IECHo e-congress, April 16 – 30 , 2022 | Online

Spent Cultivation Substrate (SCS) Management in Circular Farming System

Agnieszka Jasińska[1, 2], Ketil Stoknes[2], Michał Roszak [3]

1 Poznan University of Life Sciences, Department of Vegetable Crops, ul. J.H. Dąbrowskiego 159, 60-594 Poznan, Poland;
2 Lindum AS, Lerpeveien 155, 3036 Drammen, Norway;
3 Soppas, Nedre Keisemark 1E, 3183 Horten, Norway
Author for correspondence: agnieszka.jasinska@lindum.no

Mushroom and plant crop cultivation is normally performed through energy- and resource-intensive processes (based on fossil or mineral resources), in commercial specialized operations such as climate-controlled tunnels and greenhouses). These operations generate wastes and the CO_2 footprint of the produce is high. Spent cultivation substrate (SCS) is growing medium which stays after cultivation of mushrooms (SMS) or vegetables (SGS) and for many years was considered as a problematic waste product from farming. However recently in the new transition to sustainable, circular farming systems it is seen as a valuable product which could be recycled.

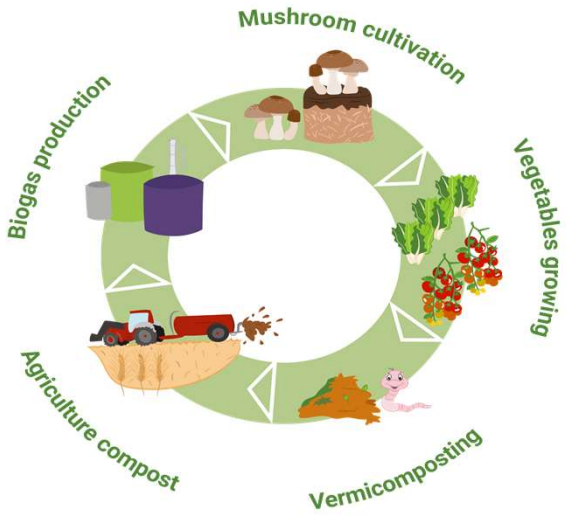
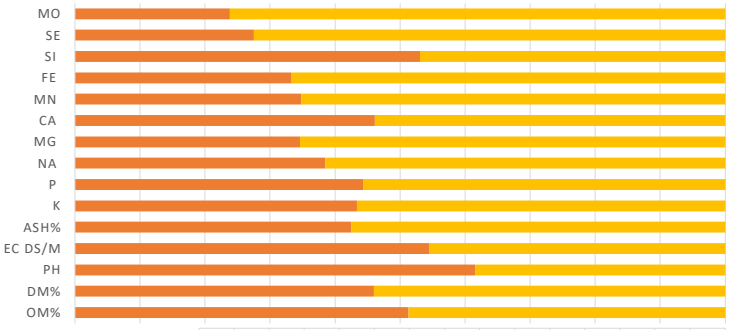


Figure 1 Circular famring system from food waste to food



	OM%	DM%	pH	EC dS/m	Ash%	K	P	Na	Mg	Ca	Mn	Fe	Si	Se	Mo
Before mushroom cultivation	87,6	30,2	8,8	4,3	12,4	10 96	3100	1955	1275	1420	51,6	28,8	45,9	1,1	0,5
SMS	83,2	35,5	5,5	3,6	16,8	14334	3900	3123	2410	1660	96,6	57,9	40,6	2,9	1,6

Figure 2 Substrate composition before and after mushroom cultivation – summary of changes (mikro and makroelements in mg/kg)

In the scope of the VegWaMus CirCrop project we have focused on recycling digestate based (from biogas production) spent mushroom substrate (SMS) into growing medium or growing medium additives for vegetables and subsequent mushroom cultivation. We also investigated reuse spent growing substrate (SGS) and crop waste from greenhouse tomato production into new cultivation substrate.

Materials and methods

SMS after 120 days of Agaricus subrufescens cultivation was thoroughly mixed and air dried. Three types of spent growing substrates (SGS) from one year greenhouse tomato cultivation were examined. The growing substrates were based on garden compost produced from mostly green waste (Lindum AS, Norway), vermicompost, earth worms crust fed with combined food waste – diary manure digestate and aged bark. The compost mixes were fertilised by liquid fraction of digestate. Spent Growing Substrate mix 1: (SGS1) 30:70 vermicompost: garden compost. Spent Growing Substrate mix 2: (SGS2) 30:35:35 vermicompost: aged bark: garden compost. Control: Peat + mineral fertigation.
The examined substrates were analysed for elemental content (ICP-OES) before and after crop cultivation and/or composting the changes in the initial constitution was evaluated. Chemical and physical features were measured such as pH, EC, dry matter content (DM), ash, organic matter content and compared.

Table 1. Some heavy metals levels in substrates after cultivation mg/kg with reference to limits and initial substrates (mg/kg)

	Cadmium (Cd)	Copper (Cu)	Zinc (Zn)
Limit value class 0	0,40	50	150
Limit value class Eco	0,70	70	200
Limit value class 1	0,80	150	400
Limit value class 2	2,00	650	800
Limit value class 3	5,00	1000	1500
Average digestate	0,32	60	250
Average garden compost	0,37	50	170
Peat substrate	0,38	470	250
Mushroom substrate before cultivation	0,62	1,99	47
SGS1	2,20	62	190
SGS2	0,60	67	210
SMS	0,72	3,30	109

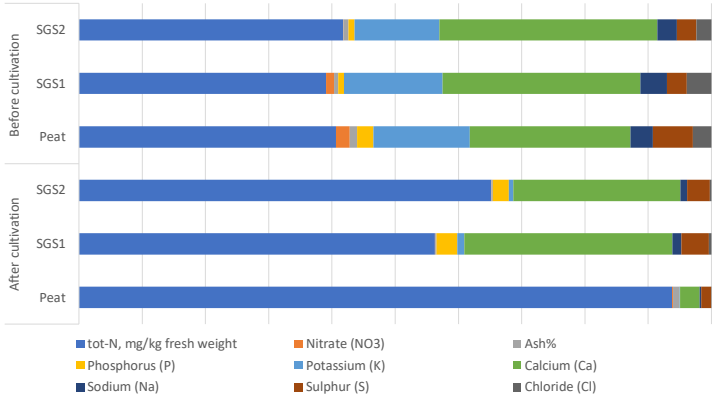


Figure 3 Substrate nutrients before and after tomato cultivation – summary of changes (mikro and makroelements in mg/l)

Conclusions

- The SMS was characterised by high organic matter content, low bulk density, is high in soluble slats content. Content of essential micro and macro nutrients increased significantly after mushroom. Also pH after mushroom cultivation dropped to 5,5, which is appropriate for most plants cultivation.
- The content of heavy metals was acceptable for both SMS and SGS, ranging in limit values of class 0 to Eco (tab.1)
- SMS features shows it could be used air dried as addition to plant cultivation medium enhancing nutrition and physical properties.
- SMS could be used as a substrate additive for other mushrooms cultivation or as a casing material.
- If used fresh, directly after cultivation both SGS should be composted or co-composted with additional waste products to eliminate potential pests and due to high mineral salt content.
- After composting SGS could be potentially used in horticulture for subsequent greenhouse vegetables cultivation.
- SGS can be also targeted for the direct use in outdoor agriculture and landscaping as soil fertility amendment.

This project has received funding from the European Union's Horizon 2020 research and innovation programme Under the Marie Sklodowska-Curie grant agreement No 751052 and Innovation Norway – Sirkulærøkonomi No 2018/1004404.