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ENVIRONMENTALLY FRIENDLY ORGANIC PRODUCTS AND ONION PESTS IN LATVIA

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Study on whether organic products - peat and vermicompost extracts affect pests was carried out. Trials were performed over two vegetation seasons under field conditions in the Western part of Latvia. Extracts made at two different temperatures (45°C and 95°C), as well as their mixtures were used. Onion bulblets were soaked and onion plants sprayed with solutions. Population and damage level of three pest species onion fly *Delia antiqua*, onion leaf miner *Phytomyza atricornis* and onion leek moth *Acrolepiopsis assectella* were evaluated. The obtained results greatly varied between seasons. It was not clearly established over the research period whether this was due to the variable climatic conditions or the treatments applied.

Key words: Onion pests, pest damages, conventional farming, vermicompost and peat extract.

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INTRODUCTION

Intensive management of monoculture farming has caused intensive development of agricultural pests. This in turn has brought about intensive usage of various insecticides and other chemicals disturbing whole ecosystems and beneficial soil biota as well as disrupting the natural balance of host-parasitoid systems (Bosch & Stern 1962, Singh 2003). To limit the application of pesticides, currently plant protection products of organic origin receive increased attention. Organic farming do not have only straight impact on environment via using zero chemical products, but also through preserving natural enemies of pests due to avoidance of insecticides. Several authors investigated the impact of insecticides on natural pest enemies and the potential role of organic farming in maintenance of the increased richness and evenness of natural enemies of *Leptinotarsa decemlineata* in organic and conventional potatoe fields near Washington (USA) (Carruthers 1985, Crowder et al. 2010). Higher evenness in organic fields reflected relatively equitable distributions of natural enemies, whereas conventional fields were dominated by one enemy taxon.

Over the last decades, various types of organic products are applied in agriculture, including vermicompost (Juarez et al. 2011, Adhikary 2012). Numerous investigations have been carried out in relation to the peat and vermicompost extract effects on plant germination, growth and yield, plant resistance and strengthening, and soil and environmental recovery, as well as antifungal and antibacterial effects (Nardi et al. 2002, Singh 2003, Mayhew 2004, Arancon et al. 2005, Schleß & Böhm 2005, Ghorbani et al 2006, Skrabule et al. 2008, Arancon 2011, Lazcano & Dominiguez

2011, Little & Cardoza 2011). It was shown that vermicompost and humic substances have a positive stimulating effect on the plant growth and promotion of plant resistance. However there are investigations demonstrating also negative effects of vermicompost on some plant species in early developmental stages (Ievinsh 2011).

Information on the usage of peat and vermicompost extracts in crop pest control is scarce. The first investigations confirming the influence of vermicompost have been performed by N. Arancon (Arancon et al. 2005, Arancon 2011), who showed that vermicompost usage as fertilizer suppressed attacks of sucking or chewing insect pests and parasitic Nematoda as well as stimulated better plant resistance to pest attacks: for example, *Acalymma vittata* (Coleoptera, Chrysomelidae) on cucumbers and *Manduca sexta* (Lepidoptera, Sphingidae) on tomatoes. If the inorganic fertilizers were used alone, the pest infestation was higher. Several authors (Edwards et al. 2010) suggested that for peach aphids, mealy bugs and two spotted spider mites in greenhouse experiments vermicompost extracts significantly suppressed pest establishment on the plants and their rates of reproduction.

While acting mechanisms of compost extracts are not well known they seem to vary depending on the host/pathogen relationship and the mode of application (Ghorbani et al. 2006, Little & Cardoza 2011). Some authors (Edwards et al. 2010, Yardim et all 2006) concluded that the most likely causes for the unacceptability of the plants to pests, their decreased reproductivity and mortality were the uptake of soluble phenolic materials from the vermicompost extracts into the plant tissues, which turned the latter distasteful to pests. The phenolic acids found in vermicompost could have positive effects on the increase of resistance of plants against pathogens and herbivores (Singh et al. 2003).

In several experiments (Little & Cardoza 2011) the increased damage caused by some pests on selective crop species in case of using vermicompost in high concentrations (e.g. 60%) was observed and selective effect of vermicompost on various pest species stated.

Delia antiqua, *Acrolepiopsis assectella* and *Phytomyza atricornis* are well known onion pests (Szwejda & Wrzodak 2009, Richter & Hommes 2003). Onion leaf miner *P. atricornis* is known to be an onion pest not for so long time and is not as dangerous as other two species. Onion fly *D. antiqua* and leek moth *A. assectella* have a wide range of distribution through Palaearctic region and are one of the most dangerous onion pests in Europe. Still there is a lack of information on potential usage of organic plant protection products in control of the above pests, as well as there is little information on pest species and their dynamics occurring in onion plantations in Eastern Europe (Szwejda & Wrzodak 2009).

The aim of the current paper is to show whether there is any effect of peat and vermicompost extracts on onion pests. Trials were performed as co-experiment in the frames of research on effects of organic products on feeding and growth of crops, and restriction of fungal diseases.

MATERIALS AND METHODS

Trials used

The impact of extracts derived from organic products for their effectiveness in limiting of pests in onion plantations was tested at State Stende Cereal Breeding Institute (SSCBI), Dižstende, Talsi municipality, 2011-2012.

Onions were planted in the 1st ten-day period of May and trials were set up in the conventional farming system with 20 treatments.

The following solutions obtained at various temperatures were used:
1) peat extract, 45°C and 95°C (P45, P95);
2) vermicompost extract, 45°C and 95°C (V45, V95);
3) peat extract 95°C + vermicompost extract 45°C (P95 + V45);
4) vermicompost extract 45°C + vermicompost 95°C (V45 + V95).

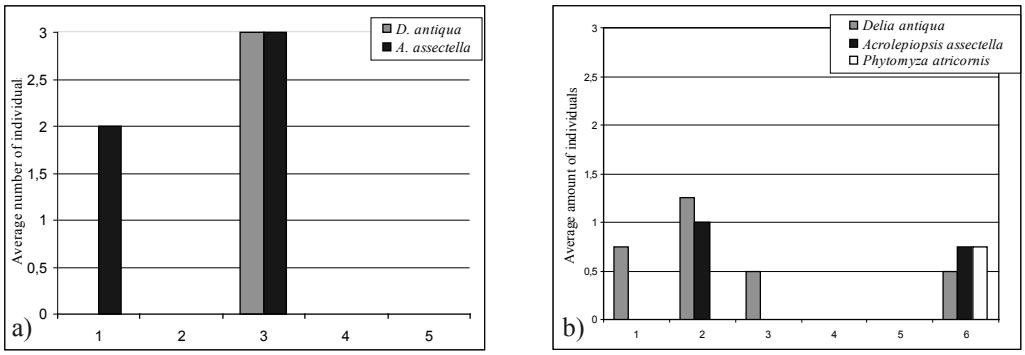

Fig. 1. Average number of individuals of *D. antiqua*, *A. assectella* and *Ph. atricornis* recorded on the yellow sticky traps in onion plantations, SSCBI, Dižstende. a) vegetation season 2011, b) vegetation season 2012. (Over a vegetation season, 1 - 6 times sticky traps were exposed).

The following scheme of treatments for each of extracts or mixtures was used:
1) bulblets treated before planting + plants treated 2 times (BBCH 19, BBCH 43-45) (T1),
2) plants treated 2 times (BBCH 19, BBCH 43-45) (T2)
3) plants treated 3 times (BBCH 13, BBCH 19, BBCH 43-45) (T3).

For the correct evaluation of the obtained results untreated control plots were also included in the trial scheme. Pre-plant fertilizer with N:P:K ratio 16-16-16 (850 kg ha^{-1}) was used. The bulblets were treated with a solution of extracts (10 ml/l) and onion plants sprayed with 0,6 % solution. Spraying was performed by the bicycle-type sprayer Birchmeier Spray-Matic 10 S. The average air temperature (°C) and amount of precipitation (mm) was measured during the vegetation seasons 2011-2012 at Dižstende Hydrometeorological station.

Pest assessment

The emergence of pests was registered by setting up HORIVER® yellow sticky traps (10 x 25 cm) („KOOPERT"). Four traps were placed in the onion plantation on the 3rd ten-day period of May. The sticky traps were collected and changed once in every seven days (five or six times over the vegetation period). Insect identification was carried out in the laboratory.

Invasion level of onion plants damaged by *A. assectella* and *P. atricornis* was evaluated on 10 plants per plot three times over the vegetation period at onion developmental stages BBCH 19, 31 and 39. The average amount of onion bulbs damaged by *D. antiqua* maggots was counted on 100 bulbs per plot in onion yield (BBCH 49).

Data analyses were made by GenStat 12 Edition.

RESULTS AND DISCUSSION

Examination of the yellow sticky traps in onion plantations reviled three potential pest species: *Delia antiqua*, *Acrolepiopsis assectella* and *Phytomyza atricornis* (Fig.1). The dynamics of flight activity of adult pests varied over the investigation seasons.

Impact of extracts derived from organic products on the onion leaf quality

Phytomyza atricornis

In the vegetation season 2011 no adults of onion leaf miner were found on sticky traps. They were recorded only in the last assessment time in 2012 (Fig. 1). Nevertheless in the control plots damage level caused by *P. atricornis* maggots was 5.0-10.0%, but in the treated plots - 0-31.3% per assessment time in 2011. The highest amount of damaged onion plants was recorded at the second

Table 1. Average amount of onion leaf damages (%) caused by *P. atricornis*, SSCBI, Dižstende, 2011-2012. (Only treatments in any assessment time having non-zero values are shown)

Onion developmental stages	**BBCH 19**	**BBCH 31**		**BBCH 39**	
Treatment	**2011**	**2011**	**2012**	**2011**	**2012**
Control	5,0	7,5	0,0	10,0	0,8
P 45-T1	5,0	7,5	0,5	18,8	1,3
P 45-T2	10,0	25,0	0,0	10,0	0,5
P 45-T3	2,5	0,0	0,0	0,0	0,8
P 95-T1	10,0	5,0	0,3	12,5	0,8
P 95-T2	10,0	25,0	0,5	12,5	0,8
P 95-T3	5,0	0,0	0,0	2,5	1,0
V 45-T1	22,5	2,5	0,0	6,3	0,5
V 45-T2	7,5	18,8	0,3	5,0	0,3
V 45-T3	7,5	0,0	0,3	5,0	1,3
V 95-T1	7,5	5,0	0,3	12,5	1,8
V 95-T2	12,5	31,3	0,5	10,0	1,8
V 95-T3	7,5	0,0	0,3	5,0	1,0
P 45+V 45-T1	7,5	5,0	0,5	12,5	1,0
P 45+V 45-T2	0,0	0,0	0,0	17,5	1,3
P 45+V 45-T3	2,5	7,5	0,0	20,0	1,3
V 95+V 45-T1	-	-	0,3	-	0,8
V 95+V 45-T2	-	-	0,3	-	0,8
V 95+V 45-T3	-	-	0,0	-	2,0
LSD <0,05			*0,5*		*1,8*

assessment time (BBCH 31).

The recorded amount of damaged onion plants was obviously lower in 2012, and treated plots did not differ significantly from control plots (Table 1). No clear effect of applied extracts on *P. atricornis* was observed in the vegetation seasons 2011-2012.

Acrolepiopsis assectella

Adults of onion leek moth were recorded on sticky traps in both investigation seasons (Figure 1), but no damages caused by *A. assectella* maggots on onion leaves were recorded in 2012. Very few damages of the above pests were recorded over the vegetation season of 2011. At the first assessment time in control plots the highest level of damage was stated. Over the vegetation season several cases of damage at the second and the third assessment times were recorded (Fig. 2).

In similar studies in Germany (Richter & Hommes 2003) variable infestation levels of onions by *A. assectella* was observed: in one season damage was stated only by overwintered generation but no infestation by summer generations. In another vegetation season a severe infestation during the whole season was recorded. Unfortunately reasons for such variations were not interpreted.

Impact of extracts derived from organic products on the onion bulb quality

Delia antiqua

The adult onion flies were found on sticky traps

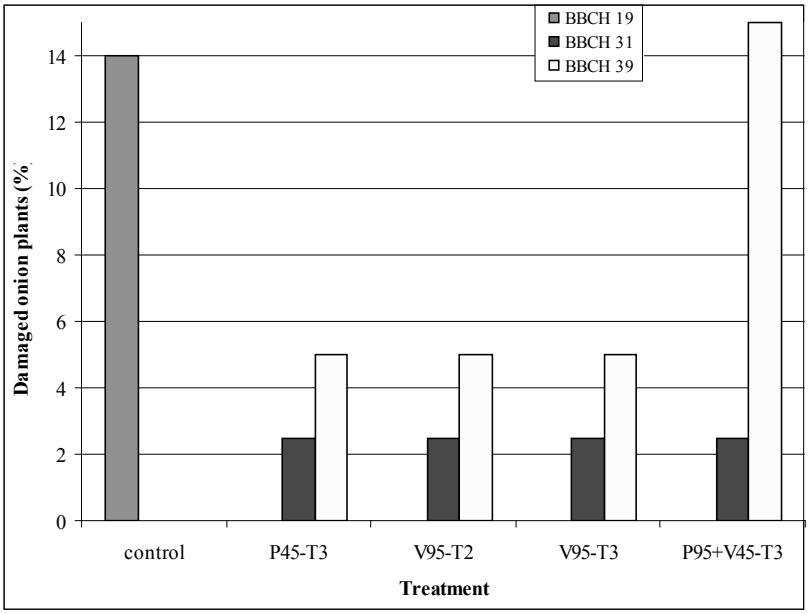

Fig. 2. Average amount of onion plant damages (%) caused by *A. assectell*a, SSCBI, Dižstende, 2011. (Only treatments in any assessment having non-zero values are presented).

in vegetation season of 2012 (Fig.1), but no damages of onion bulbs by its maggots were stated. Imagoes were found on sticky traps only in the middle of the vegetation season in 2011 (Fig. 3). The average amount of damaged onion plants varied from 3.8-12.8%. No significant difference from the control was observed.

Absence of *D. antiqua* can be explained by the lower average air temperature and the higher precipitation in vegetation season of 2012. Significant influence of weather conditions on amount of this pest was confirmed by some investigations (Musa 2005, Tanaka & Watari 2011).

Treatments used in trials were the same in both investigation periods, but the climatic conditions significantly differed between vegetation seasons: the average air temperature was higher and the average amount of precipitation lower in 2011 than in 2012. It is hard to give an eligible explanation why obtained results in current trials varied between vegetation seasons. Whether differences are caused by the influence of weather conditions or the extracts used, or those jointly with climatic conditions have some effect on pests, is not clear. There are some investigations, which confirm the role of environmental conditions in the pest-plant relationships and plant resistance (Rabinowitch 1997). There is some information on influence of environmental conditions on effects of plant extracts, as well as climatic condition effects on development of pests (Richter & Hommes 2003, Musa 2005, Skrabule et al 2008, Watari & Tanaka 2010, Tanaka & Watari 2011, etc.). Some studies differ from ours as they were performed in laboratory conditions, where the complete control of all parameters is possible.

Unfortunately, there is limited information on how the above-mentioned extracts affect invertebrates (e.g. pests). In some investigations positive effect of vermicompost in pest control was observed (Arancon et al. 2005, Arancon 2011). Still the mechanisms, which lead to decrease of pest infestation due to vermicompost, cannot be clearly identified and this has to be developed in the future investigations. There is no available information on how peat and vermicompost extracts affect onion plants

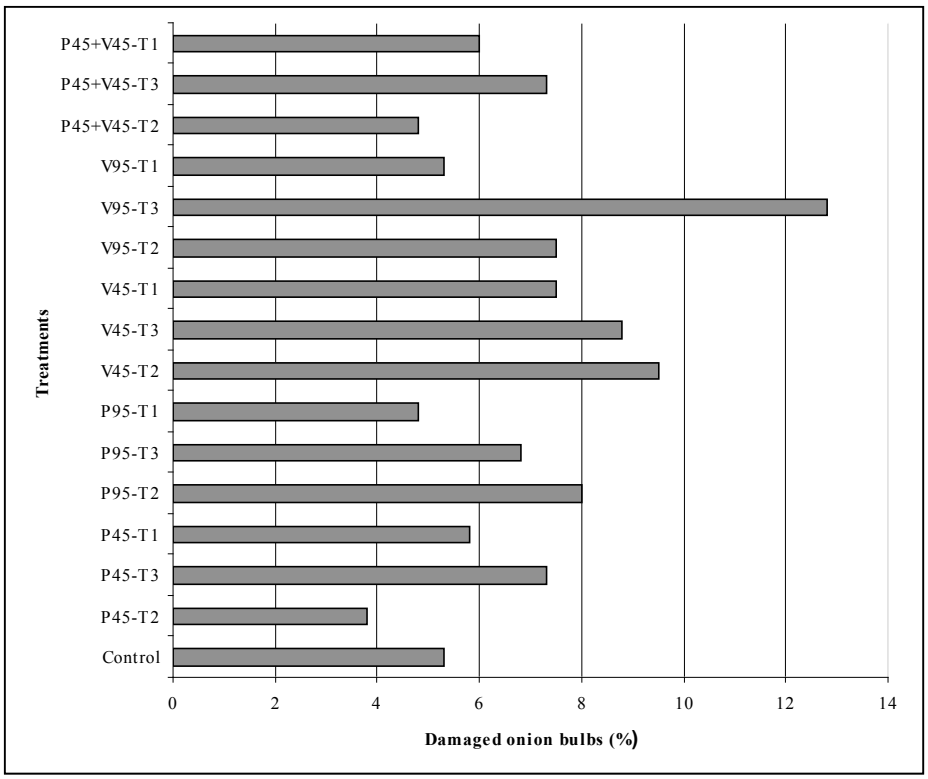

Fig.3. Average amount of onion bulbs damaged by *D. antiqua*, SSCBI, Dižstende, 2011. (Only treatments having non-zero values are presented).

and their pests. After two years research with the current set of the obtained data we cannot make any reliable conclusions on potential effects of peat and vermicompost extracts in the pest control. More possibly, particular pests on specific crops (onions) are not affected by the above extracts in the given concentration. However, assuming that such effect exists, it is possibly not direct and extracts probably act through improved plant resistance or as chemical repellents.

Obviously one of the main reasons was low concentrations of extracts used for treatment purposes. For a direct effect on pests, concentration of extracts has to be significantly higher. Yet from the literature it is known that vermicompost extracts have indirect effect through plant resistance improvement and production of some of phenolic substances.

Also weather conditions influenced plant and pest development, as well as action of used extracts.

CONCLUSIONS

No clear effects of applied extracts and their mixtures on onion pests *Acrolepiopsis assectella*, *Phytomyza atricornis* and *Delia antiqua* in onion (*Alium cepa*) plantations were recorded in the vegetation seasons 2011-2012.

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