Laboratory Studies of the Activity of Spinosad against *Leptinotarsa decemlineata* (Say) Depending on Different Temperature

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Key words: *Leptionotarsa decemlineata*, spinosad, temperature, control

Abstract

Mortality of the Colorado potato beetle larvae (Say) and adults caused by commercial formulation of spinosad at 15, 20 and 25^{0}C was determined under laboratory conditions. The insects and the leaves of potatoes were sprayed with the insecticide. Thus, the insecticide was toxic by exposure to treated surfaces and ingestion. Three concentrations of insecticide were used: 0.2%, 0.1% and 0.05%. The effect was assessed the 6th day after treatment. All concentrations caused mortality both adults and larvae; however mortality of tested insect stages increased as concentration of spinosad increased. For adults was observed the highest mortality in combination with 0.2% at 15^{0}C, whereas at this same temperature in combination with 0.1% was reached the lowest mortality. In tests with the larvae was observed that 0.2% of spinosad caused the lowest mortality at 25^{0}C, whereas concentration 0.1% of spinosad reached the best results at this same temperature. For adults and larvae concentrations 0.05% of spinosad reached the lowest mortality and differences between results in this combination depend on temperature were not observed.

Introduction

Colorado Potato Beetle (*Leptinotarsa decemlineata* Say), CPB, is a very important pest of organic farming. This pest may be managed culturally by crop rotation or destruction of crop debris. In conventional agriculture, the insecticides including imidacloprid or neonicotinoid compounds are commonly used to control of CBP populations, but this pest rapidly develops resistance and additionally these insecticides are forbidden in organic farming system (Council Regulation EEC No 2092/91).

In Poland, until now, spinosad is used to control of pests of ornamental plants and in the orchards. Proposed research can contribute to extend the spectrum of susceptible pests. The aim of current study was to evaluate the toxicity of a commercial spinosad formulation to *L. decemlineata*. Effects of post-treatment temperature and stage of development of insects on mortality were investigated.

Materials and methods

In June and July, the adults and larvae of *L. decemlineata* were collected in Western region of Poland. The insects were fed in an insectary. Larvae of the 3th and 4th instar and adults were used in the experiments. Bioassays were conducted in the laboratory

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using the Petri dishes. The insects and leaves of potatoes were sprayed with different concentrations of spinosad. Experiments have done with Biospin®, a commercial formulation of spinosad (120 g a.i. /L product; DowAgroScience). Solutions of spinosad (0.2%, 0.1% and 0.05%) were prepared in distilled water. Volume of water (500 l/ha) were equivalent to that of applied in the field. To investigate the effect of post-treatment temperature the Petri dishes were incubated in the dark at 15, 20 and 25^0C. Total number of insects used in each experiment was 50 insects. Each test was performed using two replicates. Summary mortality is presented after 6th day. The data obtained were subjected to ANOVA. The significance of differences was examined using Tukey's test.

Results

Analysis of variance showed significant differences in mortality between temperatures and concentrations of spinosad for both adults ($F=13.87$, $P<0.05$) and larvae ($F=8.06$, $P<0.05$) (Fig 1 and Fig. 2).

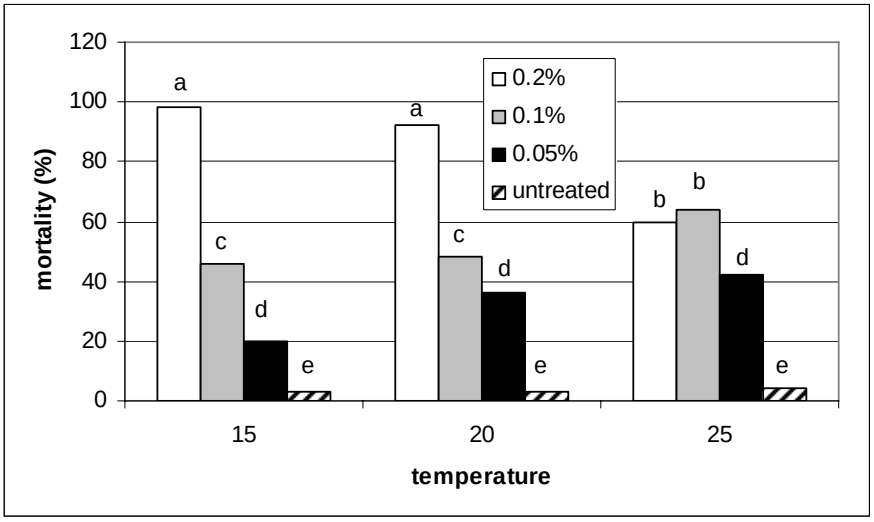

Figure 1: Effect of spinosad on the larvae of *L. decemlineata* depending on temperature (Within the figure, means followed by the same letter are not significantly different)

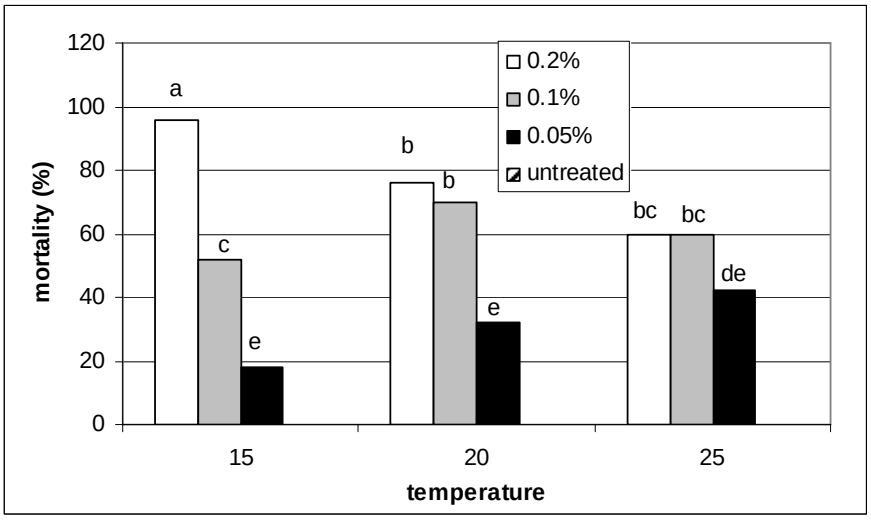

Figure 2: Effect of spinosad on adults of *L. decemlineata* depending on temperature (Within the figure, means followed by the same letter are not significantly different)

All concentrations caused mortality both adults and larvae, however mortality of tested insect stages increased as concentration of spinosad increased. For adults was observed the highest mortality in combination with 0.2% at 15^0C, whereas in this same temperature in combination with 0.1% was the lowest mortality. In tests with the larvae was observed that 0.2% of spinosad caused the lowest mortality at 25^0C, whereas concentration 0.1% of spinosad reached the best results at this same temperature. For adults and larvae concentrations of 0.05% spinosad reached the lowest mortality and differences between results in this combination depend on temperature were not observed. In the table are included mean results depending on used concentration and temperatures in replicate.

Tab. 1: Average mortality of different stages of development of *L. decemlineata* depending on temperature and concentrations of spinosad

Temperatures/ Concentrations of spinosad	Mortality of CPB larvae/replicate ± SD	Mortality of CPB adults/ replicate ± SD
15^0 C	27± 1.8b	28 ± 1.9a
20^0 C	29.3± 1.8b	30.3 ± 1.9a
25^0 C	34 ± 1.8a	27.3 ± 1.9a
0.2%	47.3±1.8a	39.3±1.9a
0.1%	28±1.8b	31±1.9b
0.05%	14.6±1.8c	15.3±1.9c
untreated	2.0±1.8d	0.0±0.0d

Within each columns, means followed by the same letter are not significantly different, n=50 insects/replicate

Discussion

Spinosad is derived from fermentation products of actinomycete bacterium (Mertz and Yao 1990). Depending on the species, stage of development or mode of application spinosad may be various toxic. The active components, spinosyn A and spinosyn D can effective control pests of the orders Lepidoptera (Sparks *et al.* 1995, 1998), house flies (Scot 1998), eggplant flea beetle (McLeod *et al*. 2002) and stored-product insect species (Huang *et al.* 2004). This insecticide is effective to insect species that are resistant to some synthetic insecticides (Lui *et al.* 1999) and has a limited impact on non-targeted organisms (Sarfraz *et al*. 2005). In the laboratory, spinosad treatments were toxic to *Mamestra configurata* Walker, *Phyllotreta cruciferae* Goeze (Elliot *et al*. 2007). Among beetle species toxicity is various, for example spinosad was over 400 times more toxic to adult of *Rhyzopertha dominica* F. than to adult *Tribolium castaneum* Herbst (Toews and Subramanyam 2003). The effect of spinosad depends on mode of application and temperatures. Temperature has no effect on the toxicity of spinosad to stored-product beetles (Fang and Subramanyam 2003), whereas in the grasshoppers that is important factor for mortality of pest (Amarasekare and Edelson 2004).

The data of this study showed that temperature influences an effect of spinosad on larvae of *L. decemlineata* and adults. The larvae of *L. decemlineata,* like *Oulema*

melanoplus (L) and adult *Epitrix fuscula* (Crotch) are characterized by different susceptibility to spinosad applied to foliage.

References

Journal articles:

Amarasekare, K.G.. Edelson, J. V. (2004) Effect of temperature on efficacy of insecticides to differential grasshopper (Orthoptera: Acrididae). Journal of Economic Entomology, 97: 1595-1602.

Council Regulation (EEC) No 2092/91 of 24 June 1991 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs.

Elliott, R., Benjamin, M., Gillott, C.(2007) Laboratory studies of the toxicity of spinosad and deltamethrin to Phyllotreta cruciferae (Coleoptera: Chrysomelidae)1 Canadian Entomologist. Ottawa:Jul/Aug 139: 4: 534.

Fang, L., Subramanyam, B. (2003) Activity of spinosad against adults of Rhyzopertha dominica (F.) (Coleóptera: Bostrichidae) is not affected by wheat temperature and moisture. Journal of the Kansas Entomological Society, 76: 529-532.

Huang, F., Subramanyam, B., Toews, M. D. (2004) Susceptibility of laboratory and field strains of four stored-product insect species to spinosad. Journal of Economic Entomology, 97: 2154-2159.

Lui, T, Sparks, A.N.. Jr.. Hendrix, W.H. Yue, B. (1999) Effects of SpinTor (spinosad) on cabbage looper (Lepidoptera: Noctuidae): toxicity and persistence of leaf residue on cabbage under field and laboratory conditions. Journal of EconomicEntomology, 92: 1266-1273.

McLeod, P., Diaz, F.J., Johnson, D.T. (2002) Toxicity, persistence and efficacy of spinosad, chlorfenapyr and thiamethoxam on eggplant when applied against the eggplant flea beetle (Coleóptera: Chrysomelidae). Journal of Economic Entomology, 95: 331-335.

Mertz, F.P., Yao, R.C. (1990). Saccharopoly spora spinosa sp. nov. isolated from soil collected in a sugar mill rum still. International Journal of Systematic Bacteriology, 40: 34-39.

Sarfraz, M., Dosdall, L.M., Keddie, B.A. (2005) Spinosad: a promising tool for integrated pest management. Outlooks on Pest Management, 16: 78-84.

Scott, J. G. (1998) Toxicity of spinosad to susceptible and resistant strains of house flies, Musca domestica. Pesticide Science, 54: 131-133.

Sparks, TC., Thompson, CD., Kirst, H.A., Hertlein, M. B., Larson, L. L., Worden, T.V., Thibault, S.T. (1998) Biological activity of the spinosyns, new fermentation derived insect control agents, on tobacco budworm (Lepidoptera: Noctuidae) larvae. Journal of Economic Entomology, 91: 1 277- 1233.

Toews, M. D., Subramanyam, B. (2003) Contribution of contact toxicity and wheat condition to mortality of stored-product insects exposed to spinosad. Pest Management Science, 59: 538-544.