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ASSESSMENT OF POSSIBILITIES OF THE USE OF STRUCTURAL SOILS WITH ADDITION OF MUNICIPAL WASTE FOR PLANTING TREES AND SHRUBS

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In municipal agglomerations is necessary create profitable the conditions for the growth of trees. In order to improve the conditions of the growth of trees, more and more frequently new technologies of arboriculture are used the stone-soil mixtures called structural soils. While preparing structural soils it is important to ensure, besides physical parameters, their adequate chemical composition. In the paper the use of poor in organic matter structural soils and compost of municipal waste was proposed for composing substrate for planting trees and shrubs. On basis of conducted analyses was affirmed, that the completion of structural soils is proposed with composts of municipal waste in an amount up to 5% of the weight was the most optimum. Such a share of composts guarantees an approximate to the required for this type of substrates share of the organic material. What is more, the applied composts enrich the structural soils with macro- and microelements accessible for the plants.

Keywords:

Introduction

In municipal agglomerations, due to the tight built-up soil surface decreasing the inflow of precipitation water, the underground infrastructure limiting the surface of roots development, and the chemical contamination of environment, the conditions for the growth of trees are unfavourable (Łukaszkiewicz, 2008; Malinowska, 2012). In order to improve the conditions of the growth of trees, more and more frequently new technologies of arboriculture are used e.g. aeration and irrigation systems, elements of anti-compressive modules filled with the solum, and the stone-soil mixtures called structural soils. These systems ensure first of all the space for the development of the trees root system, and good water, air and chemical conditions in the soil (Bassuk and Trowbridge, 2004; Garczarczyk, 2008; Grabosky et al., 2005). While preparing structural soils it is important to ensure, besides physical parameters, their adequate chemical composition. To achieve adequate physical-chemical properties of the substrates it is purposeful to use the compost of waste which is very popular with consumers (Lewandowska, 1998).

The aim of this paper was to show proportions of the chosen components for creating the substrate for planting trees and shrubs in urban agglomerations and degraded areas.

Method

In the paper the use of poor in organic matter structural soils and compost of municipal waste produced in Gorzów Wlkp and Kołobrzeg was proposed for composing substrate for planting trees and shrubs. It was proposed to create substrate on the basis of the essential element – the structural soils with addition of compost in the following amounts: 1, 5, 10, 20 and 30% of the weight. An initial analysis of potential physical-chemical properties of such substrate was carried out basing on the fundamental features of the components.

Results and discussion

The paper shows the results of studies concerning the assessment of possibilities of the use of the structural soils with addition of the compost of municipal waste for planting trees and shrubs in urban agglomerations and degraded areas.

In the study two structural soils by Tegra (Hydralit ZN and ZU) with addition of compost in the amounts of 1, 5, 10, 20 and 30% of the weight were proposed.

The Hydralit ZN mixture is the mixed material that consists of 72% of gravel and 28% of earth of light loamy sands character. The soil skeleton is made up mainly of broken brick fragments, quartz and glaze resembling gravel (according to the producer it is lava), the task of which is stabilization of the structural soils (limitation of excessive compaction and regulation of water and air relations). The Hydralit ZU mixture consists of the soil skeleton (gravel) – 81% and fine earth of light loamy sand character which constitutes the remaining percentage of the structural soils. Moreover, this mixture contains the addition of a root activator, Radolix. Both mixtures are

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Table 1 Essential physical-chemical parameters of components for creating substrates (structural soil and composts made from municipal waste in Gorzów Wlkp. and in Kołobrzeg)

Component	Organic substance	pH KCl	C org	N total	C : N	P	K	Mg	Ca	Na
	%		g kg^{-1}			g kg^{-1}				
Compost from Kołobrzeg	39.54	7.44	212.6	16.69	12.7	2.99	3.82	2.88	39.71	3.17
Compost from Gorzów Wlkp.	39.47	7.63	203.6	9.51	21.4	2.34	6.33	27.1	3.34	4.15
Hydralit ZN	4.53	7.51	30.2	1.81	16.7	0.48	3.76	1.52	10.78	1.66
Hydralit ZU	2.02	7.74	12.6	0.72	17.5	0.31	3.18	1.44	12.51	1.06

Table 2 The content of heavy metals in components for creating substrates (structural soil and composts made from municipal waste in Gorzów Wlkp. and in Kołobrzeg)

Component	Fe	Mn	Zn	Cu	Pb	Ni	Co	Cd
	mg kg^{-1}							
Compost from Kołobrzeg	7 623	194	567	134.7	93.7	28.79	3.89	1.92
Compost from Gorzów Wlkp.	11 420	407	1364	254.2	163.1*	57.32	6.08	3.14
Hydralit ZN	9 080	153	69	21.2	26.4	17.53	5.64	0.76
Hydralit ZU	9 730	157	46	40.3	20.0	12.81	4.51	0.65

* exceeded standards in Regulation of the Minister of Agriculture and Rural Development (2008)

Table 3 Essential physical-chemical parameters of the proposed substrates

Component	Organic substance	pH_{KCl}	C org	N total	P	K	Mg	Ca	Na
	%		g kg^{-1}						
The share of composts – 1% of the weight									
ZN + K	4.88	7.51	32.02	1.96	0.51	3.76	1.53	11.07	1.68
ZU + K	2.40	7.74	14.60	0.88	0.34	3.19	1.45	12.78	1.08
ZN + G	4.88	7.51	31.93	1.89	0.50	3.79	1.78	10.71	1.68
ZU + G	2.39	7.74	14.51	0.81	0.33	3.21	1.70	12.42	1.09
The share of composts – 5% of the weight									
ZN + K	6.28	7.51	39.32	2.55	0.61	3.76	1.59	12.23	1.74
ZU + K	3.90	7.73	22.60	1.52	0.44	3.21	1.51	13.87	1.17
ZN + G	6.28	7.52	38.87	2.20	0.57	3.89	2.80	10.41	1.78
ZU + G	3.89	7.73	22.15	1.16	0.41	3.34	2.72	12.05	1.21
The share of composts – 10% of the weight									
ZN + K	8.03	7.50	48.44	3.30	0.73	3.77	1.66	13.67	1.81
ZU + K	5.77	7.71	32.60	2.32	0.58	3.24	1.58	15.23	1.27
ZN + G	8.02	7.52	47.54	2.58	0.67	4.02	4.08	10.04	1.91
ZU + G	5.77	7.73	31.70	1.60	0.51	3.50	4.01	11.59	1.37
The share of composts – 20% of the weight									
ZN + K	11.53	7.50	66.68	4.79	98	3.77	1.79	16.57	1.96
ZU + K	9.52	7.68	52.60	3.91	0.85	3.31	1.73	17.95	1.48
ZN + G	11.52	7.53	64.88	3.35	0.85	4.27	6.64	9.29	2.16
ZU + G	9.51	7.72	50.80	2.48	0.72	3.81	6.57	10.68	1.68
The share of composts – 30% of the weight									
ZN + K	15.03	7.49	84.92	6.27	1.23	3.78	1.93	19.46	2.11
ZU + K	13.28	7.65	72.60	5.51	1.11	3.37	1.87	20.67	1.69
ZN + G	15.01	7.55	82.22	4.12	1.04	4.53	9.19	8.55	2.41
ZU + G	13.26	7.71	69.90	3.36	0.92	4.13	9.14	9.76	1.99

ZN – Hydralit ZN; ZU Hydralit ZU; K – compost from Kołobrzeg G – compost from Gorzów Wlk

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characterized by a very small amount of organic matter, alkaline reaction, very high or high content of available by plants forms of magnesium and potassium, and an medium or low content of phosphorus (Kubus et al., 2009; Malinowski et al., 2012).

The characteristic feature of the composts made from municipal waste of Gorzów Wlkp. is their structure of earthy and brown colour (Meller et al., 2007a, b). Their dominating component (56.7% of the mass) is fine earth (∅ <1.0 mm). The remaining components are weakly processed organic particles (∅ >1.0 mm – 36.0 % of the weight) and ballast (mainly plastic and glass – 7.3% of the weight). The content of organic substance in these composts is very high (from 31.2 to 50.1%), and is approximate to values ascertained in similar composts (Meller et al., 2006). The content of some analyzed heavy metals in the studied composts exceeds allowable values shown in Regulation of the Minister of Agriculture and Rural Development of 19 October 2008 (particularly those for cadmium, lead and nickel).

Composts made from municipal waste in the composting plant in Kołobrzeg contain on average 48.8 % of fine earth (∅ <1.0 mm), weakly processed organic particles (∅ >1.0 mm – 7.4 % of the weight) and ballast (mainly glass and plastic – 43.8% of the weight). The content of organic substance in these composts (on average 39.5%) is approximate to its amounts in the composts made from municipal waste in the ZUO (Waste Utilization Plant) in Gorzów Wlkp. The amounts of macro-elements in both proposed for use composts remain at a similar level. Composts made from municipal waste in the composting plant in Kołobrzeg do not exceed the content of heavy metals (Cd, Pb and Ni) determined in Regulations of the Ministry of Agriculture and Rural

Table 4 The content of heavy metals in the proposed substrates

Component	Fe	Mn	Zn	Cu	Pb	Ni	Co	Cd
	mg kg^{-1}							
The share of composts – 1% of the weight								
ZN + K	9 065	153	74	22.3	27.1	17.64	5.62	0.77
ZU + K	9 709	157	52	41.2	20.7	12.97	4.50	0.66
ZN + G	9 103	156	82	23.5	27.8	17.93	5.64	0.78
ZU + G	9 747	160	59	42.4	21.4	13.26	4.53	0.67
The share of composts – 5% of the weight								
ZN + K	9 007	155	94	26.9	29.8	18.09	5.55	0.82
ZU + K	9 625	159	72	45.0	23.7	13.61	4.48	0.71
ZN + G	9 197	166	134	32.9	33.2	19.52	5.66	0.88
ZU + G	9 815	170	112	51.0	27.2	15.04	4.59	0.77
The share of composts – 10% of the weight								
ZN + K	8 934	157	119	32.6	33.1	18.66	5.47	0.88
ZU + K	9 519	161	98	49.7	27.4	14.41	4.45	0.78
ZN + G	9 314	178	199	44.5	40.1	21.51	5.68	1.00
ZU + G	9 899	182	178	61.7	34.3	17.26	4.67	0.90
The share of composts – 20% of the weight								
ZN + K	8 789	161	169	43.9	39.9	19.78	5.29	0.99
ZU + K	9 309	164	150	59.2	34.7	16.01	4.39	0.90
ZN + G	9 548	204	328*	67.8	53.7	25.49	5.73	1.24
ZU + G	10 068	207	310*	83.1	48.6	21.71	4.82	1.15
The share of composts – 30% of the weight								
ZN + K	8 643	165	218	55.3	46.6	20.91	5.12	1.11
ZU + K	9 098	168	203	68.6	42.1	17.60	4.32	1.03
ZN + G	9 782	229	458*	91.1	67.4	29.47	5.77	1.47
ZU + G	10 237	232	442*	104.5	62.9	26.16	4.98	1.40

ZN – Hydralit ZN; ZU Hydralit ZU; K – compost from Kołobrzeg G – compost from Gorzów Wlk
* exceeded standards in Regulation of the Minister of the Environment (2002)

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Development of 18 June 2008 concerning some rules of the act on fertilizers and fertilizing.

The addition of composts made from municipal waste resulted in an increase in the organic matter in substrates produced in this way (Table 3). Both components show alkaline reaction, thus different proportions of the used components do not affect significantly their reaction. An increasing percent share of the composts causes a proportional growth in the content of macro-elements.

The proposed structural soils of Hydralit of the ZN and ZU type with 20% and 30% addition of composts made in Gorzów Wlkp. contain a norm exceeding amount of zinc (Regulation of the Minister of the Environment of 9 September 2002 on standards for soil quality and land quality standards). The remaining mixtures of Hydralit and composts do not exceed the allowable values defined in the regulation.

The above described results show that the most optimal addition to both the structural soils of Hydralit ZN and ZU is a 5% share of composts of municipal waste. The presented theoretical assumptions should be verified in experiments.

Conclusion

For composing substrates for planting trees and shrubs in urban agglomerations on the basis of the carried out analysis, the completion of structural soils is proposed with composts of municipal waste produced in Gorzówie Wlkp. and in Kołobrzeg in an amount up to 5% of the weight. Such a share of composts guarantees an approximate to the required for this type of substrates share of the organic material. What is more, the applied composts enrich the structural soils with macro- and microelements accessible for the plants, and at the proposed rate the safe amounts of heavy metals in the substrate will not be exceeded.

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