THE POSSIBILITY OF USING COMPOST FOR PREPARATION OF RECLAMATION SUBSTRATE

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ABSTRACT

Land degradation is of concern in many countries. People more and more must address the problems associated with the degradation of soil properties due to man. Increasingly, organic soil amendments, such as compost are being examined for their potential use in soil restoration and for preventing soil erosion. In the Czech Republic, compost is the most used to improve soil structure and increase the content of soil organic matter. Land reclamation/restoration is one of the ways to evaluate industrially produced compost because Czech farmers are not willing to use compost as organic fertilizer. The most common use of reclamation substrates in the Czech Republic is for the rehabilitation of landfills and contaminated sites.

This paper deals with the influence of reclamation substrates (RS) with different proportions of compost and sand on selected chemical soil properties. Chemical properties vary proportionally with addition of compost and sand to the control variant (topsoil). On the other hand, in the preparation of reclamation substrates should be taken into account possible phytotoxic effect on the cultivated plant. The phytotoxicity effect of reclamation substrate will be evaluated in the following measurements.

Key words: reclamation substrate, chemical properties

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INTRODUCTION

The problem of land degradation and the recovery of degraded land to its original condition is one of great concern in most countries of the world (HARRIS 2003). In Czech Republic research indicates that more than one third of the land surface is degraded in some way (water and wind erosion, influence of mineral fertilizers, human activity etc.). Also, old ecological loadings and landfill reclamation is a considerable problem in the Czech Republic.

The use of compost as an amendment for soil restoration and regeneration is increasing, not only in the Czech Republic (CELLIER *et al.* 2012). Compost amendment improves physical, chemical and biological properties of soils, in particular by increasing available nutrients mainly in the organic soil fractions (CELLIER *et al.* 2012, DIAZ *et al.* 2007).. The application of organic matter to degraded soils is a good environmental practice. Therefore, the application of compost to the soil has become a common environmental practice for soil restoration, maintaining soil organic matter, reclaiming degraded soils, and supplying plant nutrients.

Also, the application of compost increases the plant cover and stimulates soil microbial growth and activity (TEJADA *et al.* 2010). On the other hand, if the compost is applied in high doses it can negatively influence desirable groups of microorganisms and reduce yield of crops because unnaturally high proportion of organic matter (and other substances in compost) and undesirable interactions of microorganisms may lead for example to toxicity of the reclamation substrates for certain groups of microbes.

MATERIAL AND METHODS

For testing of reclamation substrate were selected fourteen variants of reclamation substrates (hereafter RS) with different weight of soil, compost and sand: C – only arable soil, and RS prepared as mixture of soil, compost and sand in different ratios: K10 – arable soil with addition of 10 % (i.e. weight percent) of compost, K20 – addition of 20 % of compost, K30 – addition of 30 % of compost, K40 – addition of 40 % of compost, K50 – addition of 50 % of compost, K60 – addition of 60 % of compost, +S10 – arable soil with addition of compost and with addition of 10 % (i.e. weight percent) of sand, +S20 – arable soil with addition of compost and with addition of 20 % (i.e. weight percent) of sand.

For the experiment we used soil (topsoil) from the experimental area in Brezova nad Svitavou. Soil sampling was done on the 9th of April 2013. Soil sampling was done in accordance with CSN ISO 10 381-6. Compost (Cerny drak) samples were taken from the Central Composting Plant in Brno on the 10th of April 2013 in accordance with CSN 46 5735. Compost (Cerny drak) is registered (under the Fertilizers Law) for agriculture use in the Czech Republic. Samples of sand were washed thrice in 6 % HCl and 10 % NaOH solution to remove all organic material which could be contained in sand. Before preparation of RS the soil was preincubated at laboratory temperature for 30 days. All samples were sieved through a sieve (grid size of 2 mm) before preparation of RS. Moisture of the mixing material were: soil (w = 20 %), compost (w = 40 %) and sand (w = 98 %).

Chemical analysis

The pH_{H2O} was measured in suspension of RS and boiled distilled water (ratio in 1:5) in accordance with ČSN ISO 10 390. The pH_{CaCl2} and available P, K, Ca and Mg were determined according to the method of Mehlich III method (ZBÍRAL 2004). EC was determined in filtrate, which was produced by filtering a suspension of reclamation substrate sample and distilled water (in ration 1:5) according to ČSN ISO 11 265. Available mineral Nitrogen was determined by distillation and titration method (PEOPLES 1989) according to (BUNDY 1994). Organic Carbon was determined by colorimetry after oxidation of the organic matter by the excess $K_2Cr_2O_7$ according to NF X 31-

109. Content of carbonate was determined by volumetric method according to ISO 10 693.rESULT AND DISCUSSION

Tab. 1: Selected chemical properties of reclamation substrate

	pH_{H2O}	pH_{CaCl2}	EC (µs/cm)	C_{org} (g/kg)	$CaCO_3$ (g/kg)	N_{min} (mg/kg)	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)
C	6,45	5,83	103,6	60,3 ± 1,7	1,2 ± 0,1	14,1 ± 1,6	182,8 ± 2,7	167,3 ± 0,5	1444 ± 40	53,4 ± 1,3
K10	6,62	6,72	532	99,4 ± 6,2	2,8 ± 0,1	29,2 ± 4,0	309,3 ± 7,4	658,2 ± 14,7	2468 ± 81	158,8 ± 4,6
K20	6,86	7,08	935	133,7 ± 36,0	4,4 ± 0,3	68,1 ± 9,0	373,1 ± 21,3	1173 ± 13	3397 ± 109	258,3 ± 21,6
K30	6,92	7,22	1223	160,7 ± 26,4	5,0 ± 0,8	157,6 ± 10,5	406,5 ± 4,8	1564 ± 47	4127 ± 147	344,9 ± 26,6
K40	7,11	7,31	1607	171,1 ± 44,3	6,4 ± 0,4	229,1 ± 17,7	465,4 ± 5,5	2140 ± 45	4610 ± 40	468,7 ± 4,8
K50	7,19	7,27	1896	243,7 ± 14,7	8,1 ± 0,4	288,9 ± 24,3	485,5 ± 3,9	2280 ± 110	5521 ± 66	636,9 ± 11,5
K60	7,22	7,43	2212	269,3 ± 17,2	8,5 ± 1,1	361,5 ± 6,6	506,4 ± 5,5	2904 ± 36	5877 ± 96	649,5 ± 4,0
K10+S10	7,1	7,02	520	96,2 ± 3,3	1,9 ± 0,2	27,4 ± 2,6	272,3 ± 3,7	600,9 ± 5,0	2104 ± 131	134,1 ± 11,3
K20+S10	7,07	7,27	963	107,5 ± 7,5	2,4 ± 0,3	69,0 ± 9,6	361,3 ± 11,5	962,3 ± 18,6	3346 ± 122	243,1 ± 26,8
K30+S10	7,08	7,29	1488	125,0 ± 9,2	3,1 ± 0,2	134,1 ± 25,6	403,6 ± 12,2	1540 ± 72	4092 ± 19	343,4 ± 5,5
K40+S10	7,23	7,34	1624	147,1 ± 7,5	4,6 ± 0,3	216,2 ± 27,4	446,2 ± 8,3	2384 ± 69	4576 ± 46	454,2 ± 16,6
K10+S20	7,09	7,11	559	91,3 ± 4,8	2,2 ± 0,1	15,8 ± 4,6	288,6 ± 5,2	679,7 ± 20,3	2512 ± 110	153,0 ± 5,6
K20+S20	7,05	7,27	910	100,0 ± 5,8	3,1 ± 0,5	63,7 ± 6,6	321,0 ± 8,4	945,7 ± 31,8	3071 ± 34	216,3 ± 10,1
K30+S20	7,13	7,32	1308	118,9 ± 25,1	3,7 ± 0,2	87,5 ± 7,6	362,3 ± 5,9	1222 ± 36	4110 ± 117	319,2 ± 6,7
K40+S20	7,26	7,40	1565	135,4 ± 18,4	4,3 ± 0,1	132,3 ± 6,5	407,1 ± 9,3	2023 ± 51	4816 ± 52	444,7 ± 29,0

Results from the measurements of chemical properties of reclamation substrates are shown in Table 1. Soil type of control soil is Luvisoil modal and soil type is loam-silt soil. pH_{H2O} a pH_{CaCl2} of the control variant were weakly acidic, the results of EC in C is a nonsaline soil (SCIANA 2002). The addition of compost changing the pH values in the most variants to neutral or slightly alkaline (K40+S20). The amount of organic carbon and mineral nitrogen vary depending on the addition of compost and sand.

Content of available nutrients were evaluated using 5 level scale of nutrient availability where very low, low, satisfactory, optimal, high and very high level is distinguished. Evaluation of C variant: P-high content, K-satisfactory content, Ca-satisfactory content, Mg-low content according to (ZBÍRAL 2004). Compost addition changed availability of available nutrients till very high level. High content of nutrients can cause increase of phytotoxicity of RS (DIAZ *et al.* 2007).

CONCLUSIONS

Addition of compost for preparation of reclamation substrates has a positive effect on the pH. On the other hand, an increased content of the compost causes an increase salinity and content of nutrients, which may adversely affect the growth of plants or cause phytotoxicity on crops. For a correct interpretation of the detected chemical parameters we will need to perform tests of phytotoxicity of reclamation substrates.

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NF X 31-109: Soil quality – Chemical methods – Determination of organic carbon by chromic oxidation (in French).