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INFESTATION OF BUCKWHEAT GRAIN AND ITS PRODUCTS BY PESTS IN STORAGE FACILITIES

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Abstract. The aim of the experiment was to assess the susceptibility of buckwheat grains and products to the infestation by *Trogoderma granarium* Everts. The observations were conducted on three buckwheat cultivars: Hruszowska, Emka and Kora. The results suggest that buckwheat grains and products as suitable for the development of the first larval stages of *Trogoderma granarium* as wheat grain and wheat flour. However, extension of the development stage on buckwheat seems to indicate that the seed cover inhibits the capacity of larvae to feed on buckwheat.

Key words: buckwheat, products, *Trogoderma granarium*

I. INTRODUCTION

High loss of grains during the storage caused by pests present in storage facilities has been most thoroughly investigated for wheat and maize grains (Gołębiowska et al. 1976; Sanchez-Marinez et al. 1997). Much evidence has been found to suggest that infestation of wheat or maize grain by *Trogoderma granarium* is difficult to assess due to the growth cycle of the pest. Therefore, determination of uric acid has been recommended as a method for assessment of infestation by the pest (Ghaedian and Wehling 1996). Likewise, analysis of volatile compounds of sorghum grains is used to assess their infestation by the most common storage pests (Seitz and Sauer 1996).

Not much attention is paid to storage loss and impaired quality of buckwheat grains and products resulting from the development of storage pests. The latest studies completed by Ciepielewska et al. (1998) suggest that *Acarus siro* L. may grow in buckwheat products, such as ground grain or flour. One of the insects which may considerably infest buckwheat grains is *Trogoderma granarium* Everts.

Trogoderma granarium is the only storage pest found on the quarantine lists of all the countries of the European Plant Protection Organisation (Lipa and Zych 1994). It is one of the most dangerous storage pests, which has completely adapted itself to the consumption of plant food. Since it is a polyphagous species, it destroys large quantities of grains of cereals and seeds of other plants, as well as their products, animal fodder, etc. Larvae are equipped with hairs with which they attach themselves to containers and packaging so that they are easily transferred.

Studies have been undertaken to show whether buckwheat grains and products can constitute a suitable environment for the development of *Trogoderma granarium*.

II. MATERIAL AND METHODS

1. Material

The experiment was performed on grains of three buckwheat cultivars: Emka, Kora and Hruszowska, obtained from the Chair of Plant Breeding and Seed Production, Warmia and Masuria University. The grains were conditioned at 30±1°C and relative air humidity 80±1%. The experiment was carried out on whole buckwheat grains, with 80% seed cover removed and grounded to pass through a mesh 2-2.5 mm and 0.8 μm.

2. Entomological observations

Pairs of 1d adults of *Trogoderma granarium* were settled on whole and grounded grains of buckwheat. The insects grew in dishes of 10 cm diameter with a 1 cm ventilation opening. The growth and mortality of each development stage was monitored at 7d intervals. Each combination was conducted in three replications. The control was grown on variety Almari wheat grain and commercial wheat flour. The experiment was carried out in the optimum conditions for the development of the species, at temperature of 27±1°C and relative humidity 70±1%. The results were analysed with analysis of variance for a two-factor laboratory experiment.

The results on the mortality of eggs and larvae expressed as percentages were subjected to the transformation according to Bliss. Significance of differences between the variants of the experiment was assessed with t-Student's test on the transformed (Bliss's angle degrees) and re-transformed (percentages) data. Significance was tested at P=0.01.

III. RESULTS AND DISCUSSION

The growth cycle of *Trogoderma granarium* was analysed according to the number of eggs laid, mortality of eggs, duration of subsequent larval stages and mortality of larvae. Insects laid eggs on buckwheat grains and products for 5-6 d, irrespective of the buckwheat cultivar. The result for wheat grain was identical (Tab. 1). Likewise, differences in the number of eggs laid were not significant statistically, both between the cultivars and between the combinations (Tab. 2). It can be suggested then that adult female insects do not distinguish

Table 1

The egg laying period of *Trogoderma granarium* according to substrate (in days)

Varieties	Combinations			Mean for variety
	whole grains	grains grounded to 2-2.5 mm	flour 0.800 μm	
Emka	6.0	5.6	6.3	6.0
Kora	5.5	6.0	5.1	5.5
Hruszowska	5.6	5.0	5.6	5.4
Wheat	5.0	–	5.3	5.2

at p = 0.01 LSD for cultivars – differences not significant
at p = 0.01 LSD for combinations – differences not significant.

Table 2

Number of eggs laid by *Trogoderma granarium* according to substrate

Varieties	Combinations			Mean for variety
	whole grains	grains grounded to 2-2.5 mm	flour 0.800 µm	
Emka	13.6	21.6	14. 6	12.1
Kora	20.6	23.0	16.6	20.1
Hruszowska	16.3	18.3	15.0	16.5
Wheat	18.3	–	11.0	14.6

at p = 0.01 LSD for cultivars – differences not significant
at p = 0.01 LSD for combinations – differences not significant.

Table 3

Mortality of *Trogoderma granarium* eggs according to substrate (in %)

Varieties	Combinations			Mean for variety
	whole grains	grains grounded to 2-2.5 mm	flour 0.800 µm	
Emka	18.7	10.6	50.0	26.5
Kora	21.9	20.8	22.4	27.7
Hruszowska	26.9	40.0	46.1	37.7
Wheat	30.8	–	26.9	28.8

at p = 0.01 LSD for cultivars – differences not significant
at p = 0.01 LSD for combinations – differences not significant.

Table 4

Period of development of *Trogoderma granarium* larval stages according to substrate (in days – mean results from three replications)

Variety	Combination	Number of larvae	Development (in days)				Number of pupae
			larva	L_1	Pupa	Imago	
Emka	C	11.0	11.5	7.0	8.3	7.0	2.3
	R	19.3	7.3	10.5	7.3	7.1	18.0
	M	7.6	7.0	9.8	7.5	7.1	6.6
Kora	C	15.0	6.8	7.0	5.5	6.5	1.3
	R	18.3	9.6	12.3	7.3	7.6	18.0
	M	13.3	7.1	11.0	7.2	7.1	8.6
Hruszowska	C	12.3	8.0	8.0	10.0	8.0	2.0
	R	12.6	8.2	9.6	7.2	7.6	10.6
	M	9.0	7.8	8.6	10.5	7.5	7.3
Wheat	C	13.0	5.6	7.1	7.0	7.0	11.3
	M	8.0	8.2	8.6	7.3	7.2	6.0

C – whole grains
R – grains grounded to 2-2.5 mm
M. – flour 0.800 µm.

Table 5

Period of development of *Trogoderma granarium* larvae according to substrate (in days)

Varieties	Combinations			Mean for variety
	whole grains	grains grounded to 2-2.5 mm	flour 0.800 µm	
Emka	81.6	86.7	69.9	79.4
Kora	65.1	91.2	84.0	80.1
Hruszowska	77.0	71.6	82.3	77.0
Wheat	55.0	–	68.0	61.8

at p = 0.01 LSD for cultivars – 12
at p = 0.01 LSD for combinations – differences not significant.

Table 6

Mortality of *Trogoderma granarium* larval according to substrate (in %)

Varieties	Combinations			Mean for variety
	whole grains	grains grounded to 2-2.5 mm	flour 0.800 µm	
Emka	75.2	7.3	9.2	30.0
Kora	90.4	1.3	30.7	40.8
Hruszowska	94.4	12.0	16.4	40.9
Wheat	4.1	–	24.0	14.0

at p = 0.01 LSD for cultivars – differences not significant
at p = 0.01 LSD for combinations – 20.08.

wheat from buckwheat grains. Buckwheat grains have a typical chemical composition and thickness of the seed cover. The highest mortality of eggs occurred in flour, but it did not differ significantly between whole grains and grains grounded to 2-2.5 mm (Tab. 3). Mortality of eggs on wheat grains was higher compared to their mortality on buckwheat grains and lower in comparison with the flour from the two cultivars: Emka and Hruszowska (Tab. 3).

The development of larval stages, pupae and imagoes was similar for all the substrates (Tab. 4). The number of larvae which successfully completed their growth to the stage of pupae makes an interesting observation. In the case of whole buckwheat grains, only 20% of larvae completed their growth cycle, but on grounded grains and in buckwheat or wheat flour their number rose to 90% (Tab. 4). Larvae of *Trogoderma granarium* need more time to complete their growth cycle on buckwheat grains or products compared to wheat grains or flour (Tab. 5). Although mortality of larvae (in %) on buckwheat grains is twenty times as high as on wheat grains, it declines significantly in grounded grains and flour (Tab. 6).

The results suggest that buckwheat grains and products resemble wheat grains and flour in terms of creating environment for the initial stages of larval development of *Trogoderma granarium*. On the other hand, the development of larvae on buckwheat grains takes the longest time and the number of larvae is the lowest. This may suggest that the seed cover of buckwheat grains inhibits the growth of *Trogoderma granarium*. Dehulling of seeds means that the natural resistance of buckwheat grains is impaired. Nevertheless, buckwheat

flour of very fine granulation contains easily available a-amylase inhibitors which reduce the use of starch as an energy source (Seitz and Sauer 1996). By testing the growth and development of different species of *Sitophilus* on non cereal media (acorns, walnuts and pea) Delobel and Grenier (1993) discovered different adaptation methods of pests.

Some earlier studies suggest that whole or dehulled buckwheat grains may become infested by various species of storage pests. *Rhizopherta dominica* and *Anagasta kuechiniella* showed the highest survival rate and reproduction potential (Zadernowski et al. 1992)

IV. CONCLUSIONS

1. Buckwheat grains and products are comparable to wheat grains and flour in terms of their suitability for the development of young development stages of *Trogoderma granarium*.
2. Dehulling of buckwheat nuts results in the elimination of an important factor of natural resistance of buckwheat grains to infestation.

V. LITERATURE

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NASIONA GRYKI I ICH PRZETWORY – ZAGROŻENIE SZKODNIKAMI MAGAZYNOWYMI

STRESZCZENIE

Badania miały na celu określenie podatności na porażenie nasion gryki i jej przetworów przez skórka zbożowego (*Trogoderma granarium* Everts.). Obserwacje prowadzono na nasionach trzech odmian gryki: Hruszowska, Emka, Kora. Wyniki badań wskazują, że ziarno gryki i jej przetwory są równie dobrym siedliskiem do rozwoju pierwszych stadiów larwalnych skórka zbożowego jak ziarno pszenicy i mąka pszenna. Jednakże przedłużenie okresu rozwojowego na gryce może świadczyć o hamującym żerowanie wpływie okrywy nasiennej.