Pestycydy, 2004, (3-4), 75-80.
ISSN 0208-8703

Dependence of the development grain weevil (*Sitophilus granarius* L.) on the addition of powdered fractions of pea seeds (*Pisum sativum* L.)

Mariusz NIETUPSKI[1], Dolores CIEPIELEWSKA[1], Bożena KORDAN[1], and Łucja FORNAL[2]

[1]*University of Warmia and Mazury, Chair of Fitopatology and Entomology, 4 Licznerskiego Str., 10-722 Olsztyn*
[2]*University of Warmia and Mazury, Chair of Plant Technology Products, 1 Cieszyński Sq., 10-957 Olsztyn*

Abstract: The effect of ground pea seed fractions on the foraging activity of grain weevil was examined in the presented work. It was found that the compounds present in the pea seed cover stimulated the development of grain weevil. The number of the grain weevil population was higher in the combinations with pea seed fractions. Likewise, the amount of dust subsequent to the foraging by grain weevil as well as the grain mass loss increased. In contrast, the substances found in pea seed cotyledons had a deterrent effect on *S. granarius* L.

Key words: plant powders, storage pests, deterrent substances

INTRODUCTION

Storage pest control with traditional methods is costly and labour-consuming. Besides, chemical methods create certain risk in that they involve using chemicals indoors. Other methods to control storage pests are therefore searched for, of which natural substances added to stored grains attract much attention. Such natural compounds, most commonly powdered parts of plants, repel foraging pests. In the present study two fractions of pea seeds: shredded seed covers and cotyledons of two pea cultivars Stig and Wiato, were tested. The seed cover

fraction contains predominantly non-starch polysaccharides with associated lignin. The repellents found in the fraction consisting of cotyledons include proteins with toxic properties and starch hardly accessible to amylolytic enzymes [1]. The objective of the experiment has been to determine whether there is any dependence between an addition of powdered pea seed covers or cotyledons to wheat grain and the parameters which specify harmfulness of grain weevil.

MATERIALS AND METHODS

The experiment involved observations of the development of grain weevil on wheat grain which differed in the hardness of the seed cover [2]. Ground fractions of pea seed covers and cotyledons were added to wheat grain. The following plant cultivars were used in the trials:

- wheat cultivars: Korweta (hard seed cover) and Mewa (soft seed cover),
- pea cultivars: Stig (edible pea) and Wiato (forage pea).

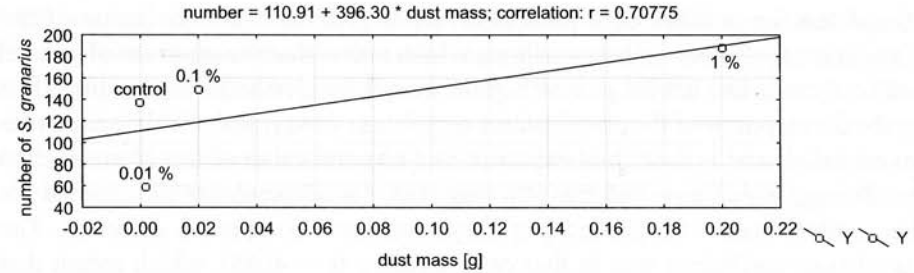
Ground fractions of pea seeds were added at three concentrations: 1%; 0.1% and 0.01%.

The development of grain weevil took place in a climatic chamber manufactured by Sanyo, at constant temperature (26 °C) and relative air humidity (70%). The experiment was established in 5 replications. Twenty young specimens (1:1) *S. granarius* L. were placed on each 20 g grain sample mixed with an appropriate amount of a ground pea seed fraction. Grain weevils developed for 8 weeks. After that all live and dead specimens of the pest were counted, thus determining the number of a population. Wheat grains were weighed in order to measure the wheat mass loss. The results of the number of grain weevil offspring were subjected to analysis of variance for the determination of significance of differences between the means. A coefficient of determination was computed between the grain weevil population number and the parameters, describing its harmful effect in the modified environment.

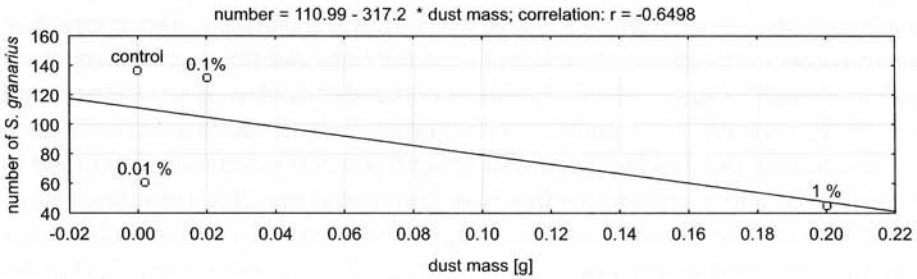
RESULTS AND DISCUSSION

Seeds of leguminous plants can be highly resistant or toxic to storage pests [3-5]. This paper presents an experiment conducted in order to examine the impact ground pea seed fractions added to wheat grains on the development of *S. granarius* L. It was ascertained that an addition of ground seed covers

stimulated the number of a population of *S. granarius* L. The value of the correlation coefficient (r) was positive, which meant that the presence of ground pea seed cover in a habitat in which grain weevil foraged had a favourable effect on the development of the pest. Positive correlation was typical of half the samples investigated, and is described most precisely by the value of the determination coefficient, which equalled 50.09% (Fig. 1a). The dependence determined for the combinations with ground pea cotyledons was completely different. The correlation coefficient was in that case negative (r = -0.65), which meant that the population number of *S. granarius* L. decreased as the amounts of ground cotyledons added to wheat grains increased (Fig. 1b). The correlation was confirmed statistically for 42.22% of the samples examined. The correlation between concentrations of the two pea seed fractions and the mass loss in wheat grains infested by grain weevil was also examined. Addition of ground pea seed covers did not have any significant effect on the loss in wheat grain mass (Fig. 2a). In contrast, the combinations with ground pea cotyledons were observed to be associated with a greater loss in wheat grain mass (Fig. 2b). The relationships found between the parameters specifying harmfulness of grain weevil suggest that the pea seed cover could be a source of substances stimulating the development of this beetle species. On the other hand, pea cotyledons, evidently had an adverse effect on the development of *S. granarius* L. This hypothesis was confirmed by an analysis of the relationships between both pea seed fractions and the amount of dust produced due to the foraging of grain weevil. It is claimed that the more dust is found in grain foraged by grain weevil, the more suitable such grain is as a habitat for this species of pest [6]. Addition of powdered pea seed covers (at the highest concentration) caused an increase in the mass of dust left after grain weevil foraging activity. The determination coefficient value (91.99%) suggested that this correlation was nearly linear (Fig. 3a). A similar correlation was found for the combination containing ground pea cotyledons. Nevertheless, the largest amount of dust appeared in the control combination grain. Both the correlation coefficient (r = 0.4) and determination coefficient (16.34%) did not show any significant statistical correlation between the analysed parameters (Fig. 3b). The main constituents of pea cotyledons are starch and proteins. It is therefore likely that the substances responsible for grain weevil development inhibition belong to either starch or proteins [4, 5].

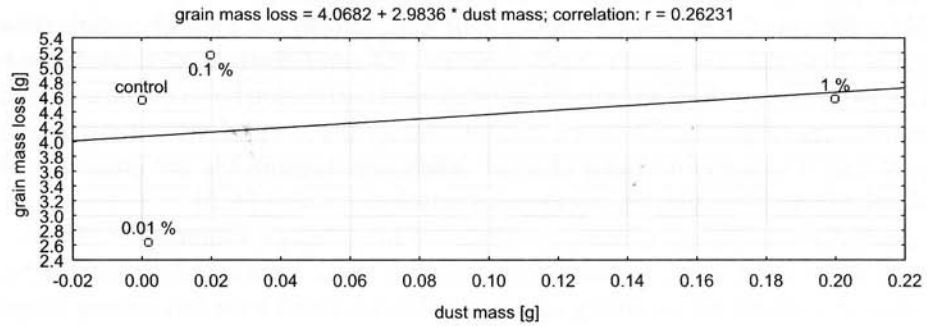


a. Addition of pea seed cover; determination coefficient: 50.09%

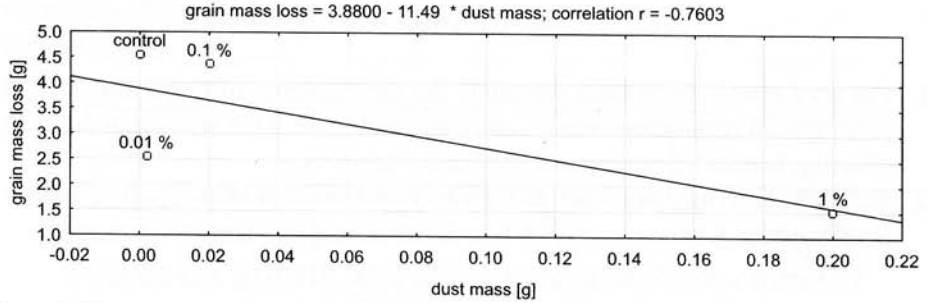


b. Addition of pea cotyledons; determination coefficient: 42.22%

Figure 1. Diagram of the correlation and regression between the *S. granarius* L. population number and the concentration of the *P. sativum* L. fraction added to wheat grain.

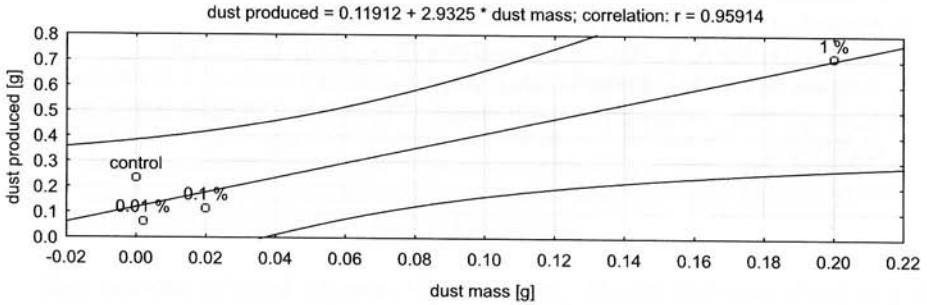


a. Addition of pea seed cover; determination coefficient: 6.88%

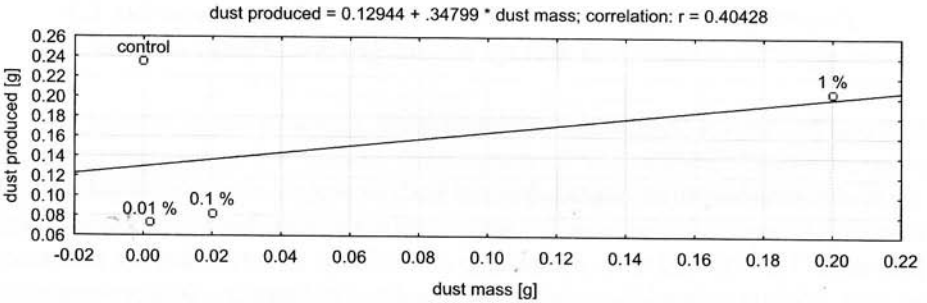


b. Addition of pea cotyledons; determination coefficient: 57.81%

Figure 2. Diagram of the correlation and regression between the wheat grain mass loss and the concentration of the *P. sativum* L. fraction added to wheat grain.



a. Addition of pea seed cover; determination coefficient: 91.99%



b. Addition of pea cotyledons; determination coefficient: 16.34%

Figure 3. Diagram of the correlation and regression between the amount of dust produced and the concentration of the *P. sativum* L. fraction added to wheat grain.

CONCLUSIONS

1. Pea seed cover compounds stimulate the development of grain weevil. The grain weevil population number increases and so does the amount of dust left after the beetles' foraging and the grain mass loss.
2. Substances from pea seed cotyledons produce a deterrent effect on *S. granarius* L.

REFERENCES

1. Kostyra H. *et al.*, COST 98. Proceeding of the sixth scientific workshop in Rome, 1998, 115-122.
2. Nietupski M. *et al.*, Progress in Plant Protection / Postępy w Ochronie Roślin, 2003, 43 (2), 833-835.
3. Fornal Ł., Ciepielewska D., Die Nahrung, 1995, 39 (4), 295-301.
4. Fields P. G., Xie X. S., Hou X., J. Stored Prod. Res., 2001, 37, 359-370.
5. Xingwei H., Fields P., Taylor W., *ibid.*, 2004, 40, 47-54.
6. Nawrot J. *et al.*, Progress in Plant Protection / Postępy w Ochronie Roślin, 1999, 39 (2), 503-508.

M. Nietupski, D. Ciepielewska, B. Kordan i Ł. Fornal

Zależność rozwoju wołka zbożowego (*Sitophilus granarius* L.) od dodatku zmielonych frakcji nasion grochu (*Pisum sativum* L.)

Streszczenie

W przeprowadzonym doświadczeniu badano wpływ rozdrobnionych frakcji nasion grochu (*Pisum sativum* L.) na żerowanie wołka zbożowego (*Sitophilus granarius* L.). Stwierdzono, że związki wchodzące w skład okrywy nasiennej grochu działają stymulująco na rozwój wołka zbożowego. W kombinacjach z dodaną frakcją nasion grochu obserwowano większą liczebność populacji chrząszcza, zwiększyła się masa pyłu pozostałego po żerowaniu oraz wzrósł ubytek masy ziarna. Natomiast substancje pochodzące z liścieni nasion grochu działały deterentnie na *S. granarius* L.