

Compared study of plant residues and organic fertilizer on yield of ryegrass

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Abstract

A pot experiment with ryegrass has been conducted to compare some plant residues and organic fertilizers on two soil types— Calcareous Chernozem and Leached Vertisol. On the based of received data it is established that the effect of examined organic materials is higher under the conditions of Calcareous Chernozem than in Leached Vertisol. The barley straw added in combination with mineral nitrogen creates most favorable conditions of ryegrass growth. The differences of examined variants in comparison with the control are proved on the degree of probability $P_{0.05}$.

Key words: organic fertilizers, plant residues, biomass of ryegrass, soil type.

Introduction

Around 90% of soils in Bulgaria are with comparatively low content of humus (from 1 to 3.5%) Filcheva, E. (2007). The humus has in a great degree important for soil structure, because it bound mineral particles together into aggregates, providing this way easy moving up the water along soil profile and free access to oxygen and carbon dioxide, which are indispensable for plants and soil microorganisms. One of the best ways for improving soil fertility is the addition of organic materials (Denef, K.&J. Six, 2006). They provide not only basic nutritional substances but also they activate useful micro flora. The soil well supplied with organic matter increases the stability of plants to the illnesses. It is established that some fungi, developed into decayed organic materials destroy harmful microorganism and improve soil productivity. It is well known that the addition of plant residues and manure improves soil fertility and ensure conditions for maintenance and reproduction of soil organic matter which is significant for stable yields.

The approach of the research is to compare the influence of different organic materials – wheat and barley straw, manure and compost from red Californian worms on the biomass of meadow ryegrass with two soil types.

Materials and methods

The experiment was carried out in 5 replications with 1 kg soil from depth 0-30 cm in vegetation house with test culture – ryegrass (*Lolium perenne*), sp. Belida. There are 15 plants in a pot. The used soil types are two – a) Calcareous Chernozem from the region of Kneja, characterized with 3.03% humus, 0.199% total N and $pH_{KCl}=6.2$; b) Leached Vertisol from the experimental station of Bojurishte, characterized with 3.5% humus, 0.165% total N and $pH_{KCl}=5.5$. Soil texture is heavy sand-loam, representative for widely spread strongly loamy Vertisols in Sofia region. Contrary Calcareous Chernozem has got middle sand-loam composition and well formed crumb-grain structure. The treatments are as follow: **1-** control, **2-** soil+ wheat straw+N (C:N=21,1; N:P:K = 1: 0,67 : 0,83), **3-**soil+ barley straw (C:N=21,1; N:P:K= 1:0,67:0,83), **4-**soil+ manure (6t/da), **5-**soil+ compost from Californian worms (3 t/da).

The manure consist 0.646% total N, 0.5% P_2O_5 , 0.4 % K_2O , 25.3 % in dry weight; humidity 74.7%, C:N=21. The wheat straw consist 37,5% total C, 0,41% total N, 0,07% P_2O_5 и 0,90% K_2O . The barley straw consist 36,0% total C, 0,38% total N, 0,09% P_2O_5 и 1,20% K_2O .

The straws are added to soil in combination with mineral N to create ratio C:N=21, so there are equivalence between different treatments on the C:N ratio. This ratio is significant for the rate and the destination of mineralization and humification processes in soil.

Results and discussion

Phenology observations during the vegetation of ryegrass show that the plants are developed in the most favorable way in treatments with two types of straws and mineral nitrogen. Plants are nearly 3 times higher in comparison with the control. The difference is significant towards treatments with manure and compost from Californian worms.

It is evident from the data of ryegrass yields in the figure 1 and 2 that the highest yield is obtained with the first swatch. Next swatches decrease consecutively in both soil types. The yields for all examined treatments are statistically proved in comparison with the control with $P_{0,05}$ degree of variability (tables 1 and 2). The differences are not proved between the treatments with wheat and barley straw and organic fertilizers.

Table 1. Dry mass and coefficient of variation of ryegrass in Calcareous Chernozem

Treatments	I swatch,g/pot		II swatch, g/pot		III swatch, /pot		IV swatch, g/pot		Total amount, g/pot
	Average	C _v %	Average	C _v %	Average	C _v %	Average	C _v %	Average
1-Control	1.89	0.06	0.85	0.001	0.43	0.007	0.35	0.0005	3.51
2 Wheat straw+N	5.80	0.14	2.07	0.13	1.40	0.05	0.61	0.004	9.88
3 Barley straw +N	5.91	0.13	2.76	0.06	1.51	0.02	0.84	0.009	11.02
4 Manure	2.91	0.10	1.15	0.06	0.78	0.005	0.51	0.006	5.35
5 Californian worm	2.78	0.05	1.17	0.01	0.82	0.002	0.56	0.001	5.33

Table 2. Dry mass and coefficient of variation of ryegrass in Leached Vertisol

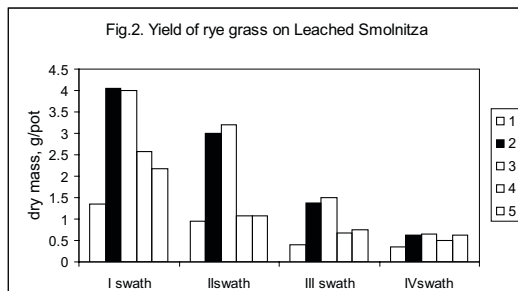
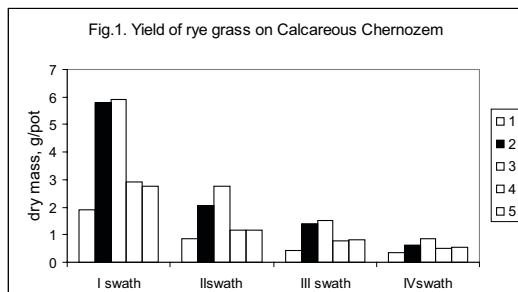
Treatments	I swatch, g/pot		II swatch, g/pot		III swatch, g/pot		IV swatch, g/pot		Total amount, g/pot
	Average	C _v %	Average	C _v %	Average	C _v %	Average	C _v %	Average
1-Control	1.34	0.05	0.95	0.003	0.39	0.008	0.36	0.005	3.04
2 Wheat straw+N	4.06	0.15	2.992	0.14	1.37	0.07	0.63	0.003	9.05
3 Barley straw +N	3.85	0.13	3.2	0.08	1.49	0.04	0.66	0.008	9.35
4 Manure	2.57	0.12	1.066	0.06	0.67	0.006	0.50	0.007	4.81
5 Californian worm	2.17	0.06	1.068	0.02	0.74	0.003	0.62	0.002	4.60

The ryegrass biomass is higher in Calcareous Chernozem than in Leached Vertisol under the conditions of all examined treatments which is due to more favorable chemical and physical properties of Calcareous Chernozem. There is an exception for the second to fourth swatch where the biomass is higher for all treatments in Leached Vertisol. This soil type has got higher water capacity than Calcareous Chernozem. Therefore thus it is provide respectively better plants with water during all long summer day. The favorable effect of straws is saved to the end of the experiment added to soil with mineral N towards the manure and the compost. The influence of barley straw is presented in higher yields in all swatches in comparison with wheat straw in both soil types but differences are not statistically proved. Similar results are marked in our previous studies (Petkova, Z., 2001).

Therefore barley and wheat straw added to soil with equal C:N ratio show similar effect on ryegrass vegetation and its obtained biomass. Similar tendency is observed between treatments with manure and Californian worms. The compost from Californian worms in all swatches from Calcareous Chernozem and Leached Vertisol gives similar proved statistically results as ryegrass biomass in comparison with manure.

The differences are significant between control and treatment with straws and with organic fertilizers.

The fourth swath is the lowest in all treatments and the augmentation of obtained biomass is nearly equal for all fertilized treatments which is an indicator that the duration of influence of used fertilizer material is close.



1- control, 2- soil+ wheat straw+N, 3- soil+ barley straw,
4- soil + manure, 5- soil + compost from Californian worms

Conclusion

It is established from this study that the biomass of ryegrass is higher in Calcareous Chernozem than in Leached Vertisol.

The best effect is achieved in treatments with addition of barley and wheat straw used in combination with mineral nitrogen (212%) in comparison with the treatments with manure and compost from Californian worms in Calcareous Chernozem. Similar regularity is observed in Leached Vertisol but the augmentation of biomass is smaller (202%).

The increase of ryegrass biomass obtained in treatments with manure and compost from Californian worms is equal.

References

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