The Effect of Fertilizer Regime on Soil Fauna

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ABSTRACT

Soil fauna activity in agricultural soil is a key factor to maintain soil fertility and to assure soil ecosystem services. It is now accepted that agricultural practices like tillage and pesticide use can harm soil organisms including earthworms and springtails. Other practices like the use of green manure or animal manure have been considered as being beneficial to these soil invertebrates. To deepen our knowledge on the effect of fertilizers (mineral and organic) on earthworms (*Aporrectodea caliginosa* and *Lumbricus terrestris*) and springtails (*Folsomia candida*) 56 microcosm experiments were made with two soil types and two hydric regimes. The microcosms were amended with four fertilizers: ammonium nitrate, mustard as green manure, cow manure and slurry. The results emphasize that mustard use had beneficial effect on *Folsomia candida* abundance and *Aporrectodea caliginosa* biomass, while mineral fertilizer had negative effects for all species used in the experiment.

Keywords: fertilization, soil, earthworms, springtails.

Introduction. Soil biotic community in arable agricultural fields provide multiple ecosystem services through their activity. Nutrient plant availability are directly related with complex relationship between soil microbiota and fauna. Wang et al. (2016) suggested that soil fauna could be a valuable indicator of soil fertility. Earthworms and collembolans are two faunal group which are able to be used as soil fertility indicators. The use of organic fertilizers in agricultural soil is associated with highest earthworm and collembolans activities (Whalen *et al.*, 1998) while mineral fertilizers use is related with detrimental effects (Donahue, 2001; Riley et al., 2008) or with no effects (Deibert and Uther, 1994; Edwards and Loft, 1982) on soil fauna.

Aims and objectives. The objective of the present study was to assess the influence of different fertilizers (mineral and organic) on two species of earthworms and one species of springtails.

Materials and methods. A number of 56 microcosms were set up in controlled condition.

Four types of fertilizers were applied: ammonium nitrate, mustard as green manure, cow manure and liquid manure. One treatment remains without any fertilizer as control. All microcosms except the control were inoculated with one individual of *Lumbricus terrestris*, one individual of *Aporrectodea caliginosa* and 200 individuals of *Folsomia candida*. After 30 days of incubation we recorded changes in earthworm wet biomass and collembolan density in all treatments.

Results and Discussion. During incubation period, the wet biomass of *Lumbricus terrestris* decreased in most treatments in both soils (Tab. 1). The decrease was more apparent in mineral treatments and in dry soil. The wet biomass of *Aporrectodea caliginosa* increased for most of the treatments. The increase was more evident in cow manure and mustard fertilized soils. In mineral fertilized soil *Aporrectodea caliginosa* registered a decrease of wet biomass. A significant increase of *Folsomia candida* abundance was observed in cow

Tab. 1. Earthworms wet biomass and collembolans abundance (mean $\pm$ S.E.)

		Liquid manure		Cow manure		Mustard		Ammonium nitrate	
Luvosoil soil		wet	dry	wet	dry	wet	dry	wet	dry
<i>Aporrectodea caliginosa</i> (g)	Start	1.57 $\pm$ 0.33	0.83 $\pm$ 0.07	1.17 $\pm$ 0.03	0.87 $\pm$ 0.03	1.37 $\pm$ 0.18	0.73 $\pm$ 0.03	1.53 $\pm$ 0.15	0.77 $\pm$ 0.09
	End	1.90 $\pm$ 0.26	1.07 $\pm$ 0.09	1.77 $\pm$ 0.20	1.70 $\pm$ 0.06	1.97 $\pm$ 0.19	0.85 $\pm$ 0.12	1.23 $\pm$ 0.15	0.95 $\pm$ 0.04
	Diff	+21%	+29%	+51%	+95%	+44%	+16 %	-19 %	+23%
<i>Lumbricus terrestris</i> (g)	Start	4.00 $\pm$ 0.35	2.53 $\pm$ 0.15	4.00 $\pm$ 0.25	2.87 $\pm$ 0.09	4.73 $\pm$ 0.93	2.80 $\pm$ 0.23	4.47 $\pm$ 0.15	3.20 $\pm$ 0.36
	End	3.63 $\pm$ 0.29	1.93 $\pm$ 0.20	3.60 $\pm$ 1.14	2.63 $\pm$ 0.23	4.70 $\pm$ 1.76	2.90 $\pm$ 0.00	3.40 $\pm$ 0.15	2.30 $\pm$ 0.00
	Diff	-9%	-24%	-10%	-8%	-1%	+4%	-24%	-28%
<i>Folsomia candida</i> (Ind)	End	77 $\pm$ 19	296 $\pm$ 70	269 $\pm$ 89	341 $\pm$ 47	453 $\pm$ 59	71 $\pm$ 7	56 $\pm$ 14	137 $\pm$ 20
	Diff	-62%	+48%	+35%	+71%	+127%	-65%	-72%	-32%
Chernozem soil		wet	dry	wet	dry	wet	dry	wet	dry
<i>Aporrectodea caliginosa</i> (g)	Start	1.10 $\pm$ 0.06	0.67 $\pm$ 0.07	1.03 $\pm$ 0.03	0.60 $\pm$ 0.00	1.10 $\pm$ 0.15	0.63 $\pm$ 0.03	1.27 $\pm$ 0.07	0.80 $\pm$ 0.06
	End	1.45 $\pm$ 0.04	1.10 $\pm$ 0.08	1.45 $\pm$ 0.04	1.30 $\pm$ 0.06	1.50 $\pm$ 0.12	1.27 $\pm$ 0.09	0.87 $\pm$ 0.09	0.70 $\pm$ 0.08
	Diff	+32%	+64%	+41%	+117%	+36%	+102%	-32%	-13%
<i>Lumbricus terrestris</i> (g)	Start	3.90 $\pm$ 0.26	2.40 $\pm$ 0.26	3.93 $\pm$ 0.34	2.40 $\pm$ 0.21	3.50 $\pm$ 0.44	2.13 $\pm$ 0.09	3.47 $\pm$ 0.81	1.97 $\pm$ 0.57
	End	3.50 $\pm$ 0.33	2.47 $\pm$ 0.26	3.97 $\pm$ 0.38	3.03 $\pm$ 0.27	3.43 $\pm$ 0.68	1.80 $\pm$ 0.49	2.50 $\pm$ 0.56	1.65 $\pm$ 0.37
	Diff	-10%	+3%	+1%	+26%	-2%	-15%	-28%	-16%
<i>Folsomia candida</i> (Ind)	End	107 $\pm$ 35	147 $\pm$ 30	193 $\pm$ 95	631 $\pm$ 111	453 $\pm$ 161	231 $\pm$ 17	41 $\pm$ 10	112 $\pm$ 24
	Diff	-47%	-27%	-4%	+216%	+127%	+16%	-79%	-44%

manure and mustard fertilized treatments.

Conclusion. The type of fertilizers used in agricultural soils can be an important driver for soil biological community. While mineral fertilizers seem to have a detrimental impact on soil fauna, the use of cow manure and green manure showed beneficial effects in terms of biomass and density of soil invertebrates.

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