Title
Growth responses in strawberry cv. Elsanta treated with a new organic fertilizer of plant origin. Preliminary results.

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1. Introduction

The interest for the use of organic fertilizers is increasing in Poland due to the decreasing level of soil organic matter content, especially in specialized fruit producing areas, and to the growing importance of organic farming fruit production. However, the availability of classical organic fertilizers (i.e. manure) is limited as well as information about the effects of new kinds of organic fertilizers like plant extracts (Sas-Paszt et al. 2007) or microbial inocula (Malusa et al. 2007) that are enhancing the plant capacity of nutrient uptake.

The aim of the study, carried out within the framework of a project intended to develop new products and technologies for organic fruit production in Poland, was to evaluate the effect of a new organic fertilizer obtained from plant extracts on growth of strawberry plants.

2. Materials and Methods

2.1 Plant cultivation

Frigo-plants of strawberry cultivar 'Elsanta' were grown in a greenhouse for 12 weeks in rhizoboxes filled with 1.85 kg of soil A podsolic soil was used, collected from an experimental field which had not been fertilized for decades (Mercik et al. 1997). Its main characteristics were: pH 6, organic matter content 0.45%; N content 0.048%, P content 1 mg P kg^{-1}, K content 115 mg K kg^{-1}.

Two treatments were compared to untreated (not fertilized) plants :

i) a standard NPK soil fertilization (20 mg N, 5 mg P_2O_5 and 10 mg K_2O per plant)

ii) an organic fertilizer derived from plant extracts (BioFeed Basis, Agrobio Products B.V., - containing 7.5% organic N, 2% P_2O_5 , 4% K_2O and 43% C) 2 g per plant

Each treatment was applied to 8 plants grown in 4 rhizoboxes placed on a completely randomized design.

2.2 Determination of plant dry biomass and growth parameters

At the end of the growing period dry biomass was determined separately for roots and shoots.

Shoots (total leaf area and number of leaves) and roots (total root length, root diameter and total number of root tips) were measured by an image analysis system with a Hewlett Packard's 7400c scanner, controlled by Delta T-Scan software.

2.3 Statistics

The results were statistically evaluated by analysis of variance and comparison of means was done at $P \leq 0.05$ with the Newman-Keuls test.

3. Results

Plants treated with the organic fertilizer showed a shoot biomass production similar to the chemically fertilized plants (Tab. 1). Fertilized plants had about 50% higher shoot biomass production in comparison to control. The increased biomass production in the fertilized plants derived from increased leaf area and not from a higher number of leaves. Indeed, both the NPK and organic fertilized plants showed a leaf area of 20% and 37% higher, respectively, in comparison to control plants. At the same time, the number of leaves per plant was on average 8.3 for both the treated and control plants (Tab. 1).

Root biomass was about 50% lower in fertilized plants with respect to untreated control plants (Tab. 2). However, the total root length was about two-fold higher in fertilized plants (on average 112.5 m) in comparison to the control (55.4 m), but without differences between the two kinds of

fertilizers. The number of root tips was also similar between the plants receiving the fertilizers, but significantly lower to that of the control plants. No differences were found as regard the diameter of the roots between the fertilized and control plants nor between the two fertilizers (Tab. 2).

The different growth behavior between the fertilized and the control plants was confirmed by the shoot/root ratio: in fertilized plants, irrespective of the kind of fertilizer, the ratio was about 2, while it was below 1 for the control (Fig. 1a). The root length for unit of soil volume was on average 2.73 and 3.35 for NPK and BF-Basis treated plants, respectively, significantly higher than in control plants (Fig. 1b). Also the specific root length was higher in fertilized plants with respect to control plants, but with no differences between the two treatments: the root length per unit of dry weight was on average 400% times higher than in the control plants (Fig. 1c).

Tab. 1: Shoot growth parameters of strawberry plants cv. Elsanta grown under different fertilization management: not fertilized (Control), chemical standard fertilizer (NPK) and organic fertilizer (BF Basis). Means ± standard error, letters show significant difference for P<0.05.

	D.W. (g)	Total Leaf Area (cm^2)	Leaf Number
Control	3.54 ± 0.2 a	394.0 ± 15.5 a	7.75 ± 0.5 a
NPK	5.05 ± 0.6 b	473.2 ± 39.3 b	8.37 ± 0.6 a
BF Basis	5.89 ± 0.7 b	540.9 ± 68.8 b	8.75 ± 0.8 a

Tab. 2: Root growth parameters of strawberry plants cv. Elsanta grown under different fertilization management: not fertilized (Control), chemical standard fertilizer (NPK) and organic fertilizer (BF Basis). Means ± standard error, letters show significant difference for P<0.05.

	D.W. (g)	Total Root Length (m)	Root Diameter (mm)	Root Tips Number
Control	5.36 ± 0.5 a	55.38 ± 2.9 a	0.64 ± 0.02 a	2119 ± 142 a
NPK	2.88 ± 0.4 b	101.0 ± 11.2 b	0.61 ± 0.05 a	1586 ± 138 b
BF Basis	3.08 ± 0.7 b	124.0 ± 11.6 b	0.61 ± 0.05 a	1588 ± 159 b

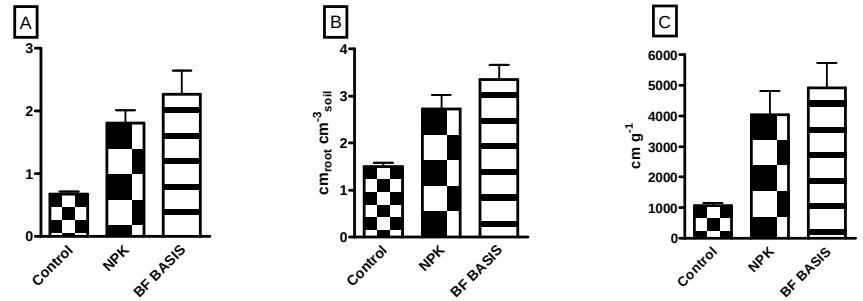

Fig. 1: Shoot/root ratio (a), root length density (b) and specific root length (c) of strawberry plants cv. Elsanta grown under different fertilization management: not fertilized (Control), chemical standard fertilizer (NPK) and organic fertilizer (BF Basis). Vertical bars represent standard error, * significant difference for P<0.05.

4. Discussion and Conclusions

The application of the organic fertilizer produced from plant extracts allowed obtaining a growth of the strawberry plants similar to that of plants fertilized with a standard synthetic fertilizer. The carbon allocation between shoots and roots was also similar, with the majority of the plant biomass represented by leaf tissues, thus expected to potentially produce a similar yield in both treatments. Application of a vermicompost on strawberries resulted in increased of up to 37% in leaf area and 37% in plant shoot biomass and the effect was confirmed also by higher yield performance (Arancon et al. 2004). Field trials under Polish conditions with strawberries, testing different classical organic amendments, resulted for the majority of them in plant growth and yield comparable to chemically fertilized plots (Sas-Paszt et al. 2007)

The morphological structure of the root system was also similar in chemically and organically fertilized plants. The diameter of the roots was not affected by the fertilization when comparing to the unfertilized plants; however, the latter plants showed a higher number of shorter roots, as it would be expected in case of nutrient deficiency.

There is a great variability in the nitrogen availability from different sources of organic fertilizers (Pang and Letey 2000). Incubation studies with an array of organic fertilizers had shown that for the Biofeed Basis the N availability was steady for a period of 6 weeks, with nearly 50% of the nitrogen contained in the fertilizer becoming available for the plants, a higher amount in comparison to the other organic fertilizers (Stutterheim pers. com.). It is known that the timing in supplying nitrogen to berry crops is critical for buds and fruit set, and the nitrogen release rates for organic fertilizers may not match the nitrogen needs of the crop. The results obtained from these preliminary tests would suggest that the Biofeed Basis product is a feasible organic fertilizer for strawberry production.

5. Acknowledgment

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6. References

1) Arancon, N. Q., C. A. Edwards, P. Bierman, C. Welch, J. D Metzger. 2004. Influences of vermicomposts on field strawberries: 1. Effects on growth and yields. Bioresource Technology, 93(2):145-153.

2) Malusa E., Sas Paszt L., Popińska W., Żurawicz E. 2007. The effect of a substrate containing arbuscular mycorrhizal fungi and rhizosphere microorganisms (Trichoderma, Bacillus, Pseudomonas and Streptomonas) and Foliar Fertilization on Growth Response and Rhizosphere pH of Three Strawberry Cultivars. Intern. J. Fruit Science: 6(4):25-41.

3) Mercik S., Stepien W. and Gebski M. 1997. Results of 75 years of continuous fertilization experiments in Skierniewice as a contribution to modification of fertilization. Arch. Acker-Pfl. Boden. 42:201-210.

4) Pang X. P. and Letey J. 2000. Organic farming: challenge of timing nitrogen availability to crop nitrogen requirements. Soil Sci. Soc. Am. J. 64:247–253.

5) Sas Paszt L., Żurawicz E., Filipczak ., Głuszek S. 2007. Rola rizosfery w odżywianiu roślin truskawki. Postępy Nauk Rolniczych 6:27-36.