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Occurrence and control of the field cockchafer *(Melolontha melolontha* L.*)* in the Czech Republic – a historical overview

Vorkommen und Bekämpfung des Feldmaikäfers (*Melolontha melolontha* L.) in der Tschechischen Republik – ein historischer Überblick

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Abstract

In the Czech Republic, the field cockchafer, *Melolontha melolontha*, is a very important pest in various crops. In this paper, informations on the harmful occurrence of *M. melolontha* in agriculture (1921–2003), orchards, grape-vine, strawberries and sugar beet each between 1960 and 2003 are presented. The greatest damage is caused by the grubs in agriculture, orchards and grapevine. On the basis of the last outbreak between 1956 and 1968, a prognosis was developed for the flying years and swarm periods. In the Czech Republic, three 3-year cycles and four 4-year cycles of *M. melolontha* are known. For control of beetles and larvae, formerly insecticides such as HCH, Lindane and DDT were used. Today, no chemicals are registered against beetles, and only Dursban 10 G (chlorpyrifos) is allowed to use against grubs in ornamentals.

Key words: *Melolontha melolontha*, occurrence, control, damage, prognosis

Zusammenfassung

In der Tschechischen Republik ist der Feldmaikäfer *(Melolontha melolontha)* ein sehr wichtiger Schädling in verschiedenen Kulturen. In dem Beitrag sind Informationen über das schädliche Vorkommen von *M. melolontha* in der Landwirtschaft (1921–2003), bei Obstbäumen, Wein, Erdbeeren und Zuckerrüben jeweils von 1960–2003 angegeben. Die größten Schäden werden durch die Engerlinge im Obstbau und Weinbau verursacht. Auf Grund des starken Vorkommens in den Jahren 1956–1968 wurde eine Prognose für die Flugjahre und Schwärmzeiten ausgearbeitet. In der Tschechischen Republik sind drei dreijährige Flugstämme und vier vierjährige Stämme bekannt. Zur Bekämpfung der Käfer und Engerlinge wurden früher neben dem Absammeln vor allem chemische Mittel, wie HCH, Lindan oder DDT eingesetzt. Zurzeit sind gegen die Käfer keine Pflanzenschutzmittel zugelassen, gegen die Engerlinge nur Dursban 10 G (Chlorpyrifos) bei Zierpflanzen.

Stichwörter: *Melolontha melolontha*, Vorkommen, Bekämpfung, Schäden, Prognose

In the Czech Republic, the field cockchafer, *Melolontha melolontha*, is a very important pest in agriculture and other crops. Both, the adults and larvae cause damage. Data on this pest insect are already from the 17th century up to 2005. As a result of 13 years of careful observations on the flight and swarming activity and intensity, a method for long term forecasting of the field cockchafer in the former Czechoslovakia was carried out in 1965, which was then specified in 1968. These data on the distribution, swarming intensity and knowledge of the biology of the pest are used in determining endangered regions, the duration of the developmental cycle in certain areas and the different cockchafer populations occurring in the country. In the following paper, these data together with actual results on recent developments in the field cockchafer populations are presented together with some remarks on control methods.

Distribution and harmful occurrence of the field cockchafer in the Czech Republic

The first observations and descriptions on damages caused by the field cockchafer are from the 17th century. Already at this time, *M. melolontha* was described as a serious pest. In the year 1606, an outbreak of *M. melolontha* occurred in Bohemia. Many trees in orchards were defoliated by the beetles. In May 1613 (5.5.1613), cockchafers were swarming in the town and the surrounding of Litomerice. Damage on grape-vine was very serious. At that time, the fee wage for workers who picked up adult cockchafers was 6–7 Meissner penny (Meissner Groschen) per day. Another calamity was described in 1638 in Moravia (region Olomouc) (Donek et al, 1932; Koleška, 1996; Koleška, 2001).

Until about 1850 only very few informations on *M. melolontha* were available. However, during the second half of the 19th century and at the beginning of the 20th century heavy damages in agriculture and other crops are again described: In the years 1866, 1876 and 1907 damages in nurseries of deciduous trees were reported, in 1908 forestry nurseries were damaged, in 1909 altogether 40 000 l of adult cockchafers were collected and in 1912 again a heavy damage in forestry nurseries occurred. In 1916, a huge outbreak was noticed which led to the publication of a decree „about picking cockchafers for fodder" (Koleška, 2001).

Data on the harmful frequency of occurrence of the field cockchafer in agriculture between 1921 to 1941 are presented in Figure 1. Crops which were damaged by this pest within 1921–1929 are listed in Table 1. Altogether 8 crops including orchards and shrubs were heavily attacked by *M. melolontha* (Anonym, 1924a; 1924b; 1930; 1931; 1933; 1941; Baudyš, 1940; Kratochvíl et al., 1953). Further damages in non specified crops were also reported in the years 1930–1941 (Anonym, 1933, 1941; Baudyš, 1940; Kratochvíl et al., 1953) and in 1949 and 1950 in Moravia (Kratochvíl et al., 1953).

Figure 1. Harmful occurrence of *M. melolontha* in agriculture in the Czech Republic between 1921–1941 (in accordance with districts, Source: Ochrana rostlin 1921–1941).

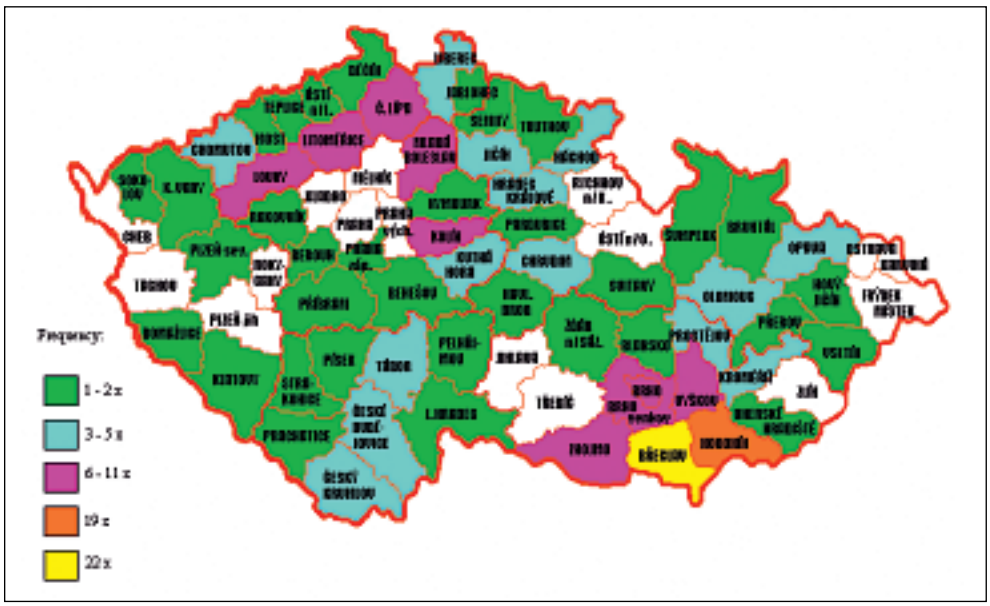

Figure 2. Number of districts in the Czech Republic with harmful occurrence of *M. melolontha* from 1960–2003 (in accordance with districts, Source: UKZUK Brno, SRS Praha).

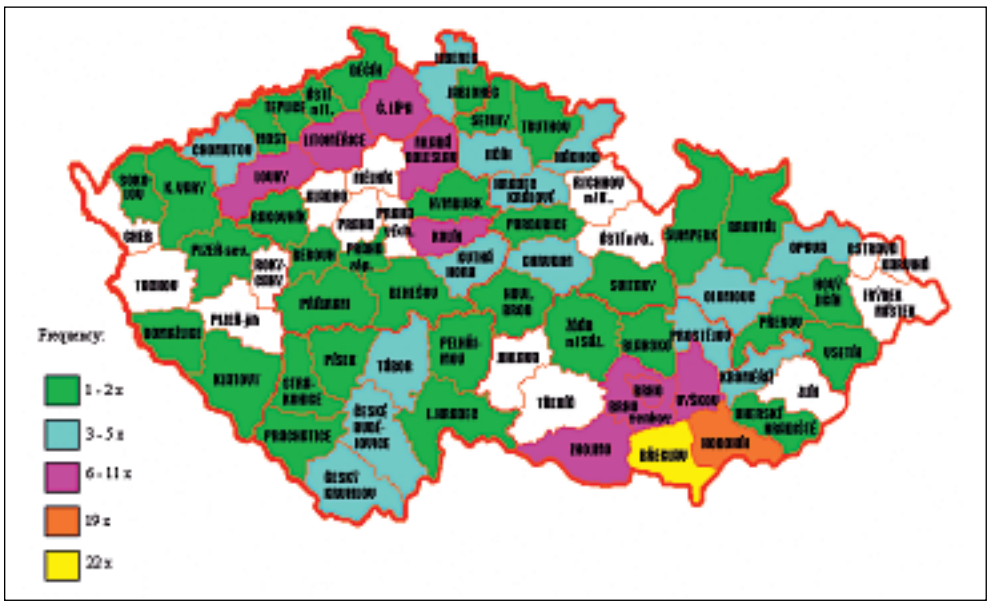

Figure 3. Number of districts in the Czech Republic with harmful occurrence in orchards of *M. melolontha* from 1960–2003 (in accordance with districts, Source: UKZUK Brno, SRS Praha).

Figure 4. Number of districts in the Czech Republic with harmful occurrence in grapevine of *M. melolontha* from 1960–2003 (in accordance with districts, Source: UKZUK Brno, SRS Praha).

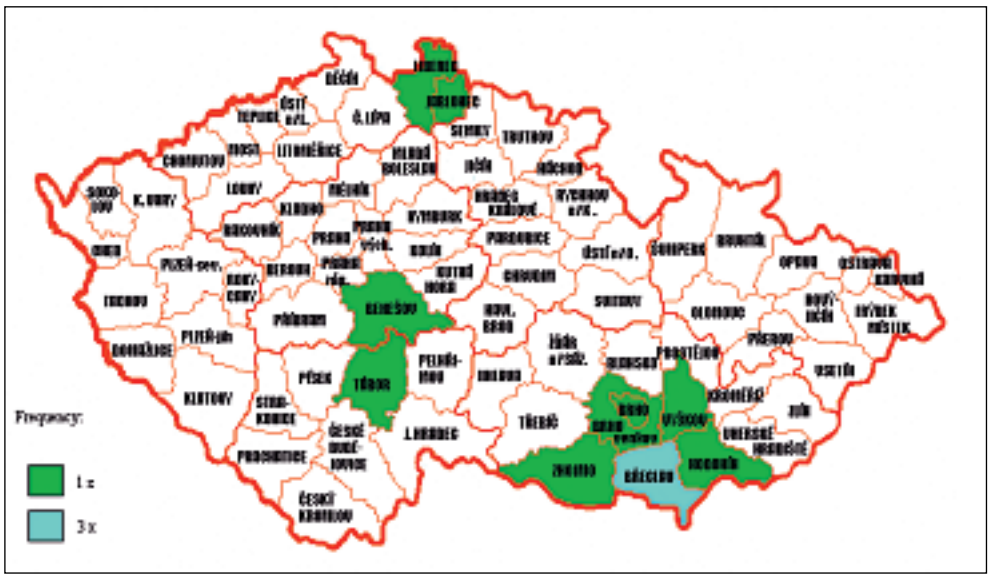

Figure 5. Number of districts in the Czech Republic with harmful occurrence in strawberry of *M. melolontha* from 1960–2003 (in accordance with districts, Source: UKZUK Brno, SRS Praha).

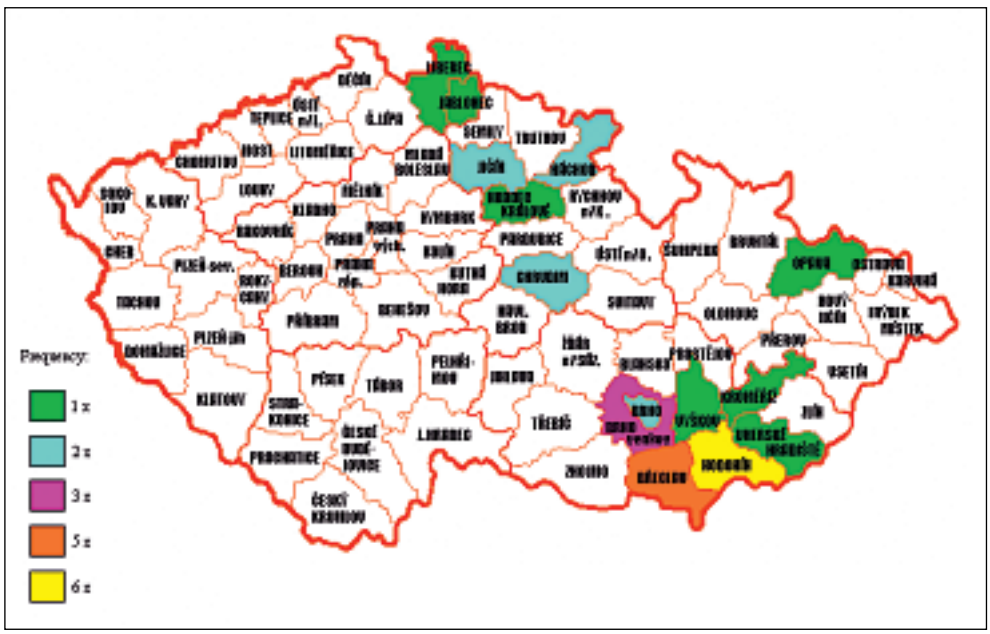

Figure 6. Number of districts in the Czech Republic with harmful occurrence in sugarbeet of *M. melolontha* from 1960–2003 (in accordance with districts, Source: UKZUK Brno, SRS Praha).

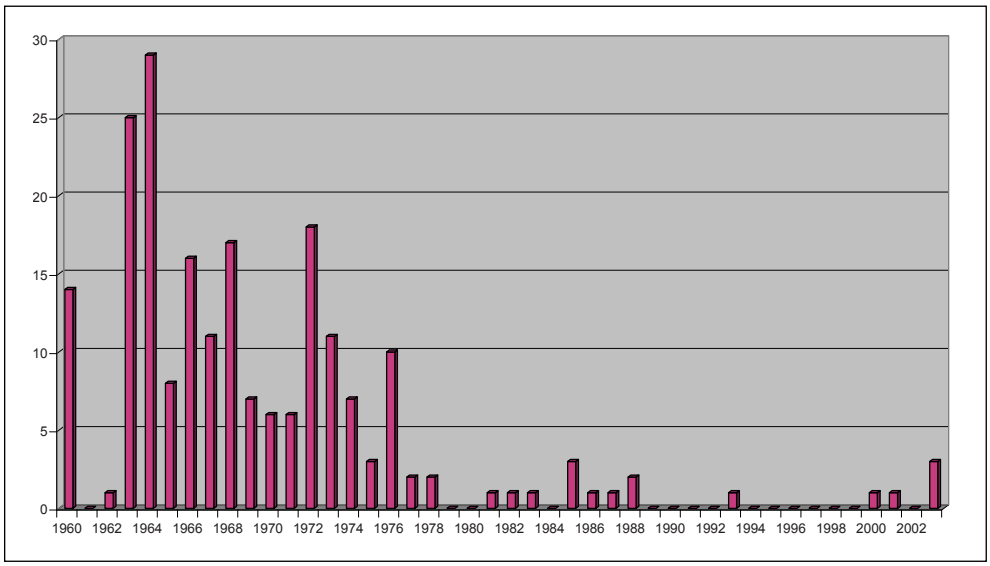

Figure 7. Numbers District with Harmful Appearance Cockchafer 1960–2003 in the Czech Republic (Source: ÚKZÚZ Brno, SRS Praha).

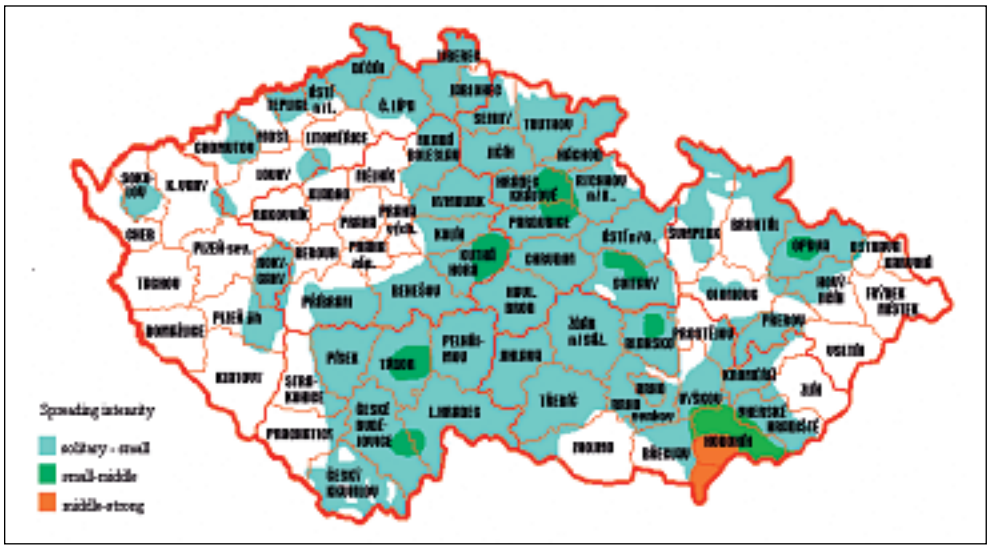

Figure 8. Spreading *M. melolontha* in the Czech Republic – 2004.

Data on the distribution and harmful occurrence of the field cockchafer in the Czech Republic between 1960 and 2003 are presented in the Figures 2–6. These informations are yearly published by the ÚKZÚZ Brno and ÚKSÚP Bratislava (Central Institute for Supervising and Testing in Agriculture Brno and Bratislava) in the book „Some Pests and Diseases of Cultivated Plants Occurring in Czechoslovakia (in the Czech Republic) 1960–2003“ (ANONYM, 1997a, 1997b, 1997c, 2000a, 2000b, 2000c, 2000d, 2000e, 2001a, 2001b; HAURELAND, 1984, 1985, 1986, 1987, 1988, 1989; KUZMA Š., 1990; MADAR, 1993; RICHTER, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969; RICHTER and ŠIMKO, 1970; ZÁBRANSKÝ, 1978, 1979, 1980a, 1980b, 1982; ZÁBRANSKÝ and ŠIMKO, 1971; ZÁBRANSKÝ and SATKO, 1972, 1973, 1974, 1975, 1976, 1977).

Tab. 1. Years with damaged crops by *Melolontha melolontha* in the Czech Republic between 1921–1930

Crop	Year
sugar beet	1923, 1929
fodder beet	1929
potatoes	1923
grasses	1923
chicory	1923
orchards and shrubs	1923
barley	1929
cucumber	1930

Tab. 2. Years with damaged crops by *Melolontha melolontha* in the Czech Republic between 1960–2003

Crop Special crops	Year
orchards and shrubs	1960, 1962–1983, 1985–1988, 2003
strawberry	1965–1968, 1970, 1972, 1973, 1977
grape	1965, 1966, 1967, 1969–1971, 1973, 1976, 2000, 2001, 2003
hop	1993
Field crops	
potatoes	1963–1965, 1967, 1973, 1976
sugar beet	1963–1968, 1970-1972, 1974
maize	1963, 1965
cereals	1965, 1972
Vegetables	
pea	1964
celery	1968
onion	1968, 1971
lettuce	1971
cauliflower	1972
cucumber	1972
other vegetables	1993, 2003

Figure 9. Spreading *M. melolontha* in the Czech Republic – 2005.

In Figure 7, the number of districts in the Czech Republic with harmful occurrence of *M. melolontha* in 1960–2003 is summarized. Between 1960 and 1976, except 1961 and 1962, the pest insect occurred in about 5 to more than 25 (in 1964) different districts in the whole country. The crops damaged by the beetles and larvae during this time are listed in Table 2. From 1977–1988, damage was only reported in fruit wood. Yet, between 1989 and 1999, no damaged crops, except in 1993 on hop in the district Olomouc) were observed.

During these 43 years, field cockchafers were found in agriculture nearly in the whole country with different frequencies of occurrence (Figure 2). In some districts, such as in Cheb and Tachov near the German border, *M. melolontha* even occurred in 22 out of 43 years. Generally, the crops which were heavily attacked by the field cockchafer during this time were orchards (Figure 3), grape-vine (Figure 4), strawberry (Figure 5) and sugar beet (Figure 6). In Table 2, altogether 14 crops and other vegetables without specification are listed which have been attacked and damaged by the field cockchafer. Since the year 2000, a gradual increase of the field cockchafer is noticed. In 2000, 2001 and 2003 grape-vine was damaged, in 2003 *M. melolontha* occurred in orchards and vegetables (Table 2). The distribution of *M. melolontha* in 2004 and 2005 is presented in Figure 8 and 9.

Swarming prognosis

The possibility of cockchafer prognosis has been known for centuries. In 1871, it was published that cockchafers have only a four year cycle (ANONYM, 1994). In contrast, RAMBOUSEK (1923, 1927) wrote that the field cockchafer has only a three year cycle in the territory of the Czech Republic. First, rather incomplete reports about the cockchafer swarming in the Bohemia territory were published by ZWEIGELT (1928). Later, a more detailed study on the cockchafer swarming was compiled by KRATOCHVÍL et al. (1953), who also gave some information about the distribution of the field cockchafer in Moravia. However, data on the occurrence in Bohemia were not included.

Based on data and an exact map documentation from the period 1956–1968, Muška established a long-term prognosis on the frequency of occurrence of *M. melolontha* in the former Czechoslovakia. This prognosis was based on data obtained from a questionnaire made by LANDA in 1954 year for certain areas of Bohemia and Moravia. It could be shown, that the border between the three- and the four-year developmental cycle is identical with the average air temperature of 14 °C for Moravia. In Slovakia the temperature is 13 °C. In areas with a lower temperature, *M. melolontha* has a four-year cycle, in those with higher air temperature the populations have a three-year cycle (MUŠKA, 1975a).

The average air temperature of the vegetation period (April–August) was taken over fifty years (1901–1950). Czechoslovakia was the first among the European countries with a long-term prognosis of the flight years and swarming periods of the field cockchafer, *M. melolontha*, in the whole country. The frequency of occurrence and the flight years for the different cockchafer populations are given in Table 3 (MUŠKA, 2000, 2001a, 2001b, 2001c, 2002a, 2002b, 2003a, 2003b, 2003c, 2004a, 2004b, 2004a, 2005a, 2005b).

As a result of these long-term observations, three cockchafer populations with a three-year cycle and four with a four-year cycle are recorded in the Czech Republic. The border between the three-year and the four-year populations is still determined by a 50-years average of air temperature during the vegetation period, i. e. from April 1 to September 30). Therefore, swarming of cockchafers in the Czech Republic is very different in each year.

Control methods of beetles and larvae in agriculture and other crops

In the history of the Czech Republic, the field cockchafer always was a very important pest which had to be controlled by different means. In 1870, a special decree on the collection of cockchafers was published. On 2. 7. 1924, the next act was created. In this tome was proposal price for one catch adult *M. melolontha* 1 heller. In act from 1870 one half pay village second half state. This duty for state in act from 1924 was not yet. (RAMBOUSEK, 1927). For plant protection against *M. melolontha* not only the prognosis but also direct control measures are important. RAMBOUSEK (1923) recommended the collection of adults and grubs from damaged plants or the application of carbon disulphide to in the soil. However, chemical protection was not very effective. Collected cockchafers were used as medicaments, food for fowls and pigs and as fertilizer (RAMBOUSEK, 1923). At the next outbreak of the field cockchafer between 1950 and 1960, the chemical insecticides HCH and also DDT were used (KRATOCHVÍL et al., 1953; MUŠKA, 1965, 1969), while between

Tab. 3. Frequency *M. melolontha* in the Czech Republic (MUŠKA, 1975a)

Three-Years development cycle

Frequency III_0
Bohemia: not registered
Moravia: Pavlovské vrchy (hills), Dyjskosvratecký úval (graben) till Brnenská vrchovina (highland) without the south part, Vyškovská brána (gate), south half of Hornomoravský úval (graben), Litencické vrchy (hills), Zdánický les (highland), Chríbské podhurí (piedmont), south part of Moravská brána (gate) till the town Hranice except of Hostýnské vrchy (hills), Dolnomoravský úval (graben) and catchment area of the rivers Olšava (from Uherský Brod) and Morava (from Uherské Hradište), island area between the towns Litovel and Šternberk.

Frequency III_1
Bohemia: not registered
Moravia: Dyjsko svratecký úval (graben) and area between the towns Znojmo – Moravský krumlov – Rajhrad, Vyškovská brána (gate), Litencické vrchy (hills) southern part of Hornomoravský úval (graben), Zdánický les (highland), Chriby (highland), Chribské podhurí (piedmont), Dolnomoravský úval (graben), catchment area of Olšava river from Uherský Brod, catchment area of Morava river from Ostroh.

Frequency III_2
Bohemia: not registered
Moravia: small territory including the south part of Dolnomoravský úval (graben) and Chribské podhurí (piedmont) to the town Zidlochovice throught Slavkov and Vyškovská brána (gate) and Prostejov to the town Olomouc.

Four-Years development cycle

Frequency IV_0
Bohemia, Moravia and Silesia: west part of Sokolovská pánev (basin), south-west part of Zatecká plošina (plateau), north part of Mostecká pánev (basin), a large area determined as follows: north of Decinské steny (rocks) – Luzická pahorkatina (hilly land) – a furrow between Decínské steny (rocks) and Ceské stredohorí (mts.) – Luzické hory (mts.) – Jizerské podhurí (piedmont) – Liberecká kotlina (basin) – Jestedské pohorí (mts) – Krkonoške podhurí (piedmont) – Broumovské mezihorí (highland) – Orlické podhurí (piedmont) – Jesenické podhurí (piedmont) – Vidnavská pahorkatina (hilly land) – Osoblazská pahorkatina (hilly land) – north part of Nízký Jeseník (mts.) – Hlucínská pahorkatina (hilly land); east of Oderské vrchy (hills) – Nízký Jeseník (mts.) – Hrubý Jeseník (mts.) – Trebovské mezihorí (highland) – Boskovická brázda (furrow) – north part of Brnenská vrchovina (highland) – Ceskomoravská vrchovina (highland) – Trebonská pánev (basin) –Budešjovická pánev (basin), south of the line Rosice – Moravské Budejovice – Vratetním – Slavonice – Nová Bystrice – Ceské Velenice – Kaplice – Ceský Krumlov; west border with east part of Šumavské predhurí (piedmont) – Stredoceská vrchovina (highland) through Netolice – Vodnany – Písek – Blatná – Príbram – Benešov – east half of Polabí through – Kourim – Nymburk – Jicinská pahorkatina (hilly land) throught Mladá Boleslav – Mnichovo Hradište- east half of Dokská pahorkatina (hilly land) through Mimon – Ceská Lípa and Ceské Stredohorí (mts.). Small island areas of the town Louny and between Blovice and Rokycany.

Frequency IV_1
Bohemia: Stredoceská vrchovina (highland) in the vicinity of Jílové and Ceský Brod and the area Kolín – Kutná Hora.
Moravia – not registred.

Frequency IV_2
Bohemia: east part of Rakovnická plošina (plateau), Karlštejnská plošina (plateau), Hrebeny north part of Stredoceská vrchovina (highland), Polabí from Kutná Hora through Kolín to Ústínad Labem, vicinity of the town Jicín, central part of Brdy, south part of Zatecká plošina (plateau) from village Stebno in the direction of Podborany and Kadan.
Moravia – not registered.

Frequency IV_3
Bohemia: south part of Zatecká plošina (plateau), valley of Dzbán in the Direction to the river Ohre, Dolní Poohrí, west part of Ceské stredohorí (mts.), west half of Doksanská pahorkatina (hilly land), west part of Polabí to the line Litomerice – Úštek – Dubá – Doksy – Belá pod Bezdezem – Mladá Boleslav – Melník, island area north of Brandýs nad Labem, small area the vicinity of Kutná Hora to Prelouc.
Moravia and Silesia: island areas east of Frýdek Místek, north of Bílovec, Osoblazská pahorkatina (hilly land)

1960–1970 mostly Lidenal with the active ingredient lindan was applied (MUŠKA, 1969, 1975b). Later, the field cockchafer was controlled by products with the active ingredient phosmamidon (MUŠKA, 1975b, 1990).

At present, in the Czech Republic a very small number of plant protection products for control of the field cockchafer is now registered in agriculture. Against the adults no chemical products are registered. Against the grubs only Dursban 10 G (a.i. chlorpyrifos) is registered and used in ornamentals. Therefore, in this situation a preventive determination of the number of cockchafer larvae in the soil is very important with respect to the control measures.

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