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EFFECT OF CATTLE LIQUID MANURE FERTILIZATION ON SOIL MITES (ACARI) OF LOWLAND MEADOW

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The effects of cattle liquid manure, treated with Effective Microorganisms (EM) or bactericidal agent, on soil mites of lowland meadow was investigated, with species analysis of Oribatida. Doses of cattle liquid manure 30 $m^3 \cdot ha^{-1}$ and 60 $m^3 \cdot ha^{-1}$ increased the crop of green forage, more with EM than with bactericidal agent, while a dose 90 $m^3 \cdot ha^{-1}$ had no effect. A cattle liquid manure reduced the density of mites, including the Oribatida and comparing to the control plot, but with bactericidal agent reduced the density more than with EM. Among Oribatida *Liebstadia similis*, *Scheloribates laevigatus*, *Eupelops occultus*, *Achipteria coleoptrata* and *Tectocepheus velatus* were relatively abundant, while the other species occurred in low densities. The mites lived mostly on the lower parts of plants, and the density decreased with the soil depth.

Keywords: cattle liquid manure, grassland, Acari, Oribatida, Effective Microorganisms

1. INTRODUCTION

Mites are one of the largest group of soil mesofauna, which inhabit mainly the upper soil layer [13]. They participate in transformation of soil organic matter and mix it with the mineral soil [3, 4, 13]. Therefore, a high activity of mites results in faster circulation of elements, which are necessary for plant growth and are important for production of ecosystem.

Generation of huge amounts of liquid manure at industrial farms creates environmental problems. If liquid manure is improperly stored, it drains in the soil and ground water, and pollutes it. Liquid manure can be also used as a fertilizer on grasslands, but it contains pathogenic microorganisms, and should be disinfected before using. Usually, chemicals are used, which also effect the soil, but Effective Microorganisms (EM) are without chemicals, and also limit the development of pathogenic microorganisms. Properly used liquid manure is an important source of macro- and microelements for plants, and also enriches the soil in organic matter, improving its fertility. This paper aims to know the effects of cattle liquid manure with EM or bactericidal agent on soil mites (Acari), with species analysis of Oribatida.

2. MATERIAL AND METHODS

This experiment was performed on permanent lowland meadow, which belongs to the Agricultural Experimental Station in Minikowo (University of Technology and Life Sciences in Bydgoszcz), situated in the Valley of Bydgoszcz Canal. Seven plots (4 x 5 m each) were chosen, with 5 m buffer zones between them, from which one was a control (0), and the other were fertilized with cattle liquid manure in doses 30 $m^3 \cdot ha^{-1}$, 60 $m^3 \cdot ha^{-1}$ and 90 $m^3 \cdot ha^{-1}$, either with EM (plots 1–3, respectively) or bactericidal agent (plots 4–6, respectively).

Soil samples of 17 cm^2 and 9 cm deep were taken from each plot in spring of 2008 in 10 replications. The samples were next divided into lower part of plants (3–0 cm) and two soil layer (0–3 and 4–6 cm). Oribatid mites were extracted in high gradient Tullgren funnels, conserved and determined to species, including the juvenile stages. Totally 5333 mites, including 1628 oribatid mites were investigated. We compared the species with the abundance (*A*) and dominance (*D*) indices, and mite communities with abundance, number species of Oribatida, and the Shannon *H* index [8]. The results were verified using U Manna-Whitney test at $P \leq 0.05$ (Statistica 6.0), with earlier logarithmic transformation of data [1, 12]. Names of oribatid species follow Weigmann [15].

3. RESULTS AND DISCUSSION

A low and medium doses of cattle liquid manure slightly increased the crop of green forage, compared to the control plot, more with EM than with bactericidal agent, while the highest dose has no effect on this crop (Table 1).

Table 1. Green forage and abundance of mites (*A* in thousand individuals $\cdot$ m^{-2}), number of species (*S*) and Shannon *H* index of Oribatida in the investigated plots

Tabela 1. Plon zielonki a abundancja roztoczy (*A* w tysiącach sztuk $\cdot$ m^{-2}), liczba gatunków (*S*) i indeks *H* Shannona Oribatida na badanych poletkach

	Plots – Poletka						
Group – Grupa	0	1	2	3	4	5	6
Green forage Plon zielonki	11.6	13.1	13.5	11.3	12.9	13.2	10.9
Acari – Roztocze	61.0	51.5	44.8	38.6*	46.8	44.4	37.3*
Gamasida	0.3	2.7*	0.3a	0.1a	1.3*bc	1.8*bc	1.2*bc
Actinedida	40.2	34.3	31.3	26.1	31.2	29.7	23.5*
Other – Inne	0.5	0.3	0.4	0.0	0.5	0.3	0.4
Oribatida	20.0	14.2	12.8	12.4*	13.8	12.6*	12.2*
S	9	7	7	7	7	5	6
H	1.47	1.46	1.49	1.44	1.46	1.61	1.72

Significant differences at $P \leq 0.05$ between – Istotne różnice przy $P \leq 0,05$ pomiędzy: *control plot and plots 1–6 – poletkiem kontrolnym a poletkami 1–6; a plot 1 and plots 2–6 – poletkiem 1 a poletkami 2–6; b plot 2 and plots 3–6 – poletkiem 2 a poletkami 3–6; c plot 3 and plots 4–6 – poletkiem 3 a poletkami 4–6; d plot 4 and plots 5–6 – poletkiem 4 a poletkami 5–6; e plot 5 and plot 6 – poletkiem 5 a poletkiem 6

A cattle liquid manure fertilization reduced the density of mites, comparing to the control plot, along with increasing doses of fertilizer, but bactericidal agent reduced the density more than EM, and the results were significantly lower only in plots with the highest doses of liquid manure. Among the mites the most abundant was Actinedida, and the second most abundant was Oribatida, while the other groups occurred in low densities. The oribatid mites were sensitive to cattle liquid manure, which is partly consistent with literature [2, 7, 14]. The influence of cattle liquid manure on oribatid mites in the nearby meadows was negative at doses of 40 $m^3 \cdot ha^{-1}$ and 80 $m^3 \cdot ha^{-1}$ [7], while the influence of pig liquid manure was negative at doses 20 $m^3 \cdot ha^{-1}$ and 40 $m^3 \cdot ha^{-1}$, and positive at dose 60 $m^3 \cdot ha^{-1}$ of this fertilizer [14]. Bielska [2] also observed negative influence of liquid manure on the density, species number and age structure of oribatid mites of grassland.

Among Oribatida *Liebstadia similis*, *Scheloribates laevigatus*, *Eupelops occultus*, *Achipteria coleoptrata* and *Tectocepheus velatus* were relatively abundant, while the other species occurred in low densities (Table 2).

Table 2. Abundance (*A* in thousand individuals $\cdot$ m^{-2}) and dominance (*D*) indices of some oribatid species in the investigated plots; tot – total, juv – *juveniles*

Tabela 2. Abundancja (*A* w tysiącach sztuk $\cdot$ m^{-2}) i dominacja (*D*) niektórych gatunków Oribatida na badanych poletkach; tot – ogółem, juv – formy młodociane

Species Gatunki		Plots – Poletka						
		0	1	2	3	4	5	6
Oribatida	*A* tot	20.0	14.2	12.8	12.4*	13.8	12.6*	12.2*
	A juv	4.1	3.5	2.2	2.5	2.6	2.2*	2.1*
	D	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liebstadia similis	*A* tot	9.0	6.9	5.2	5.7	4.9	4.5*	4.3*
	A juv	2.1	1.8	1.0	1.4	1.0*	0.9*	0.8*
	D	44.7	48.9	40.4	45.6	45.4	35.9	35.2
Scheloribates laevigatus	*A* tot	3.9	2.5	3.1	2.6	3.8	3.0	2.7
	A juv	0.8	0.4	0.5	0.4	0.8	0.7	0.7
	D	19.5	17.9	24.4	20.9	27.5	23.9	21.3
Eupelops occultus	*A* tot	3.5	2.5	2.2	2.6	3.3	2.7	2.6
	A juv	1.0	0.8	0.4*	0.7	0.6	0.5	0.5
	D	17.7	17.4	17.4	20.9	24.0	21.5	21.3
Achipteria coleoptrata	*A* tot	2.0	1.3	1.4	0.6*	0.9	0.8	0.7*
	A juv	0.2	0.4	0.2	0.0a	0.1	0.1	0.1
	D	9.9	8.9	10.8	4.9	6.5	6.7	5.5
Tectocepheus velatus	*A* tot	1.0	0.4*	0.5	0.4*	0.7	0.5	0.7
	A juv	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	D	4.8	3.0	4.2	3.4	4.8	4.3	5.9

Significant differences at P ≤ 0.05 between – Istotne różnice przy P ≤ 0,05 pomiędzy: *control plot and plots 1–6 – poletkiem kontrolnym a poletkami 1–6; [a] plot 1 and plots 2–6 – poletkiem 1 a poletkami 2–6; [b] plot 2 and plots 3–6 – poletkiem 2 a poletkami 3–6; [c] plot 3 and plots 4–6 – poletkiem 3 a poletkami 4–6; [d] plot 4 and plots 5–6 – poletkiem 4 a poletkami 5–6; [e] plot 5 and plot 6 – poletkiem 5 a poletkiem 6

Four former species represent typical meadow species, and often dominate in permanent meadows [7, 14], while the latter species is more abundant in forests [9]. *Tectocepheus velatus* dominated in oribatid mite communities in alternating meadow, and tolerated both cattle and pig liquid manure [6, 11], but in permanent lowland meadows it was not abundant [7, 14]. A cattle liquid manure slightly limited the participation of juveniles in oribatid mite communities, but the results were significantly lower only in plots with medium and higher doses of liquid manure with bactericidal agent.

The mites occupied mainly lower parts of plants, and their density decreased with the soil depth. The influence of cattle liquid manure on vertical distribution of oribatid mites was indistinct, and oribatid mites occupied mainly lower part of plants. The densities of these mites on plants in plots 0, 1, 2, 3, 4, 5 and 6 were 31.1, 22.2, 19.8, 20.3, 20.8, 18.6 and 17.7 individuals · 50 cm^{-3}, respectively, while in upper soil horizon were 2.3, 1.3, 1.5, 0.4, 2.2, 2.3 and 2.5 respectively, which was consistent with Graczyk et al. [7] and Wasińska-Graczyk et al. [14]. Presence of abundant typical meadow species like *Achipteria coleoptrata*, *Scheloribates laevigatus* on lower parts of grasses can create economic problems. These mites are intermediate hosts of tapeworms [5, 9], which parasite on some domestic animals.

4. CONCLUSIONS

1. A low and medium doses of cattle liquid manure slightly increased the crop of green forage, compared to the control plot, more with EM than with bactericidal agent, while the highest dose has no effect on this crop.
2. A cattle liquid manure reduced the density of mites, including the Oribatida and comparing to the control plot, but bactericidal agent reduced the density more than EM.
3. Among Oribatida *Liebstadia similis*, *Scheloribates laevigatus*, *Eupelops occultus*, *Achipteria coleoptrata* and *Tectocepheus velatus* were relatively abundant, while the other species occurred in low densities.
4. The mites lived mostly on the lower parts of plants, and the density decreased with the soil depth.

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WPŁYW NAWOŻENIA GNOJOWICĄ BYDLĘCĄ NA ROZTOCZE GLEBOWE (ACARI) ŁĄKI NIZINNEJ

Streszczenie

Wpływ gnojowicy bydlęcej z dodatkiem Efektywnych Mikroorganizmów (EM) lub czynnika bakteriobójczego na roztocze glebowe łąki nizinnej badano za pomocą analizy gatunkowej Oribatida. Gnojowica bydlęca w dawkach 30 $m^3 \cdot ha^{-1}$ i 60 $m^3 \cdot ha^{-1}$ stosowana z dodatkiem EM powodowała wyższy wzrost plonu zielonki niż z dodatkiem czynnika bakteriobójczego, natomiast dawka 90 $m^3 \cdot ha^{-1}$ nie wywarła żadnego wpływu. Gnojowica bydlęca zmniejszała zagęszczenie roztoczy, łącznie z Oribatida, w porównaniu z poletkiem kontrolnym, przy czym redukowała je w większym stopniu z dodatkiem czynnika bakteriobójczego niż EM. Wśród Oribatida stosunkowo licznie występowały *Liebstadia similis*, *Scheloribates laevigatus*, *Eupelops occultus*, *Achipteria coleoptrata* i *Tectocepheus velatus*, podczas gdy pozostałe gatunki występowały w niskim zagęszczeniu. Roztocze żyły przeważnie na niższych częściach roślin, a ich zagęszczenie zmniejszało się wraz z głębokością gleby.

Słowa kluczowe: gnojowica bydlęca, użytki zielone, Acari, Oribatida, Efektywne Mikroorganizmy