The implication of seed treatment of winter oilseed rape

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ABSTRACT

Small plot trials studying the impact of different seed treatments on the occurrence of pests and diseases in autumn were carried out during 2000–2003. The aim was to verify the efficiency of different fungicidal and insecticidal oilseed rape seed treatments and to determine the economical effectiveness of this method of protection. The following insecticidal seed treatments were used: Promet 400 CS (furathiocarb), Cosmos 500 FS (fipronil), Chinook 200 FS (imidacloprid & beta-cyfluthrin) and Marshal ST (carbosulfan). The seed treatment Chinook 200 FS in combination with newly developed fungicidal compound was also assessed. The most effective treatment was Chinook 200 FS (imidacloprid & beta-cyfluthrin), particularly against flea beetles (*Phyllotreta* spp.), and lower infestations by larvae of the turnip gall weevil (*Ceutorhynchus pleurostigma* Marsh.) were also found. However, the efficiency lasts no more than 4–5 weeks after sowing. The use of common insecticidal treatments in cases of necessity was found to be beneficial. Plant density in autumn and in spring was greatest in the Chinook 200 FS treatment and in some years a positive influence on yield was also observed with this treatment.

Keywords: *Brassica napus*; oilseed rape; seed treatment; autumn protection; *Phyllotreta* spp.; *Ceutorhynchus pleurostigma*; *Delia* sp.

Winter oilseed rape is one of the most successful market crops of present Czech agriculture. The total growing area in CR has exceeded 300 000 ha within recent years, and its part in crop rotation of many farms is higher than the recommended upper level of 12.5%. This increase in area is leading to increasing problems caused by the resulting dissemination of pests and diseases. The effective control of pests and diseases is vital for plant establishment from the time of sowing onwards. However, pest control during autumn is most demanding and allows for many mistakes. The spectrum of pest's species is relatively broad, their occurrence is irregular, with local importance and yet, all links to their harmfulness were not explained sufficiently.

At the same time, oilseed rape production heads towards a considerable reduction in seed rate, especially for the more expensive hybrid varieties. Due to the lower number of seeds, it is increasingly necessary to secure complete protection of the young plants, since their loss is irreversible. The first experiences with seed treatment of oilseed rape were published at the end of the 1990's (Finch and Edmonds 1999).

The insecticidal and fungicidal seed treatment of different crops is still being developed and increasingly better results are being achieved. Therefore, the utility value of the protection of young plants increases, and has become economically profitable. Since the system has a lower negative environmental impact than conventional systems, it can be viewed as environmentally friendly (Brandl and Biddle 2001). Therefore, treated seeds of oilseed rape have been used for several years in most countries of Western Europe. Untreated seeds are distributed only at the express delivery of farmers, which comes very seldom.

In the Czech Republic, untreated seeds were used as the norm until 1998. Since then, the situation has dramatically changed in favour of treated seeds. Seed treatment has become an essential part of seed production. This article presents results from field trials over 4 years to investigate the effect of seed treatment on pests and diseases in oilseed rape.

MATERIAL AND METHODS

Small plot trials to study the impact of different seed treatments on the occurrence of pests and diseases in autumn were carried out from 2000–2003. The aim was to verify the efficiency of different fungicidal and insecticidal oilseed rape

Realized in cooperation of the Czech University of Agriculture and the Union of Oilseeds Growers and Processors, and supported by the Ministry of Agriculture of the Czech Republic, Project No. QE 1262/2001.

seed treatments and to determine the economical effectiveness of this method of protection. In particular, we studied:

– the efficiency of seed treatment against flea beetles (*Phyllotreta* spp.) during emergence
– plant density in autumn and in the spring after overwintering
– the efficiency of seed treatment against formation of galls by the turnip gall weevil (*Ceutorhynchus pleurostigma* Marsh.)
– the efficiency of treatments with combined insecticidal and fungicidal effects
– the effect of seed treatment on yield

The following insecticidal seed treatments were used: Promet 400 CS (furathiocarb), Cosmos 500 FS (fipronil), Chinook 200 FS (imidacloprid & betacyfluthrin), and Marshal ST (carbosulfan). The seed treatment Chinook 200 FS in combination with a fungicidal compound was also assessed. Treatments were selected from those commercially available at the time of the study and our personal experiences.

Trials were established annually on three different localities choosen from following experimental stations: Praha-Uhříněves, Červený Újezd, Humpolec, Kujavy and Kroměříž. Each treatment was replicated four times. The hybrid cultivars Pronto or Artus were used and the same cultivar was used for each treatment at all localities. All seed was pre-treated by the distributors. Each plot was 3 m × 4 m (12 m^2); 10 m^2 was taken at harvest for yield assessments. Seed rate was 70 seeds/m^2 in the first year, and was too high according to our experience. Therefore, the seed rate was reduced to 40 seeds/m^2 in the following years. The seed rate was increased slightly only at the regularly dry locality of Kroměříž.

Damage categories: flea beetle (*Phyllotreta* spp.)

The number of healthy, slightly and seriously damaged plants over 1 m^2 (4 m × 0.25 m) was evaluated for each replicate of each treatment. Healthy plants were completely undamaged. Slightly damaged plants had one or a few small holes; these unlikely to affect the development of the plant. Seriously damaged plants were recorded if the plant had suffered many small holes or a significant reduction of leaf surface; damage to an extent which could lead to weakening or death of the plant.

The coefficient of infestation was then calculated from using the formula:

$$\frac{x + 2y}{z} \times 100$$

where: x = number of slightly damaged plants
y = number of seriously damaged plants
z = total number of plants

Thus, high coefficient values correspond to high and serious incidences of plant damage.

Plant density

The number of plants present in 1 m^2 (4 m × 0.25 m) was counted for each replicate of each treatment.

Plant infection by *Leptosphaeria maculans* (*Phoma lingam*)

Disease symptoms on the leaves were assessed in autumn by recording the number of fully unrolled leaves on plants present in 1 m^2. The leaves were divided into the following categories:

0 = without damage
1 = 1 spot with pycnium
2 = 2–4 macules spots with pycnia
3 = 4 + macules (or fewer larged (merged) macules, covering a significant area of leaf with pycnia)

Stem necrosis was not assessed as no plants were observed with these symptoms during autumn.

Occurence of galls by the turnip gall weevil (*Ceutorhynchus pleurostigma*)

The number of galls on the belowground parts was assessed in early November and at the end of March. In each replicate, we sampled the plants in a 1 m^2 (4 m × 0.25 m) area, counting the number of galls. The average per plant was then calculated.

Yield

All trial plots were harvested using a small-plot harvester and the seed weights determined and values were converted to standard 12% of humidity. The results from years and localities with significant occurrence of studied pests on the control plots are given in this article.

RESULTS AND DISCUSSION

Only results from years and localities where in regards to weather conditions, pest's occurrence and the general state of growth appeared to have the highest differences are presented. Usable results also from other years and localities do not much

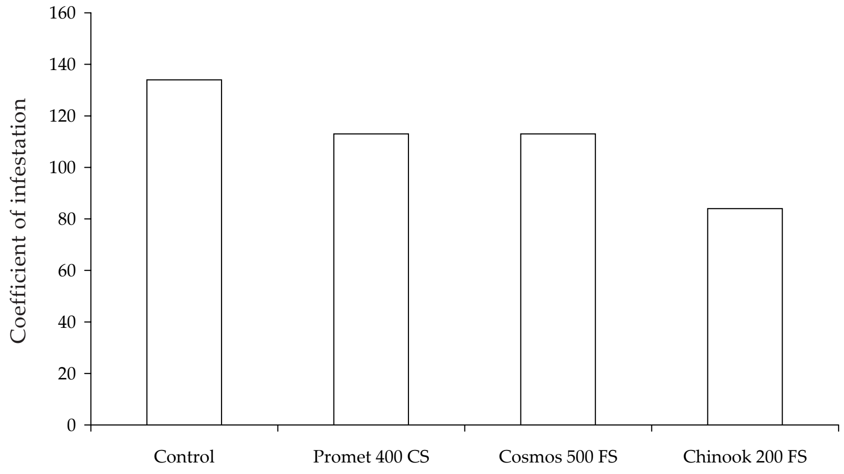

Figure 1. Plant damage by *Phyllotreta* sp., average of two localities (2000)

differ from the typical ones, differences between variants were not considerable.

The occurrence of both pests and diseases was very different between experimental years as well as between experimental localities. In cases where low occurrence, even on control treatments, was measured, the locality was not included in the analysis. Also due to unfavourable weather conditions some localities could not be evaluated because of lack of crops to samples.

Efficiency of seed treatment against flea beetles from *Phyllotreta* spp. and next pests in the period of emergence

In experimental years with low occurrence of pests, the results between treatments were quite similar, and the most damaged plant occurred in the control. However, the plants usually survived such low levels of damage. Good effectiveness was recorded repeatedly in Marshal ST treatments.

The highest occurrence of flea beetle feeding damage was detected in autumn 2000. Evaluation in mid September showed that seed treatment with Promet 400 CS and Cosmos 500 FS were approximately equally effective against flea beetles. Chinook 200 FS was significantly better than all other treatments (Figure 1).

A small amount of damage to the leaf by pest insects is necessary in order that they absorb the active ingredient, which will kill them. Therefore we used the most efficient coefficient allowing the differentiation of low and high damage of the plants.

The plants in the Chinook 200 FS treated plots were significantly less damaged than the other two treatments (ANOVA, $F = 8.254$, 3.9 *df*, $P < 0.1$, $P < 0.05$, $P < 0.01$). The most seriously damaged plants occurred in the control (Figure 2).

Seed treatment by Chinook provided statistically significantly better control.

The effectiveness of imidacloprid against flea beetles at emergence and on other *Brassica* species has been previously reported (e.g. Addison et al. 2002, Green 2002, Ester et al. 2003). Nevertheless, Finch and Edmonds (1999) and Ester et al. (2003) also noticed the low efficiency of imidacloprid against the damage of roots by cabbage root fly larvae (*Delia radicum* L.). This dipteran pest causes many problems in Germany during the autumn period (Erichsen et al. 2004). Jukes et al. (2001) detected much higher control of cabbage root fly by watering plants with fipronil than by seed

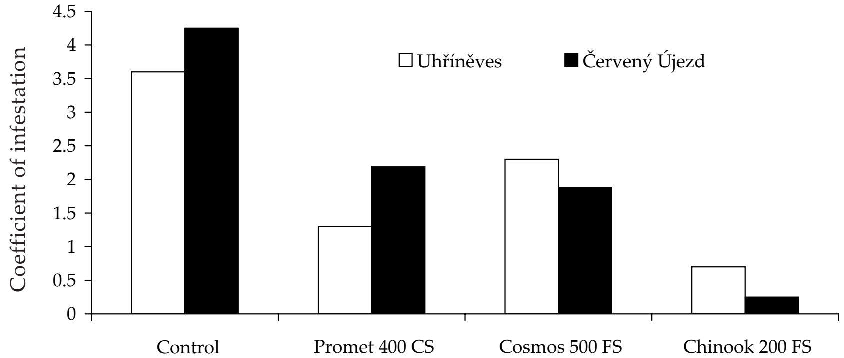

Figure 2. Seriously damaged winter rape plants by *Phyllotreta* sp. (14.9.2000)

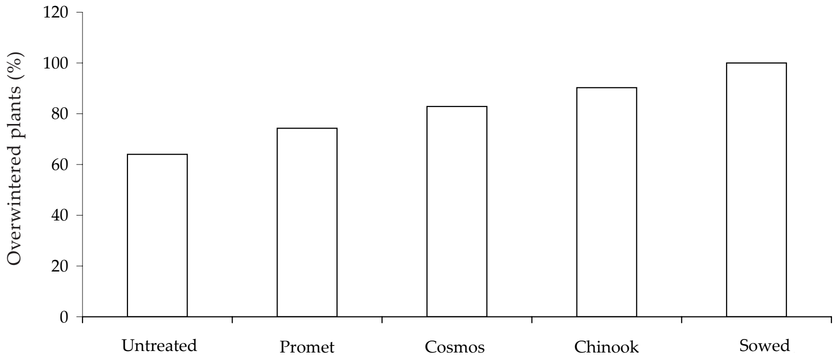

Figure 3. Survival winter rape plants in year 2000–2001 (%)

dressing. However, the amount of active ingredient effectively used in the seed treatment was too low in this experiment and using a solution would be impractical for farmers. Imidacloprid is also uneffective against field slugs (Simms et al. 2003).

Generally in the Czech Republic we noticed in practice markedly lower damage of plants by flea beetles on treatments using treated seed. In instances when the number of flea beetles were high, spraying with pyrethroid could not substitute seed dressing: the efficiency spraying on its own is relatively low. The best results are therefore achieved by combining a seed dressing with subsequent sprays where necessary. In the Czech Republic the registered preparation Cruiser OSR (imidacloprid & beta-cyfluthrin) was the least effective. It is generally accepted that the best seed treatment is by Chinook 200 FS. However, the combined insecticide-fungicidal preparation Cruiser OSR is the most effective solution against pests and diseases than other seed treatment preparations available to date. In experiments in Europe excellent control was achieved against all important pests of young plants including flea beetles (*Phyllotreta* sp. and *Psylliodes* sp.), turnip sawfly (*Athalia* sp.) and aphids as well as against all seed and soil transmitted diseases (*Peronospora* sp., *Alternaria* sp., *Rhizoctonia* spp., *Pythium* spp., *Fusarium* spp. and *Leptosphaeria maculans*).

The Cruiser with its insecticidal effect also provides control against persistent virosis transmitted by sucking insects. According to our experiences, the effective duration even of the best dressing preparations remains about 4–5 weeks. In the case of next pressure of pests shows necessary application of an insecticide. The same effective duration of imidacloprid seed treatment against Cabbage Aphid (*Brevicoryne brassicae*) detected by Schroeder et al. (2001). The effectiveness of seed treatment considerably decreased six weeks after sowing.

Plant density in autumn and in spring after overwintering

In all experiments, there was no significant negative impact of seed treatments on plant germination. However, germination at some localities was decreased sporadically by Marshall seed treatment. It has been known that insecticidal seed dressing does not influence the energy required for germination of crops such as maize, sunflower, Lucerne.

Autumn plant density in plots treated with Chinook was regularly higher than other treat-

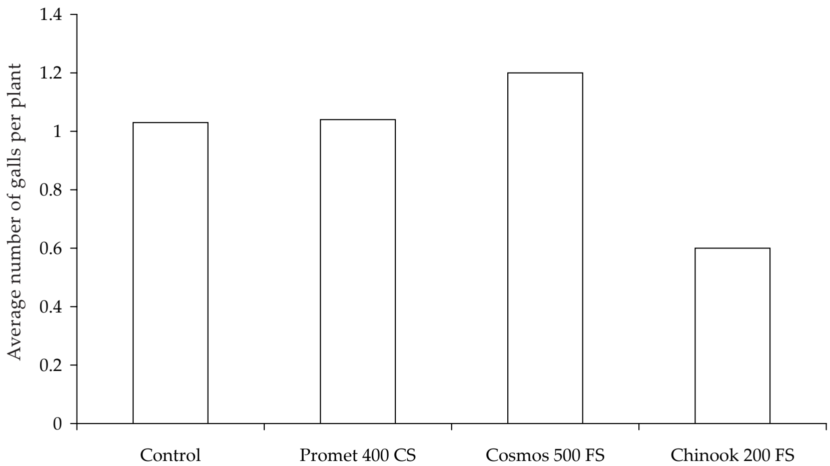

Figure 4. Number of galls by *C. pleuristigma*; average from several localities (2000)

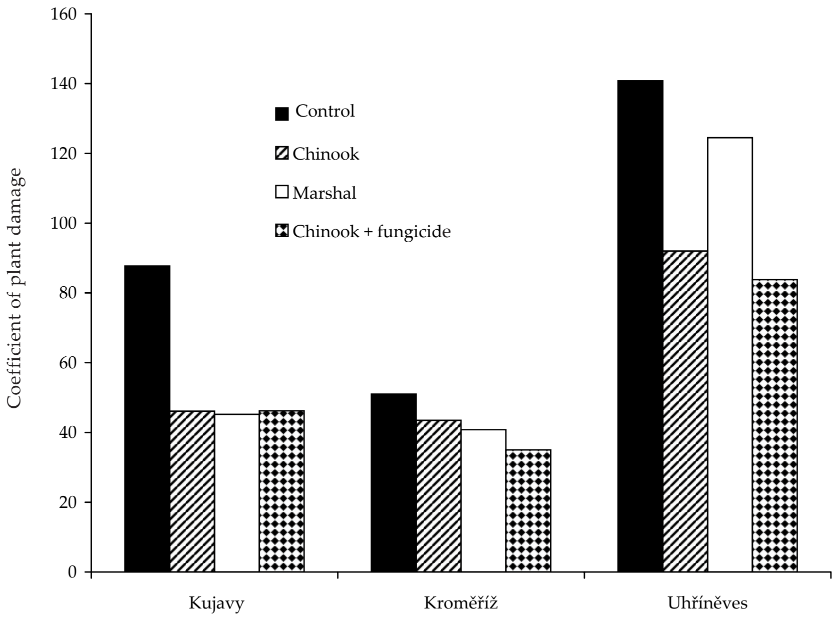

Figure 5. Coeffients of plant damage by pests (autumn 2002)

higher value = higher damage

ments (ANOVA, F = 8.254, 3.9 df, P < 0.1, P < 0.05, P < 0.01). The important measurement for farmers is how many plants remain after winter. Figure 3 shows the average number of plants per m^2, which successfully overwintered after warm and dry autumn 2000.

Statistical evaluation of plant density revealed no highly significant differences. The results varied too, the differences between treatments were not great. Similar results were also obtained from other localities.

Successful overwintering of Chinook-treated seeds was attributed not only to leaf area lost through pest damage but also to plant mass both above and below ground. The higher weight of *Brassicas* grown from imidacloprid-dressed seeds was also detected in laboratory experiments (Finch and Edmonds 1999).

Efficiency of seed treatment against galls of the turnip gall weevil (*Ceutorhynchus pleurostigma*)

An extraordinarily high occurrence of *C. pleuristigma* galls was found in autumn 2000. Older seed dressing treatments proved ineffective. Only Chinook provided good control (Figure 4). Better results were achieved by a combination of seed dressing and subsequent insecticidal treatment at the end of September. Same as the effectiveness of seed treatment by Cruiser was similar to the treatment with Chinook. Nevertheless, the effectiveness is on a good level that it is not necessary to practice targeting application against turnip gall weevil, because of minimal influence on final yield.

Seed treatment by Chinook provided statistically significant better control.

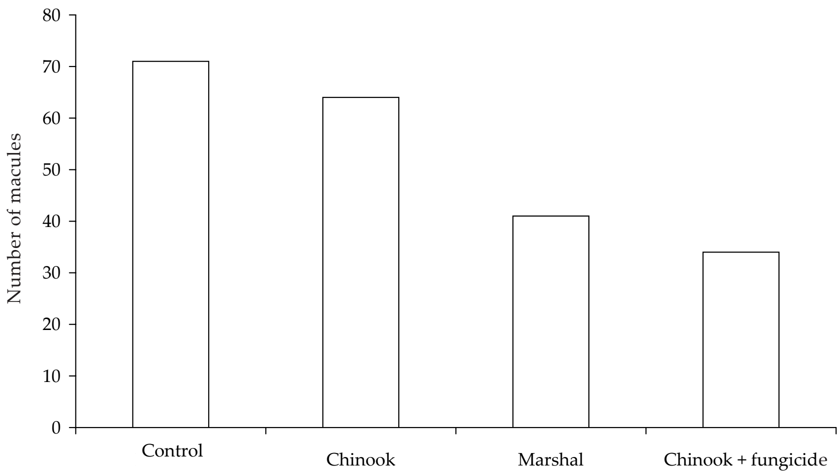

Figure 6. Number of macules by *Leptosphaeria maculans* at leaves (2002)

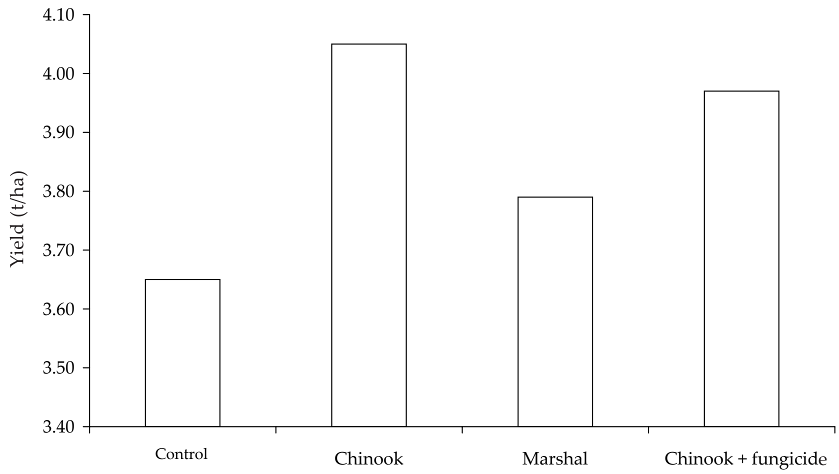

Figure 7. Yield of oilseed rape (2003)

Efficiency of combined insecticide-fungicidal seed treatments

In our field trials we tested only one non-registered combined preparation: Chinook + fungicide. According to the standpoint of the treatment producer, in Europe as well as in the Czech Republic common used preparation Cruiser OSR (containing two fungicidal components – thiamethoxam + fludioxonil + metalaxyl-M) was not included into our experiments.

From Figure 5, it can be seen that the combined seed treatment is mostly slightly more effective against flea beetles as well.

The occurrence of leaf spots caused by *Leptosphaeria maculans* was markedly less in treatments including the fungicide than in other treatments (Figure 6). It is interesting to note that even insecticidal seed treatments, particularly Marshal ST, reduced the occurrence of fungal disease in comparison to the control (Figure 6).

Impact of seed treatment on yield

Oilseed rape takes a long time from sowing until harvest, and within that time, growth and development remains under the influence of many factors. The determination of the factors, which have an important influence on the yield, is complicated. Our experiments were primarily concerned with the occurrence of fungal diseases in some years during May and June. Therefore was the impact of seed treatment on final yield fully concealed.

Only in 2003 occurred any deranging influences during whole vegetation, which may cause dissimilarities between treatments. Therefore, we ascribe the yield differences as ensuing response of seed treatment. This influence was probably furthermore increased by unfavourable overwintering conditions during winter 2002/2003.

Figure 7 shows that all seed treatments had a significantly positive effect on yield compared with the untreated control (ANOVA, $F = 8.254$, 3.9 df, $P < 0.1$, $P < 0.05$, $P < 0.01$). Seed treatment with Chinook had the most effect on yield, increasing it by around 500 kg/ha.

Yield of treatments Chinook and Chinook + fungicide were significanly higher than the untreated control. Differences between replicates were large, caused by many factors during vegetation.

In the year 2000 (seed rate 70 seeds/m^2) Chinook treated plots yielded moderately less than the plot treated by Promet and Cosmos. This was probably due to the markedly higher number of plants in this treatment than in the control. Higher plant density negatively influences yield. Therefore, when sowing seeds dressed with quality preparations, it is necessary to decrease seed rate to about 50 seeds/m^2 particularly for hybrid varieties.

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Received on December 6, 2004

ABSTRAKT

Moření osiva ozimé řepky

V letech 2000–2003 byly založeny maloparcelkové pokusy s cílem ověřit vliv různého moření osiva ozimé řepky na výskyt škůdců a chorob v podzimním období. Byla hodnocena účinnost moření osiva ozimé řepky fungicidními a insekticidními mořidly a ekonomická návratnost tohoto způsobu ochrany. Do pokusu byla zařazena osiva namořená insekticidními mořidly Promet 400 CS (ú.l. furathiocarb), Cosmos 500 FS (ú.l. fipronil), Chinook 200 FS (ú.l. imidacloprid & beta-cyfluthrin) a Marshal ST (carbosulfan). Testováno bylo i mořidlo Chinook 200 FS v kombinaci s fungicidní složkou. Ze zkoušených mořidel byla zjištěna nejvyšší účinnost u Chinook 200 FS (ú.l. imidacloprid & beta-cyfluthrin) zejména proti dospělcům dřepčíků rodu *Phyllotreta*. Rovněž bylo zjištěno menší množství hálek krytonosce zelného (*Ceutorhynchus pleurostigma*). Účinnost trvá maximálně 4–5 týdnů po zasetí. Moření však neúčinkuje proti larvám květilek (*Delia*) na kořenech. V případě potřeby ochrany v dalším období je nutné využít běžná pesticidní ošetření. Moření přípravkem Chinook 200 FS rovněž zvýšilo počet rostlin v podzimním i jarním období. V některých letech byl zjištěn též pozitivní vliv na výnos.

Klíčová slova: *Brassica napus*; ozimá řepka; moření osiva; podzimní ochrana; *Phyllotreta* sp.; *Ceutorhynchus pleurostigma*; *Delia* sp.

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