Effect of Field Treatments against Root-Knot Nematodes on Soil Suppressiveness against Fusarium oxysporum f.sp. linii

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Introduction

Soil treatments that are applied in organic horticulture with the aim of eradicating problems with soil-borne pathogens can affect soil biodiversity, and thus soil suppressiveness against diseases. To select proper soil treatments, it is necessary to know if and how these treatments influence soil suppressiveness.

Materials and Methods

We examined soil suppressiveness against *Fusarium oxysporum* f.sp. *linii* after applying 3 field treatments against the root-knot nematode *Meloidogyne incognita*, compared with a control treatment. The treatments consisted of field application of (1) Sarepta mustard (*Brassica juncea*), (2) Sarepta mustard covered with a plastic sheet for 8 days, (3) RICASA: a mixture of *Ricinus communis*, *Capsicum annuum* and formic acid and (4) a control treatment. Four weeks after field treatments were carried out, soil was sampled and tested in a bioassay for soil suppressiveness, using a pathosystem combining flax (*Linum usitatissimum* L. cv. Belinka) and *Fusarium oxysporum* f.sp. *linii*. Two inoculation levels of *Fusarium* were used: 10^4 and 10^5 cfu/g soil, compared to a not inoculated control treatment. Disease progress was measured, and for each treatment, the area under the disease progressive curve (AUDPC) was calculated. Low AUDPC values correspond to high levels of suppressiveness. Soil samples were also analysed for bacterial and fungal biomass, protozoa (flagellates, ciliates, amoebae) and nematodes. Multiple regression was carried out to investigate the relation between suppressiveness and the presence of soil biota.

Results

Flax plants inoculated with low levels (10^4 cfu/g soil) of *Fusarium* showed no significant differences in disease development between treatments. When inoculated with high levels of *Fusarium* (10^5 cfu/g soil) the AUDPC showed significant differences ($P<0.05$). Disease suppressiveness of the RICASA treatment was significantly higher than of the unamended control treatment, while the soil treatments with mustard (covered or uncovered) had in-between levels of disease development (Figure 1). Suppression of Fusarium wilt (low AUDPC levels) showed a negative correlation with the Maturity Index and the number of flagellates, and a positive correlation with the number of nematodes in cp-class 2. When including a third variable into the model, suppressiveness also has a positive correlation with the Enrichment Index and a negative correlation with the total fungal / bacterial biomass.

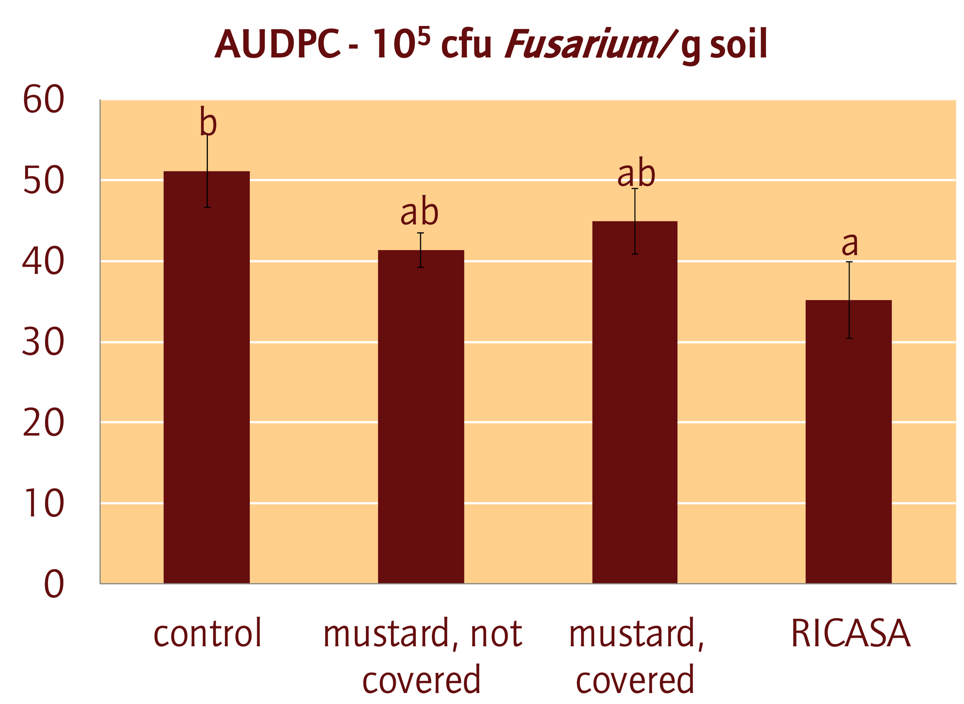

Figure 1. Area Under Disease Progressive Curve (AUDPC)

Table 1. Best regression models for AUDPC of the *Fusarium oxysporum* f.sp. *linii* / flax pathosystem

Regression models with 2 parameters[a]	% variance accounted for
32.1^{***} + 14.3 × [Maturity Index 1-5*] – 2.9 × [nematodes cp-class 2^{*b}]	48.3
35.6^{***} + 9,3 × [∑ Maturity Index 1-5*] – 2.5 × [nematodes cp-class 2^{*b}]	44.5
-30.9^{ns} + 13.5 × [∑ Maturity Index 1-5**] + 4.7 × [flagellates^{*b}]	42.9
Regression models with 3 parameters	
-31.0^{ns} + 13.2 × [∑ Maturity Index 1-5***] - 2.8 × [nematodes cp-class 2^{**b}] + 5.3 × [flagellates^{**b}]	70.6
-23.2^{ns} + 18.0 × [Maturity Index 1-5***] – 3.3 × [nematodes cp-class 2^{***b}] + 4.5 × [flagellates^{**b}]	67.5
329.5^{***} - 3.9 × [nematodes cp-class 2^{***b}] – 3.1 × [Enrichment Index**] + 79.1 × [total fungal biomass / total bacterial biomass**]	67.4

[a] *=P<0.05, **P<0.01, ***P<0.001, ns = not significant
[b] log-transformed (ln) data

Conclusion and Discussion

Regression analysis results in models pointing at the predominance of bacteria and bacteria-feeding nematodes in *Fusarium* suppressive soil. A low Maturity Index, a high Enrichment Index, and a low fungal/bacterial biomass rate are all indicative of ecosystems that are predominantly based on bacteria and bacteria feeders. Nematodes in cp-class 2 are characterised by their stress-tolerance, and by the possibility to slow down metabolism for a longer period. The question remains whether the disease suppressiveness is actually mediated by these bacteria and bacteria feeders, or if their dominance is a mere result of the application of organic amendments in combination with the stress of toxic compounds, that are released when these amendments start to decompose.

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