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Mini Review

Integrated vermicomposting and green roof techniques for food production in urban and rural areas

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Abstract

Thousands of tons of biodegradable organic waste generates in urban and rural areas every day, creating disposal problems. Urban organic waste can be converted into valuable output products (vermicompost, vermin-liquid, and earthworms) by applying a vermicomposting technique that had different. Implementing green roofs via soilless culture systems as micro-scale farms led to increasing natural resource use efficiencies as well as producing fresh food. The integration of both techniques will create not just reduce pollution and climate change impacts but also for increasing food production and security in urban, enhance the lifestyle and increase public awareness of environmental issues. This process is profitable at any scale of operation.

More Information

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Introduction

Under climate change impacts and food security needs, megacities citizens are huge customers but contributions as pioneers in mitigation and adaptation of climate change impacts while creating sustainable cities and satisfying food production could be achieved, through implement integrated environmental management of urban horticulture via the soilless culture for producing food and vermicomposting for recycling urban organic wastes.

Urban horticulture includes all horticultural crops grown for human consumption and ornamental use. Urban horticulture is not just working on producing a large variety of vegetables, cereals, flowers, ornamental trees, aromatic vegetables and mushrooms but also fighting the climate change impacts, poverty, hunger, malnutrition and illness while helping food security, economy and social needs (FAO 2012).

Vermicomposting is a double process in which earthworms play a major role in digesting the organic wastes to worm manure (vermicompost) and microbes play a secondary process (humification) in decreasing the C: N ratio and enhancing the decomposition (worm cast) while mitigating CO_2 emission and save the essential nutrients into nutrient-rich vermicompost [1-4]. Different urban organic wastes could be recycled by vermicomposting by different epigeic earthworms instead of which include urban solid waste, city leaf litter, food wastes, paper waste, and residues of plant decomposition [1].

The use of soilless culture techniques through different hydroponic and substrate culture systems in producing vegetables under urban horticulture led to avoiding the problems of urban soil contamination, and shortage of soil, water, and natural resources besides maximizing the production. The real advantages of using soilless culture in urban agriculture are the use of neglectable areas as rooftops as cultivation areas and the high water use efficiency.

Many researchers investigated urban agriculture mainly in soil cultivation such as the contamination effect of trace and heavy elements in urban soils on leafy vegetables growth and production [5], human health risk assessment of vegetables consumed from contaminated urban soil, and foodborne pathogens [6], The role of urban agriculture in sustainable production and food security in urban and peri-urban areas (Bvenura and Afolayan 2015).

Green roof systems avoid all urban soil problems and contaminations while offering the opportunity to use vermicomposting products as organic fertilizers (vermicompost solid and liquid), organic substrate instead of peat moss or coco peat besides the use of vermin-liquid as a strong fungicide to prevent and control the vegetable fungi diseases. The benefits of mixing both systems together vermicompost and green roof (Image 1) create a promising hope to save the environment, producing safe live food and

Image 1: The integrated vermicomposting technique and simple green roof systems.

helping the poor everywhere. The producer in this case is the consumer at the same time [1-4,7].

Results

Through different studies and investigations on the integrated environmental management via vermicomposting and green roof techniques for food production (celery, lettuce, salad, red cabbage, Molokai, spinach tomato, cucumber, snap bean and strawberry,) in urban and rural areas under Egyptian conditions, the most revealed results could be summarized as follows:

1. The high potential of converting urban organic wastes into vermicompost via vermicomposting instead of incineration or burial. Vermicomposting could contribute in mitigate CO_2 emissions and saving essential nutrients and energy via recycling urban organic wastes to vermicompost [1,2].

2. Vermicomposting has a high environmental impact through offering multi products such as vermicompost, vermin-tea and vermin-liquid that could be used as organic substrates instead of peat moss or organic fertilizer or as a substitute for the chemical nutrient solution.

3. The use of vermicompost in small proportions of 10% - 30% led to improve physical and chemical properties of different substrates [2-3,7].

4. Also simple soilless culture systems (hydroponic (nutrient film technique and deep water culture) and substrate systems (pots, bags and containers) in an urban area could be used as micro-farm scale (green roof) for producing different vegetable crops [2-4,7-9].

5. Integrated environmental management via simple substrate culture and vermicomposting in cultivating different vegetable crops could achieve food safety and at the same time food security that helps in avoiding malnutrition problems and hungry and reduce the pressure on the agriculture system under the climate change impacts [2-4,7-9].

6. The best vegetative growth and yield of sweet pepper were given by perlite: peat moss: vermicompost (40:40:20) followed by perlite: peat moss: vermicompost (45:45:10). The use of vermicompost as a substrate amendment resulting in improve the pepper growth and productivity during summer season Abul-Soud, et al. [2].

7. The substrate sand + vermicompost (80: 20 (v/v)) in pot volume 6 L recorded the highest yield of celery, lettuce, salad and red cabbage economically and environmentally [8].

8. The recommended treatments for producing lettuce are vermicompost + sand combined with vermi-liquid and perlite + vermicompost (3: 1 v/v) combined with vermi-tea Abul-Soud, et al. [3].

9. Applying vermi-liquid as an organic nutrient solution combined with substrate peat moss: perlite: 10% vermicompost for producing molokhia and spinach in simple substrate culture to create green roofs and to produce green food environmentally. To assure food safety, applied vermi-liquid combined with substrate peat moss: perlite: 20 % vermicompost for reducing Pb content in molokhia and spinach leaves Abul-Soud and mency [10].

10. The chemical nutrient solution gave the highest results of vegetative, yield, and quality characteristics of strawberries in bags and pot systems of substrate culture. Vermi-tea and compost-tea need to improve to be used as a nutrient solution in substrate culture. Vermicompost + sand (20:80 and 15:85 v/v%) had

a high potential in substrate culture of strawberry production instead of peat moss + perlite (control) substrate [3].

11. The use of substrate sand + rice husk + vermicompost (40: 40: 20 (v/v)) in pot volume 8 L for producing more healthy and environmentally celery and red cabbage. The economic results had a different viewpoint, pot volume 4 L/ plant combined with a vermicompost rate of 10% followed by 20 %, and pot volume 8 L/ plant combined with a vermicompost rate of 10% followed by 20% had the highest economic values for celery and red cabbage respectively. While the lowest economic use gave by 8 L/ plant combined with peat + perlite substrate (control) [11-14].

12. Chemical nutrient solution at EC level 1.5 (dSm^{-1}) + substrate sand: peat moss: vermicompost (40: 40: 20% (v/v)) produced the highest yield of lettuce. While for environmental safety, vermi-liquid + Ec level 1.5 dS m^{-1} + substrate sand: peat moss: vermicompost (40: 40: 20% (v/v)) was recommended. The study supported the micro and small-scale urban farm to match the food security and safety needs via using vermicomposting outputs and simple substrate culture in the top roof garden technique. Ecology food could be sustained under urban conditions Abul-Soud, et al. [7].

13. The ability to use vermi-liquid as a nutrient solution source for producing celery and lettuce in different deep water culture systems, vermi-liquid had a negative impact on DOI. Implementing air pumping combined with chemical + vermi-liquid (1:1) as a nutrient solution in deep water culture for producing leafy vegetables. Deep water culture as an inexpensive and simple soilless culture system could attribute strongly to the ecology production of lettuce and celery. On the other hand, the use of vermi-liquid as a nutrient solution reduces chemical use and environmental risk while sustaining vegetable production [9].

Conclusion

Integrated vermicomposting and green roof techniques had wide objectives scales including public health, human lifestyle, knowledge transfer, social and economic as well as food security, climate change, sustainability and environmental.

References

1. Abul-Soud M, Medany M, Hassanein MK, Abul-Matty Sh, Abu-Hadid AF. Case study: Vermiculture and vermicomposting technologies use in sustainable agriculture in Egypt. The seventh international conference of organic agriculture, Cairo, Egypt. Egypt. J. Agric. 2009; 87 (1): 389:403.

2. Abul-Soud MA, Emam MSA, Hawash AH, Hassan M, Yahia Z. The utilization of vermicomposting outputs in ecology soilless culture of lettuce. Journal of Agriculture and Ecology Research. 2015; 5(1): 1-15, Article no.JAERI.20008

3. Abul-Soud MA, Emam MSA, Noha G. El-Rahman A. The potential use of vermicompost in soilless culture for producing strawberries. International Journal of Plant & Soil Science. 2015; 8(5): 1-15.

4. Abul-Soud M. Achieve food security of some leafy vegetables in urban (How to create resilient cities?). Global Journal of Advanced Research. 2015; 2 (10):1705-1722.

5. McBride MB, Shayler HA, Spliethoff HM, Mitchell RG, Marquez-Bravo LG, Ferenz GS, Russell-Anelli JM, Casey L, Bachman S. Concentrations of lead, cadmium and barium in urban garden-grown vegetables: the impact of soil variables. Environ Pollut. 2014 Nov;194:254-261. doi: 10.1016/j.envpol.2014.07.036. Epub 2014 Aug 28. PMID: 25163429; PMCID: PMC4175907.

6. Swartjes FA, Versluijs KW, Otte PF. A tiered approach for the human health risk assessment for consumption of vegetables from with cadmium-contaminated land in urban areas. Environ Res. 2013 Oct;126:223-31. doi: 10.1016/j.envres.2013.08.010. Epub 2013 Sep 23. PMID: 24071061.

7. Abul-Soud M, Emam MSA. Potential of ecology substrate culture for producing celery in urban. The 5th international conference of Agricultural & Bio Engineering "The role of agricultural and biological engineering for advancement of the agricultural sector", Cairo, Egypt. J. Agric. 2017; Part 2: 541 - 557.

8. Abul-Soud M, Gomaa AM. Urban horticulture of mallow and spinach environmentally via simple substrate culture system and vermicomposting outputs. . Global Journal of Advanced Research. 2015; 2(12):1832-1847.

9. Abul-Soud MA, Emam MSA, Mohammed MH, Hawash AMH, Maharik ZY. The sustainable production of lettuce and celery ecologically in deep water culture. Bioscience Research. 2019;16 (3): 2866-2881.

10. Abul-Soud M, Gomaa AM. Urban horticulture of mallow and spinach environmentally via simple substrate culture system and vermicomposting outputs. . Global Journal of Advanced Research. 2015, 2(12): 1832-1847.

11. Ahmed SH, Emam MSA, Abul-Soud M. Effect of different vermicompost rates and pot volumes on producing celery and red cabbage under urban horticulture conditions. Zagazig J. Agric. Res. 2017; 44:4; 1245-1258.

12. SF El-Sayed, Hassan HA, Abul-Soud M, Doaa AM. Gad. Effect of different substrates and nutrient solutions on vegetative growth, mineral content, production and fruit quality of strawberries. Zagazig J. Agric. Res. 2016; 43 (6A): 1912-1938

13. Abul-Soud MA, Emam MSA, Maharik ZY, Mohammed MH, Hawash AMH. How to sustain ecology food production under urban conditions. Zagazig J. Agric. Res. 2017; 44:(4); 1259-1276.

14. Shaaban KhN, Abul-Soud M, El-Behairy OA. The production of tomato and strawberry in ecology urban agriculture. J. Environ. Sci. 2018; 44(1): 93-115.