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PRELIMINARY STUDY ON THE INFLUENCE OF THE USE OF VERMICOMPOST AS A CULTURE SUBSTRATE ON THE QUALITY OF LETTUCE SEEDLINGS (*LACTUCA SATIVA* L.)

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Abstract

The experiment was carried out at the University of Agronomic Sciences and Veterinary Medicine Bucharest, Faculty of Horticulture under laboratory conditions in 2020. During the COVID 19 pandemic, it took place in the university greenhouse, from the end of October until the end of November 2020. The biological material was represented by Red Oak lettuce cultivar, vermicompost (also known as vermicast), peat, zeolite and perlite. The paper aimed to present the benefices of using vermicompost in reducing nutrient solution and a higher yield. We tested 13 variants with 3 repetition each and used vermicompost in different percent as substrate such as 0%, 25%, 50% and 100% of pot volume. The vermicompost was produced by California Red Wigglers from converting two types of precomposted manure, horse and cattle over the period of 26 weeks. The vermicompost has a neutral PH 6,8-7,2 and does not burn the plant. The lettuce from variants where vermicompost was added, had a lower nutrient solution intake, this being an economic effect to reduce water consumption.

Key words: *vermicompost, peat, perlite, zeolite, lettuce.*

INTRODUCTION

Large quantities of animal manure and different organic waste are produced in farming and agricultural production along with sewage biosolids and food waste. If not disposed/treated properly these have the harmful potential of increasing water and soil pollution, globally. With the current world population of 7,999,420,420, we will reach 8 billion people by 15th of November 2022 and 9 billion by 2037 according to https://www.worldometers.info. It's harder and harder to dispose of our garbage in a safe and sustainable way for the environment. A sustainable process for waste and nutrient management is composting and/or vermicomposting. Over 50% of total wastes is organic and can be diverted from the landfills to compost and vermicompost facilities.

Edwards et al., 2011, in "Vermiculture Technology", presents a vermicomposting pilot program started in USA, in different colleges and universities such as The Evergreen State College located in Olympia, Washington, Southern Illinois University Carbondale located in Carbondale, Illinois, University of Oregon located in Eugene, Oregon, University of Massachusetts Lowell located in Lowell, Massachusetts.

Although composting and vermicomposting is happening since the beginning of life on Earth, researchers still don't have an exact definition for compost.

Comforter Compost, Banner Batches and The Complete Compost Gardening Guide use the word "compost" to describe a putrefaction, decay process.

Compost was one of the topics that has interested me since 2008 and over the years I came to the conclusion that you need 5 ingredients to make compost, such as oxygen, water, carbon, nitrogen and time. Adding worms to your compost system, will result in vermicomposting.

Blackburn, 2022, shows that vermicompost is the by-product of vermicomposting or worm composting. Vermicompost typically consists of unprocessed organic materials, microorganisms and worm castings.

Hernández et al., 2010, used vermicompost obtained from cattle manure as a substrate for growing lettuce and they observed that the plants presented a medium and small volume compared to variants cultivated in compost or urea fertilisation.

The substrate is very important for obtaining high quality lettuce seedlings (Draghici et al., 2016).

León et al., 2012, concluded that the volume of lettuce, number of leaves and nitrate content was influenced by applying different proportions of vermicompost to the nutrient solution.

Durak et al., 2017, in his study regarding the effect of vermicompost applied on lettuce, he showed that by applying 200-300 kg/ha of vermicompost, the growth parameters got better, soil quality improved and that lead to an optimal harvest.

Pleasant et al., 2008, mentions that the decomposition of organic materials process is over when you can see it visually and no fermentation odours come from the compost and/or vermicompost system.

Suthar, 2007, used the *Perionyx sansibaricus* (Perrier), a worm for vermicomposting and concluded that the most efficient conversion into vermicompost was from farm waste, sewage and different urban waste.

Tognetti et al., 2013, writes about the quality of vermicompost that it is influenced by the materials used to feed the worms.

Theourn et al., 2022, proves that the increasing of vermicast produced a higher number of active carbon (microorganism carbon energy source) also known as permanganate-oxidizable carbon (POXC).

Payal et al., 2006, did a study and evaluated the efficiency of *Eisenia foetida* (an epigeic worm) on processing organic waste from household, agricultural waste, sewage and fibre from the textile industry and they obtained a valuable vermicompost.

Munroe, 2009, writes about vermicompost's abilities to supress plant diseases and the concept of „soil food web".

Nancarrow et al., 1998, writes about how vermicompost/castings hold their nutrients wrapped around in a membrane. This helps the nutrients to be released slowly so the plant has access and availability as needed to it, over a period of time.

Vermicompost is a natural and organic product, that all farmers should use to improve their soil and production. Mala, 2022, remarks that this organic fertiliser is still unpopular among farmers.

The paper aimed to present the influence of vermicompost on pot substrate, the consumption of nutrient solution, as well as the difference of hight and number of leaves on lettuce.

MATERIALS AND METHODS

The experiment was carried out at the University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture under laboratory conditions, using the metric system.

The biological material was represented by Red Oak lettuce cultivar planted in individual pots for 30 days.

The vermicompost was produced over a period of 6 months from two type of manure, horse and cattle. Prior to feeding the worms, the manure was precomposted for 6 months. Then it was screen and feed to the worms every week, for 26 weeks. After this period, we sifted the worms from the castings (vermicompost) and used it under laboratory conditions for our experiment. The experimental variants consisted in the use of different nutrient substrates of vermicompost (from manure), peat, zeolite and perlite in percent of 0%, 25%, 50%, 75% and 100% also in different proportion (Table 1).

Table 1. The experimental variants

Variant	Substrate type
V1	Peat 100%
V2	Zeolite 100%
V3	Perlite 100%
V4	Vermicompost 100%
V5	Vermicompost 75% + peat 25%
V6	Vermicompost 50% + peat 50%
V7	Vermicompost 25% + peat 75%
V8	Vermicompost 75% + zeolite 25%
V9	Vermicompost 50% + zeolite 50%
V10	Vermicompost 25% + zeolite 75%
V11	Vermicompost 75% + perlite 25%
V12	Vermicompost 50% + perlite 50%
V13	Vermicompost 25% + perlite 75%

The pot experiment started on the 27th of October 2020 and ended on the 27th of November 2020. We used 13 varieties of substrate in different combination with 3 repetition each.
Appearance of lettuce seedlings in figure 1.

Figure 1. Appearance of seedlings

RESULTS AND DISCUSSIONS

Over the course of 30 days, during seedling production, we used a different quantity of nutrient solution, depending on the growing medium. We discovered that for V1 where we used 100% peat for culture substrate, 562.67 ml/plant of nutrient solution was used. With the exception of V3 where we used 100% perlite as a substrate and 615.67 ml/plant nutrient solution. With 53.00 ml more then V1, 9% higher than the control variant (V1). Only V13 variant (vermicompost 25% + perlite 75%) had a significantly similar quantity of nutrient solution added, 562.33 ml.
In the case of using vermicompost at a rate of 100% (V4) the amount of nutrient solution absorbed by the plant was lower compared to the control V1. The amount administered was 466.67 ml with 96.00 ml less nutrient solution than V1, with a distinctly negative significance. We also found that when using vermicompost 75% + peat 25% (V5) the amount of nutrient solution compared to V4 in which only vermicompost was used, was 77.00 ml lower than V1 peat (control).
As the amount of peat in the mixture increased, the amount of nutrient solution used increased, but it was lower than V1-control. In the case of using zeolite in the nutrient mixture in a percentage of 100% (V2), we found that, on average, on the variant, an amount of 463.33 ml of nutrient solution was used, with a percentage of 82.35% less than the control (V1).

A similar aspect was found when vermicompost was used in combination with perlite (Table 2.)

Table 2. The influence of culture substrate on the intake of nutrient solution

VARIANTS	Nutritive Quantity (ml)	Difference (ml)	(%)	Significance
V(0) average	514.41	-48.26	91.42	OOO
V(1)	562.67	0.00	100.00	Ct
V(2)	463.33	-99.33	82.35	OOO
V(3)	615.67	53.00	109.42	***
V(4)	466.67	-96.00	82.94	OOO
V(5)	**485.67**	**-77.00**	**86.32**	**OOO**
V(6)	**551.00**	**-11.67**	**97.93**	**OOO**
V(7)	**553.33**	**-9.33**	**98.34**	**OOO**
V(8)	423.33	-139.33	75.24	OOO
V(9)	522.67	-40.00	92.89	OOO
V(10)	525.33	-37.33	93.36	OOO
V(11)	427.67	-135.00	76.01	OOO
V(12)	527.67	-35.00	93.78	OOO
V(13)	562.33	-0.33	99.94	N

DL 5% =	4.640	DL 5% in % =	0.8246
DL 1% =	6.290	DL 1% in % =	1.1179
DL 0.1% =	8.440	DL 0.1% in % =	1.5000

The appearance of seedlings on experimental variants is shown in Figures 2 and 3.

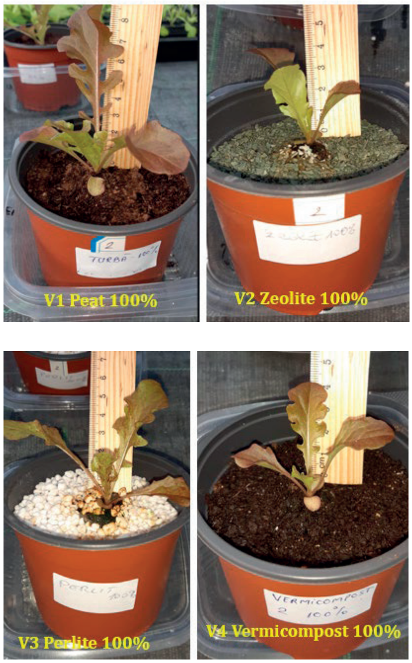

Figure 2. Appearance of seedlings on experimental variants

Figure 3. Appearance of seedlings on experimental variants

Analysing the height of the lettuce seedlings we found that at V1 control - peat 100%, the seedlings had a height of 10.66 cm, compared to the variants in which we used substrate of perlite, zeolite and vermicompost.
The smallest height of 8.67 cm was recorded at V10-Vermicompost 75% + perlite 25%. In the case of variants where vermicompost was used in combination with perlite and zeolite, the height of the seedlings was higher compared to the control variant (Figure 4.).

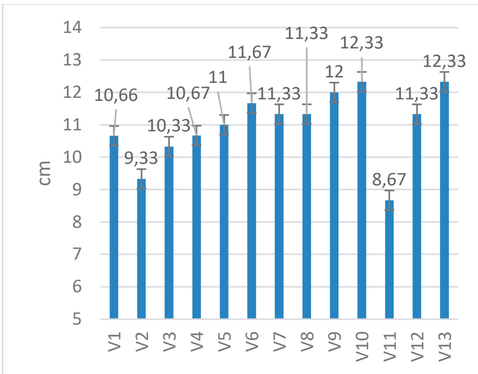

Figure 4. The height of lettuce seedlings after 30 days

It was noted that in the case of V2 in which we used zeolite substrate (V2), the height of the seedlings was 1.33 cm below the V1 - control, aspect noted as well in V3 - perlite, the difference being 0.33 cm, as well as in V11 (Vermicompost 75% + perlite 25%) 1.99 cm.
At the variant where we used 100% vermicompost, it showed a height close to the control version (V1). The highest height of the seedling was identified in V10 (Vermicompost

25% + zeolite 75%) and V13 (Vermicompost 25% + perlite 75%) 1.67 cm above the control V1 (Figure 5).

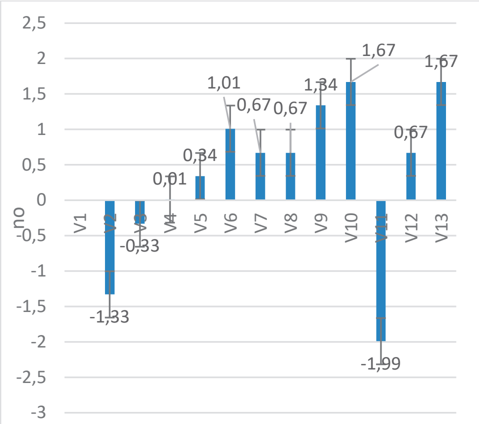

Figure 5. Difference from the control variant (V1 peat substrate) on the height of lettuce seedlings

Regarding the number of leaves we found insignificant differences from the control - V1 between the variants grown on the substrates of zeolite 100% and perlite 100% as well as between V7 - Vermicompost 25% + peat 75%, V9-V13. Significant negative differences were noted in the rest of the variants (Table 3).

Table 3. Numbers of leaves for the lettuce seedlings

Variants	Number of leaves no.)	Difference (no.)	(%)	Significance
V(1)	4.33	0.00	100.00	Ct
V(2)	3.67	-0.67	84.62	N
V(3)	4.00	-0.33	92.31	N
V(4)	3.33	-1.00	76.92	O
V(5)	3.33	-1.00	76.92	O
V(6)	3.33	-1.00	76.92	O
V(7)	4.33	0.00	100.00	N
V(8)	3.33	-1.00	76.92	O
V(9)	3.67	-0.67	84.62	N
V(10)	3.67	-0.67	84.62	N
V(11)	3.67	-0.67	84.62	N
V(12)	4.33	0.00	100.00	N
V(13)	4.67	0.33	107.69	N

DL 5% = 0.910 DL 5% in % = 21.0000
DL 1% = 1.230 DL 1% in % = 28.3846
DL 0.1% =1.660 DL 0.1% in % = 38.3077

CONCLUSIONS

Based on the results obtained, it can be estimated that the largest amount of nutrient solution was used in V3, a variant in which 100% perlite was used.

In the case of using vermicompost, the amount of nutrient solution used throughout the seedling's production was lower, the percentage being 82% nutritional solution compared to the peat-control V1, which means that the substrate retained a higher humidity, a longer time with economic effects to reduce water consumption.

Regarding the height of the seedlings, there were no significant differences, an aspect to be taken into account for the uniformity of the seedling but also for the economic establishment of the components used in the growing substrate.

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