audisio *et al*. 2001, 2005; Marczali & Keszthelyi 2003). Identification was based on comparisons of morphometric and colour characters and on differences in male and female genitalia.

For each of the sampling places indices of dominance (Losos *et al*. 1985; Magan *et al*. 2003) for the individual *Meligethes* species were stated. The values of *D* (%) were calculated for each *Meligethes* species separately. For calculating *D* the following formula was used:

$$D = (n_i/n) \times 100 \qquad (\%)$$

where:

n – sum of all *Meligethes* individuals recorded in the sample

n_i – number of individuals of a certain *Meligethes* species in the sample

According to the calculated value, one of five dominance indices was assigned to every recorded *Meligethes* species in each sample (eudominant > 10.1%; dominant 5.1–10%, subdominant 2.1–5%, recedent 1.1–2%, and subrecedent < 1%).

RESULTS

M. aeneus, *M. viridescens* Fabricius, 1787, *M. subaeneus* (Sturm, 1845), *M. atratus* (Olivier, 1890), and *M. coracinus* Sturm, 1845 were recorded in each of the three years (2009–2011). In addition, *M. nigres-*

Table 1. Dominance indices stated for individual species of *Meligethes* genus recorded at various localities in the Czech Republic in 2009

Locality (district), date of sampling	Growth stage (BBCH)	Locality No.	Dominance index *D* (%)				
			D5 eudominant	D4 dominant	D3 subdominat	D2 recedent	D1 subrecedent
Blučina (BO) 20.4.2009	55	1	*M. aeneus* 84.2	*M. viridescens* 7.9 *M. coracinus* 7.2			*M. subaeneus* 0.7
Troubsko (BO) 20.4.2009	55-57	2	*M. aeneus* 79.7 *M. coracinus* 12.8	*M. viridescens* 7.5			
Žabčice (BO) 20.4.2009	55	3	*M. aeneus* 94.8		*M. viridescens* 2.2 *M. coracinus* 3.0		
Blatnička u Hodonína (HO) 22.4.2009	59	4	*M. aeneus* 88.2	*M. viridescens* 10.0		*M. coracinus* 1.8	
Moutnice (BO) 22.4.2009	60	5	*M. aeneus* 91.0	*M. viridescens* 6.5	*M. coracinus* 2.5		
Brno-Líšeň (BM) 27.4.2009	60	6	*M. aeneus* 89.2	*M. coracinus* 7.0	*M. viridescens* 3.2		*M. nigrescens* 0.0 *M. atratus* 0.6
Braniškov (BO) 10.5.2009	65	7	*M. aeneus* 88.1	*M. viridescens* 8.1	*M. coracinus* 2.4	*M. atratus* 1.4	
Veverská Bítýška (BO) 10.5.2009	63–65	8	*M. aeneus* 90.7		*M. viridescens* 4.8 *M. coracinus* 4.0		*M. atratus* 0.5
Maršov (BO) 10.5.2009	65	9	*M. aeneus* 71.0 *M. viridescens* 20.0	*M. coracinus* 9.0			
Horní Domaslavice (FM) 17.5.2009	65–67	10	*M. aeneus* 82.8 *M. coracinus* 10.9	*M. viridescens* 6.3			
Kněževes (ZR) 18.5.2009	67	11	*M. aeneus* 90.6	*M. viridescens* 6.4	*M. nigrescens* 2.1		*M. atratus* 0.6 *M. coracinus* 0.3
Rozseč nad Kunštátem (BK) 18.5.2009	65–67	12	*M. aeneus* 81.4 *M. viridescens* 12.1		*M. atratus* 3.6 *M. coracinus* 2.9		
Olešnice (BK) 18.5.2009	65	13	*M. aeneus* 87.8	*M. viridescens* 8.7	*M. coracinus* 3.4		
Rovečné (ZR) 18.5.2009	65–67	14	*M. aeneus* 88.9	*M. viridescens* 8.9	*M. coracinus* 2.1		
Zbraslavec (BK) 18.5.2009	67	15	*M. aeneus* 81.3 *M. viridescens* 15.6		*M. coracinus* 3.1		

BO – Brno-venkov; HO – Hodonín; BM – Brno-město; FM – Frídek-Místek; ZR – Žďár nad Sázavou; BK – Blansko

cens was recorded in 2009 and 2011, *M. carinulatus* (Förster, 1849) and *M. maurus* (Sturm, 1845) were recorded in 2010 and 2011. The dominance indices stated for particular *Meligethes* species present in individual samples from different localities are shown in Tables 1–3. There is a complete list of *Meligethes* species recorded in the three years in Table 4.

In 2009, *M. aeneus* was eudominant and clearly the most abundant in all samples (15 samples totally). *M. viridescens* was eudominant (together with *M. aeneus*) in 3 samples (Rozseč 18.5., Zbraslavec 18.5., Maršov 10.5.), dominant in 9 samples, and subdominant in 3 samples. *M. coracinus* was eudominant in 2 samples (Troubsko 20.4., H. Domaslavice 17.5.), dominant in 3 samples, and subdominant in 8 samples. *M. nigrescens* and *M. atratus* also appeared among the subdominant species (Table 1).

In 2010, *M. aeneus* was the most abundant and eudominant in all 27 samples compared. Its *D* values ranged from 70.4% to 96.9%. *M. subaenus* (Pivonice 1.6., Lazníky 13.7., Blučina 20.4., Žďár nad Sázavou 13.6., Zvole 24.5.), *M. viridescens* (Věcov 1.6.), and *M. carinulatus* (Bohdalec 13.6.) were eudominant together with *M. aeneus* in several

Table 2. Dominance indices stated for individual species of *Meligethes* genus recorded at various localities in the Czech Republic in 2010

Locality (district), date of sampling	Growth stage (BBCH)	Locality No.	Dominance index *D* (%)				
			D5 eudominant	D4 dominant	D3 subdominant	D2 recedent	D1 subrecedent
Žabčice (BO) 20.4.2010	57–59	16	*M. aeneus* 92.0	*M. subaeneus* 5.5		*M. viridescens* 1.3	*M. carinulatus* 0.5 *M. coracinus* 0.8
Měnín (BO) 20.4.2010	55	17	*M. aeneus* 91.6	*M. subaeneus* 6.5		*M. coracinus* 1.3	*M. viridescens* 0.4 *M. atratus* 0.2
Žatčany (BO) 20.4.2010	57–59	18	*M. aeneus* 90.1	*M. subaeneus* 5.6	*M. coracinus* 2.5	*M. maurus* 1.1	*M. viridescens* 0.4 *M. atratus* 0.4
Telnice (BO) 20.4.2010	60	19	*M. aeneus* 90.5	*M. subaeneus* 5.9		*M. viridescens* 1.1 *M. coracinus* 1.1 *M. maurus* 1.1	*M. atratus* 0.4
Blučina (BO) 20.4.2010	57–59	20	*M. aeneus* 87.5 *M. subaeneus* 10.6			*M. coracinus* 1.1	*M. maurus* 0.4 *M. carinulatus* 0.4
Nesovice (VY) 26.4.2010	61–63	21	*M. aeneus 95.5*		*M. subaeneus* 4.5		
Zvole (ZR) 24.4.2010	61	22	*M. aeneus* 80.4 *M. subaeneus* 10.8	*M. viridescens* 5.9	*M. coracinus* 2.4		*M. carinulatus* 0.3
Hodějice (VY) 26.4.2010	63	23	*M. aeneus* 92.1	*M. subaeneus* 7.1			*M. viridescens* 0.8
Letonice (VY) 26.4.2010	63	24	*M. aeneus* 95.1		*M. subaeneus* 3.8	*M. coracinus* 1.1	
Blažovice (BO) 26.4.2010	61–63	25	*M. aeneus* 93.8		*M. subaeneus* 3.2	*M. viridescens* 1.2 *M. carinulatus* 1.8	
Velká nad Veličkou (HO) 10.5.2010	65	26	*M. aeneus* 93.2	*M. subaeneus 6.8*			
Vnorovy (HO) 10.5.2010	65	27	*M. aeneus* 91.0	*M. subaeneus* 7.5			*M. viridescens* 0.7 *M. maurus* 0.7
Olešnice (BK) 10.5.2010	65	28	*M. aeneus* 90.7	*M. subaeneus* 7.4		*M. viridescens* 1.9	
Bedihošť (PV) 10.5.2010	65	29	*M. aeneus* 94.4		*M. subaeneus* 2.8	*M. carinulatus* 1.4 *M. coracinus* 1.4	
Lesoňovice[P] (ZR) 1.6.2010	69	30	*M. aeneus* 91.9		*M. subaeneus* 2.2 *M. carinulatus* 4.4	*M. viridescens* 1.5	
Domanínek (ZR) 1.6.2010	69	31	*M. aeneus* 83.1	*M. subaeneus* 6.7 *M. carinulatus* 7.3	*M. viridescens* 2.9		
Pivonice (ZR) 1.6.2010	69	32	*M. aeneus* 78.7 *M. subaeneus* 11.1	*M. viridescens* 7.4	*M. carinulatus* 2.8		
Velké Janovice (ZR) 1.6.2010	69	33	*M. aeneus* 96.9			*M. subaeneus* 1.5 *M. carinulatus* 1.6	
Věcov (ZR) 1.6.2010	69–73	34	*M. aeneus* 75.7 *M. viridescens* 10.8	*M. subaeneus* 8.1 *M. coracinus* 5.4			
Jamné (JI) 13.6.2010	69–73	35	*M. aeneus* 81.6	*M. viridescens* 8.6 *M. carinulatus* 6.0	*M. subaeneus* 2.6		*M. coracinus* 0.8 *M. atratus* 0.4
Bohdalec (ZR) 13.6.2010	69–73	36	*M. aeneus* 70.4 *M. carinulatus* 11.2	*M. subaeneus* 9.9 *M. viridescens* 6.6		*M. atratus* 1.3	*M. coracinus* 0.7

Table 2 to be continued

Locality (district), date of sampling	Growth stage (BBCH)	Locality No.	Dominance index *D* (%)				
			D5 eudominant	D4 dominant	D3 subdominant	D2 recedent	D1 subrecedent
Dolní Rozsíčka (ZR) 13.6.2010	69–73	37	*M. aeneus* 87.6	*M. viridescens* 5.6	*M. subaeneus* 2.1 *M. carinulatus* 3.9		*M. atratus* 0.9
Nové Město na Moravě (ZR) 13.6.2010	69–73	38	*M. aeneus* 85.6	*M. subaeneus* 6.5	*M. carinulatus* 3.7 *M. coracinus* 3.2		*M. viridescens* 0.5 *M. atratus* 0.5
Žďár nad Sázavou (ZR) 13.6.2010	69–73	39	*M. aeneus* 79.6 *M. subaeneus* 14.9		*M. viridescens 3.2*		*M. carinulatus* 0.9 *M. coracinus* 0.5 *M. atratus* 0.9
Lazníky[P] (PR) 13.7.2010	69	40	*M. aeneus* 69.4 *M. subaeneus* 28.9			*M. carinulatus* 1.6	*M. viridescens* 0.1
Rodkov[P] (ZR) 19.7.2010	69	41	*M. aeneus* 93.6	*M. carinulatus* 5.2			*M. subaeneus* 0.3 *M. viridescens* 0.6 *M. coracinus* 0.3
Tasovice u Kunštátu[P](BK) 19.7.2012	69	42	*M. aeneus* 96.0			*M. subaeneus* 2.0 *M. carinulatus* 2.0	

[P]*Meligethes* adults sampled in poppy (*Papaver somniferum* L.) crop; BO – Brno-venkov; VY – Vyškov; HO – Hodonín; BK – Blansko; PV – Prostějov; ZR – Žďár nad Sázavou; JI – Jihlava; PR – Přerov

samples. *M. viridescens* was dominant in five other samples and subdominant in two samples. On the other hand, it was recedent or subrecedent in 12 samples (44.4%) and in 7 samples it did not occur at all (25.9%). That is a great difference from the situation recorded in 2009. In contrast to *M. viridescens*, *M. subaeneus* occurred markedly more in 2010. It was dominant in 12 samples, subdominant in 6 samples, but recedent or subrecedent only in 3 samples (11.1%). The species was recorded in all samples. M. *carinulatus* was dominant in 2 samples and subdominant in 4 samples. In 2009 the species was not recorded at all. In the group of dominant and/or subdominant species *M. coracinus* appeared, too. In 2009 this species was somewhat more frequent (Table 2).

In 2011 *M. aeneus* was the most abundant and eudominant again in all 22 samples. Its *D* values ranged from 80% to 98%. Only in one sample *M. aeneus* was accompanied by another eudominant species. It was *M. subaeneus* with a *D* value of 17.3% (Veselíčko 29.5.). *M. subaeneus* was dominant in 7 samples and subdominant in 6 samples. It was recedent or subrecedent in 4 samples (18.2%) and did not occur in another 4 samples. In 2011 the species occurred markedly more frequently than in 2009 but somewhat less than in 2010. *M. viridescens* was dominant in 2 samples and subdominant in 6 samples. It was recedent or subrecedent in 11 samples (50%) and did not occur in 3 samples (13.6%). In 2010 the frequency of the species was similar. In 2009 the species was markedly more important. *M. coracinus* was dominant in 1 sample and subdominant in 4 samples. This species occurred at a similar level in 2010, but was markedly more frequent in 2009. Finally, *M. carinulatus* was also recorded among the dominant and/or subdominant species in 3 samples. In 2009 the species was not recorded at all and in 2010 it was more frequent (Table 3).

In both samples collected in white mustard (Vranovice 18.5.2011; Lysice 24.5.2011) *M. aeneus* highly predominated. The most frequent accompanying species was *M. subaeneus* (Table 2). In poppy (3 samples in 2010, 2 samples in 2011) the *Meligethes* species composition was similar. In one sample (Lazníky 13.7.2010), the most frequent accompanying species, *M. subaeneus*, was eudominant together with *M. aeneus*.

DISCUSSION

Not surprisingly, the most frequent *Meligethes* species was *M. aeneus* in all the compared samples

Table 3. Dominance indices stated for individual species of *Meligethes* genus recorded at various localities in the Czech Republic in 2011

Locality (district), date of sampling	Growth stage (BBCH)	Locality No.	Dominance index *D* (%)				
			D5 eudominant	D4 dominant	D3 subdominant	D2 recedent	D1 subrecedent
Brno-Tuřany (BM) 21.4.2011	57–59	43	*M. aeneus* 90.0	*M. coracinus* 6.0	*M. viridescens* 3.0		*M. atratus* 0.6 *M. subaeneus* 0.4
Tvarožná (BO) 21.4.2011	59	44	*M. aeneus* 95.4		*M. subaeneus* 3.0	*M. viridescens* 1.0	*M. coracinus* 0.6
Těšice (PR) 21.4.2011	57–59	45	*M. aeneus* 90.0	*M. subaeneus* 8.0		*M. viridescens* 1.0	*M. carinulatus* 0.3 *M. coracinus* 0.7
Kuřim (BO) 27.4.2011	59	46	*M. aeneus* 91.0		*M. viridescens* 4.0 *M. coracinus* 4.0		*M. nigrescens* 0.5 *M. atratus* 0.5
Moravské Knínice (BO) 27.4.2011	60–63	47	*M. aeneus* 92.0		*M. viridescens* 4.0 *M. coracinus* 3.0		*M. atratus* 0.6 *M. nigrescens* 0.4
Čebín (BO) 27.4.2011	63	48	*M. aeneus* 91.5	*M. viridescens* 5.0	*M. coracinus* 2.5	*M. atratus* 1.5	
Dobrochov (PV) 1.5.2011	63–65	49	*M. aeneus* 93.2		*M. subaeneus* 4.0	*M. viridescens* 2.0	*M. coracinus* 0.5 *M. atratus* 0.3
Dobromilice (PV) 1.5.2011	63–65	50	*M. aeneus* 92.3	*M. subaeneus* 5.0	*M. viridescens 2.0*		*M. coracinus* 0.6 *M. nigrescens* 0.1
Bedihošť (PV) 1.5.2011	63	51	*M. aeneus* 95.0		*M. subaeneus* 3.0	*M. coracinus* 1.0 *M. carinulatus* 1.0	
Zvole (ZR) 2.5.2011	57–59	52	*M. aeneus* 93.0	*M. carinulatus* 5.0		*M. subaeneus* 1.0	*M. viridescens* 0.6 *M. coracinus* 0.4
Dambořice (HO) 9.5.2011	65	53	*M. aeneus* 94.0	*M. subaeneus* 5.0			*M. viridescens* 0.6 *M. coracinus* 0.4
Slavkov u Brna (VY) 9.5.2011	65	54	*M. aeneus* 93.8	*M. subaeneus* 5.4			*M. viridescens* 0.8
Žabčice (BO) 18.5.2011	65–67	55	*M. aeneus* 93.0	*M. subaeneus* 5.5	*M. viridescens* 1.5		
Vranovice[WM] (BO) 18.5.2011	59–63	56	*M. aeneus* 94.2	*M. subaeneus* 4.0		*M. viridescens* 1.0	*M. coracinus* 0.8
Lipůvka (BK) 24.5.2011	69	57	*M. aeneus* 91.6	*M. viridescens* 5.0	*M. coracinus* 3.0		*M. atratus* 0.4
Lysice[WM] (BK) 24.5.2011	61–63	58	*M. aeneus* 97.2		*M. subaeneus* 2.0		*M. viridescens* 0.4 *M. coracinus* 0.4
Písečné (ZR) 29.5.2011	69	59	*M. aeneus* 97.0	ZR – Žďár nad Sázavou		*M. subaeneus* 1.5 *M. carinulatus* 1.0	*M. viridescens* 0.5
Blažkov (ZR) 29.5.2011	69	60	*M. aeneus* 93.0		*M. subaeneus* 3.0 *M. viridescens* 3.0		*M. coracinus* 0.5 *M. maurus* 0.5
Bratrušín (ZR) 29.5.2011	69	61	*M. aeneus* 92.1		*M. carinulatus* 4.2 *M. subaeneus* 2.0	*M. viridescens* 1.0	*M. coracinus* 0.7
Veselíčko (PR) 29.5.2011	67–69	62	*M. aeneus* 81.0 *M. subaeneus* 17.3			*M. carinulatus* 1.7	
Prosenice[P] (PR) 19.6.2011	65	63	*M. aeneus* 98.0			*M. subaeneus* 1.0	*M. viridescens* 0.4 *M. coracinus* 0.4 *M. nigrescens* 0.2
Penčice[P] (PR) 27.6.2011	65	64	*M. aeneus* 90.0	*M. subaeneus* 8.0	*M. carinulatus* 2.0		

Meligethes adults sampled [P]in poppy (*Papaver somniferum* L.) and [WM]in white mustard (*Sinapis alba* L.) crop; BO – Brno-venkov; PR – Přerov; PV – Prostějov; BK – Blansko

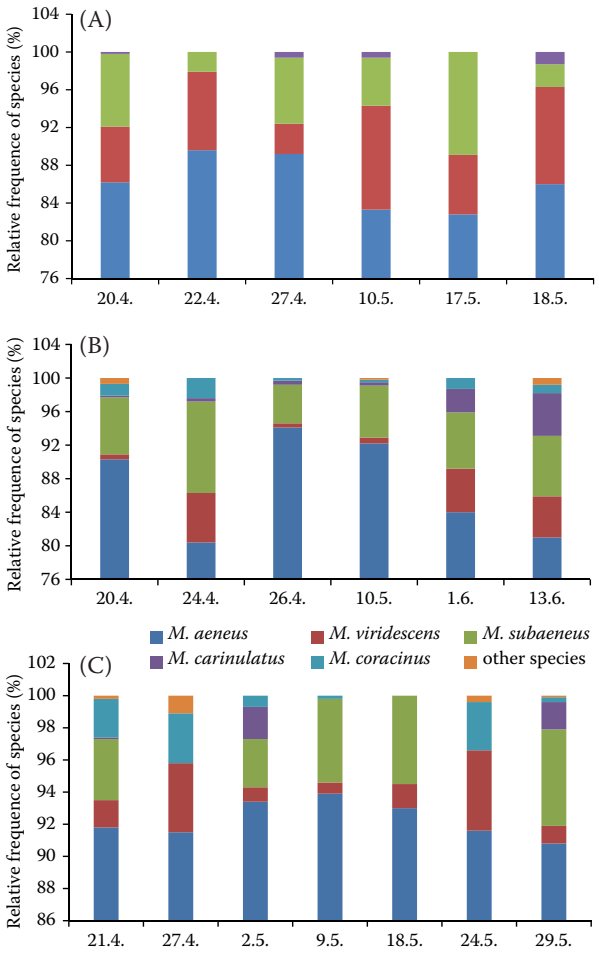

Figure 2. Relative frequencies of *Meligethes* species in samples collected in different winter oilseed rape fields in different dates (A – 2009; B – 2010; C – 2011)

(2009–2011). This is in line with published data across Europe (Jourdheuil 1962; Billquist & Ekbom 2001; Marczali & Keszthelyi 2003; Thieme *et al.* 2008; Tóth *et al.* 2011). With regard to the accompanying *Meligethes* species, their frequencies varied in individual samples. Among them *M. subaeneus* and *M. viridescens* were markedly more frequent in this study. They accompanied *M. aeneus* as eudominant ($D > 10.1\%$) or dominant ($D = 5.1–10\%$) species in many samples. *M. coracinus* and *M. carinulatus* also achieved relatively high values of *D* (eudominant, dominant, subdominant) in several samples. Contrary to data published by Thieme *et al.* (2008), the species accompanying *M. aeneus* appeared already at the beginning of flowering in winter oilseed rape fields in this study (April samples). We did not record any clear tendency to increasing the frequencies of the other *Meligethes* species during the flowering periods (2009–2011). The portions of the other

Table 4. Complete list of *Meligethes* species recorded in different crops in each of the three years (2009–2011)

Year	Crop	*Meligethes* species
2009	WOR	*M. aeneus; M. coracinus; M. viridescens; M. nigrescens; M. atratus; M. subaeneus*
2010	WOR	*M. aeneus; M. coracinus; M. viridescens; M. atratus; M. subaeneus; M. carinulatus; M. maurus*
	P	*M. aeneus; M. coracinus; M. viridescens; M. subaeneus; M. carinulatus*
2011	WOR	*M. aeneus; M. coracinus; M. viridescens; M. subaeneus; M. carinulatus; M. atratus; M. nigrescens; M. maurus*
	WM	*M. aeneus; M. coracinus; M. viridescens; M. subaeneus*
	P	*M. aeneus; M. coracinus; M. viridescens; M. subaeneus; M. carinulatus; M. nigrescens*

WOR – winter oilseed rape (*Brassica napus* L.); WM – white mustard (*Sinapis alba* L.); P – poppy (*Papaver somniferum* L.)

species fluctuated in *Meligethes* samples during the whole flowering period but not increased at the second part or at the end of flowering (Figure 2). These results are inconsistent with Thieme *et al.* (2008) and partly with Marczali and Keszthelyi (2003). Thieme *et al.* (2008) usually recorded the accompanying species in the course of the second part of flowering periods (samples collected in June) in Germany and in the UK (Thieme *et al.* 2008). At the beginning of June *M. viridescens* appeared and later, in the second half of June, the other species (*M. nigrescens*, *M. coeruleovirus*, *M. coracinus*) joined them. Marczali and Keszthelyi (2003) in agreement with Thieme *et al.* (2008) detected later appearance of the accompanying species and continual increase of their frequencies in oilseed rape fields. They were delayed 2–3 weeks after the first *M. aeneus* adults. On the other hand, the other *Meligethes* species accompanied *M. aeneus* from the beginning of April in oilseed rape in the Hungarian study. Hence, they were present in rape fields in the course of the whole flowering period along with *M. aeneus*. In this aspect that was similar to our study. According to Jourdheuil (1962), Billquist and Ekbom (2001), and Thieme *et al.* (2008) in Western and Northern Europe the most frequent companion of *M. aeneus* is *M. viridescens*. The other *Meligethes* species should be substantially less important in oilseed rape. On the basis of our

results and those of Marczali and Keszthelyi (2003) the situation in Central Europe could be rather different. Not only *M. viridescens*, but also *M. subaeneus*, *M. coracinus,* and *M. carinulatus* should be included among the most important companions of *M. aeneus* in oilseed rape crops (as well as in white mustard and poppy) in the Czech Republic. Marczali and Keszthelyi (2003) studied the occurrence of *Meligethes* species in oilseed rape in Hungary. They consider *M. aeneus* to be the dominant species, *M. coracinus*, *M. viridescens*, and *M. picipes* to be important, *M. nigrescens* and *M. maurus* to be of rare occurrence and *M. atratus*, *M. denticulatus,* and *M. erythropus* (synonym *M. carinulatus*) to occur sporadically. In fact, *M. picipes* and *M. nigrescens* are synonyms, too (Fauna Europea 2012). *M. denticulatus,* which was mentioned by them (Marczali & Keszthelyi 2003), was not recorded in this study.

As mentioned in the introduction, resistance of pollen beetles (*M. aeneus* only or *Meligethes* species in general?) species to pyrethroids is a reality and will affect future oilseed rape production in Europe (Zlof 2008). According to Thieme *et al*. (2008) this resistance should be determined only for true oilseed rape pollen beetles (*M. aeneus*). Ignoring this distorts the bioassay and results in apparent susceptibility because the accompanying *Meligethes* species are considered to be more susceptible. As already reported by Derron *et al*. (2004), *M. viridescens* is not resistant. And also the other *Meligethes* species should be more, or at least differently, susceptible to pyrethroids in comparison to *M. aeneus*.

In relation to the recorded frequencies (often not negligible) of the accompanying species of *M. aeneus* in samples compared in this study, distinguishing between them during (or after) laboratory tests on their susceptibility to insecticides could be helpful.

Analysis of *Meligethes* samples collected in winter oilseed rape, white mustard, and poppy (2009 to 2011) does not show any dramatic differences in *Meligethes* species composition in the three crops.

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