Agraarteadus
1 * XXIX * 2018 25–28

Journal of Agricultural Science
1 * XXIX * 2018 25–28

THE EFFECT OF VERMICOMPOST ON THE GROWTH AND QUALITY OF CRESS (*LEPIDIUM SATIVUM*)

Margit Olle

Estonian Crop Research Institute, J. Aamissepa 1, 48309 Jõgeva, Estonia

Saabunud: Received: 04.04.2018
Aktsepteeritud: Accepted: 22.05.2018

Avaldatud veebis: Published online: 23.05.2018

Vastutav autor: Corresponding author: Margit Olle
E-mail: margit.olle@gmail.com
Phone: +372 671 1554

Keywords: cress, growth, vermicompost, quality.

doi: 10.15159/jas.18.02

ABSTRACT. Vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes *etc*. are converted while passing through the worm-gut to nutrient rich vermicompost. The aim was to find suitable substrate to grow cress. 1. 30% vermicompost, peat, sand and dolomite stone. 2. 25% vermicompost, peat, gravel, perlite. 3. 25% vermicompost, peat, gravel, light gravel. 4. Growth substrate bought from a shop in Estonia (seller didn't allow to usage the name of the brand). 5. 20% vermicompost and organic matter rich claysoil. Results: Most elongated cress plants were in treatment 4, and the shortest ones in treatment 5. At the same time the longest roots were measured from plants in treatment 2, but shortest in treatment 5. The thickest stem was measured by treatment 1 and the thinnest stem was by treatment 5. The chemical analyses are showing that the smallest content of nitrogen was by treatment 3 and the highest by treatment 4. The smallest content of phosphorus was by treatment 5 and the highest by treatment 4. The smallest content of potassium was by treatment 4 and the highest by treatment 5. The smallest content of calcium was by treatment 4 and the highest by treatment 3. The smallest content of magnesium was by treatment 4 and the highest by treatment 5. Conclusion: out of the results of this experiment we could conclude that the best substrate to grow cress is substrate number 3: 25% vermicompost, peat, gravel, light gravel.

Introduction

Vermicompost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes *etc*. are converted while passing through the worm-gut to nutrient rich vermicompost. Vermi worms were used here to act as biological agents to consume those wastes and to deposit excreta in the process called vermicompost (Adhikary, 2012). Vermicompost produced by the activity of earthworms is rich besides the macro and micronutrients also in vitamins, growth hormones, enzymes such as proteases, amylases, lipase, cellulose and chitinase and immobilized microflora (Barik *et al*., 2011).

Civilizations, including Greece and Egypt valued the role earthworms played in soil. The ancient Egyptians were the first to recognize the beneficial status of the earthworm. The Egyptian Pharaoh, Cleopatra (69–30 B.C.) said, "Earthworms are sacred." (Medany, 2011). The thoughts of ancient Indian Scientist Sir Surpala (10 Cent. A.D.), who recommended to add earthworms in the soil to get good fruits of pomegranate (Sinha, 2014a). Earthworms are truly justifying the beliefs and fulfilling the dreams of Sir Charles Darwin who called them as "unheralded soldiers' of mankind" and "friends of farmers". They are also justifying the beliefs of great Russian scientist Dr. Anatoly Igonin, who said "Nobody and nothing can be compared with earthworms and their positive influence on the whole living Nature". (Sinha *et al*., 2014b).

The beneficial impacts of vermicompost on soil (Sinha, 2014a):

1. Increase the 'Soil Organic Matter' (SOM), soil structure and prevent soil erosion.
2. Increase beneficial soil microbes, microbial activity and essential nutrients.
3. Improve cation exchange capacity.
4. Reduces bulk density of soil, prevents soil compaction and erosion.
5. Suppression of soil-born plant diseases.
6. Increase water holding capacity of soil.
7. Remove soil salinity and sodicity.
8. Maintain optimal pH value of soil.

Important feedback from farmers using vermicompost (Sinha *et al*., 2009):

1. Reduced use of 'water for irrigation';
2. Reduced 'pest attack' (by at least 75%);
3. Reduced 'termite attack';
4. Reduced 'weed growth';
5. Faster rate of 'seed germination' and rapid seedlings growth and development;
6. Greater numbers of fruits per plant (in vegetable crops) and greater numbers of seeds per ear (in cereal crops), heavier in weight-better in both, quantity and quality as compared to those grown on chemicals;
7. Fruits and vegetables had 'better taste' and texture and could be safely stored up to 6–7 days, while those grown on chemicals could be kept at the most for 2–3 days.

Studies on the production of important vegetable crops have shown that in addition to increasing plant growth and productivity, vermicompost may also increase the nutritional quality of some vegetable crops such as tomatoes, Chinese cabbage, spinach, strawberries and lettuce (Adhikary, 2012).

The purpose of the work was to assess the influence of vermicompost based growth substrates on cress growth and nutrient content.

Materials and methods

The experiments were carried through in company K. Compos glassgreenhouses from December 2015 to February 2016. In present investigations cress was grown.

Treatments were followed (Company K. Compos do not want to give accurate recepies as it remains their property right):

1. 30% vermicompost, peat, sand and dolomite stone.
2. 25% vermicompost, peat, gravel, perlite.
3. 25% vermicompost, peat, gravel, light gravel.
4. Growth substrate bought from a shop in Estonia (seller did not allow to usage the name of the brand). Control.
5. 20% vermicompost and organic matter rich claysoil.

The results of substrates analyses are in Table 1. Substrates were analysed just before the start of experiment.

Table 1. The results of substrates analyses

Substrate No.	pH_{KCl}	N, %	P, mg kg^{-1} (AL)	K, mg kg^{-1} (AL)	Ca, mg kg^{-1}	Mg, mg kg^{-1}	Organic matter, %
1	6.56	1.005	2689.2	5029.1	2656.5	2193.6	29.61
2	6.79	0.305	684.0	2423.4	2303.3	572.2	11.80
3	6.48	0.370	859.3	2638.2	2131.4	626.0	13.53
4	5.58	0.968	936.3	2478.6	4887.1	1066.2	76.44
5	6.71	0.690	1347.1	2469.2	2691.7	792.3	12.68

The seeds in first experiment were sown on 2 November 2015 and plants harvested together with registration of growth results on 11 November 2015. The second experiment was carried through at the same time. It means that in the second experiment the seeds were sown on 2 November 2015 and plants harvested and results notified on 11 November 2015.

The plants in experiment 1 were grown in 5 different boxes. Each treatment was represented by one box. From each box 10 plants were measured (so there was 10 replications). The sizes of boxes were (20 × 25 cm). The experiment was repeated at the same time, it means that in experiment 1 there were 5 boxes in total and also 5 boxes in experiment 2. In total 10 boxes.

In the end of experiment on cress the height of shoots, length of roots and the stem diameter were measured.

The plants were grown in greenhouse with lighting from high pressure sodium lamps at light intensity of 10 000 lux. The lighting period was 18 hours (04.00–22.00). A minimum day and night temperature of 23–24 °C was maintained in the greenhouse.

The contents of nitrogen, phosphorus, potassium, calcium and magnesium were determined. Nitrogen content was determined according to the Copper Catalyst Kjeldahl Method (984.13). Phosporus determination was carried through in Kjeldahl Digest by Fiastar 5000 (AN 5242; Stannous Chloride method, ISO/FDIS 15681). Potassium determination was by the Flame Photometric Method (956.01). Calcium determination was by the o-Cresolphthalein Complexone method (ISO 3696, in Kjeldahl Digest by Fiastar 5000). Magnesium determination was by Fiastar 5000 (ASTN90/92; Titan Yellow method).

Analyses of variance were carried out on the data obtained using Excel. Used signs: *** – $P < 0.001$, ** – $P = 0.001$–0.01, * – $P = 0.01$–0.05; NS – not significant, $P > 0.05$. In order to make results more clear to understand on the tables first experiment data are given, as the second experiment gave similar results.

Results

The growth of cress

The length of the shoots was statsitically different (Table 2). The length of shoots was lowest in treatment 5 compared to all other treatments.

The length of the roots was statsitically different (Table 2). The length of roots is lowest in treatment 5 compared to all other treatments.

The stem diameter was statsitically different (Table 2). The stem diameter was lowest in treatment 5 compared to all other treatments. The largest stem diameter was in treatment 1.

Table 2. The length of cress shoots (cm), the length of cress roots (cm) and cress stem diameter (mm) depending on growth substrates.

Substrate No.	Shoot length, cm	Root length, cm	Stem diameter, mm
1	6.09	2.98	0.40
2	5.49	4.04	0.28
3	6.04	2.50	0.30
4	7.03	3.00	0.30
5	4.96	2.00	0.20
P	***	***	***
LSD	0.12	0.07	0.04

Conclusion. Cress growth parameters are showing that best growth substrates to grow this plant are treatments 1 and 2.

The content of nutrients in cress

The content of nitrogen in cress dry matter was statistically different (Table 3). The content of nitrogen was lowest in treatment 3 compared to all other treatments.

The content of phosphorus in cress dry matter was statistically different (Table 3). The content of phosphorus was highest in treatment 4, then in treatment 2, and lowest in treatment 5 compared to all other treatments.

The content of potassium in cress dry matter was statistically different (Table 3). The content of potassium was highest in treatments 5 and 3, lowest in treatment 4 compared to all other treatments.

The content of calcium in cress dry matter was statistically different (Table 3). The content of calcium was lowest in treatments 4 and 2. The calcium content was highest in treatment 3.

The content of magnesium in cress dry matter was statistically different (Table 3). The content of magnesium was lowest in treatment 4. The magnesium content was highest in treatment 5.

Table 3. The contents (%) of nitrogen, phosphorus, potassium, calcium and magnesium in dry matter of cress according to growth substrates.

Substrate No	N	P	K	Ca	Mg
1	6.25	0.92	7.41	0.93	0.54
2	6.36	1.03	7.73	0.74	0.56
3	6.02	0.99	8.82	0.95	0.53
4	6.49	1.18	7.14	0.71	0.4
5	6.34	0.83	8.97	0.94	0.61
P	***	***	***	***	***
LSD	0.04	0.02	0.08	0.02	0.06

Conclusion. The nutrient content of cress plants shows that best suitable growth substrate is treatment 3, because of it contains lowest amount of nitrogen, second highest content of potassium and highest content of calcium in dry matter.

Discussion

In present investigation vermicompost improved the growth parameters of cress plants. Vermicompost is proven as both growth promoter & protector for crop plants (Adhikary, 2012). It might be so because of that vermicompost is made up primarily of C, H and O, and contains nutrients such as NO_3, PO_4, Ca, K, Mg, S and micronutrients which exhibit similar effects on plant growth and yield as inorganic fertilizers applied to soil (Theunissen *et al*., 2010). Accordingly Mistry (2015) found that vermicompost can have dramatic effects upon the germination, growth, flowering, fruiting and yields of crops. Similar results were gained at Cornell University lab in trials, where they have applying the solid vermicompost and saw a definite impact on leaf growth and weight gain (Dunn, 2011). The same way all vermicomposts stimulated growth of tomato transplants, with up to a 2.2-fold increase occurring in shoot biomass (Tringovska, Dintcheva, 2012). Similarly data revealed that Parthenium Vermicompost applied at 5 t ha^{-1} enhanced the growth of eggplants (Seethalakshmi, 2011). Therefore we can agree with Joshi *et al*. (2015) that vermicompost is an ideal organic manure for better growth and yield of many plants. Application of vermicompost increased seed germination, stem height, number of leaves, leaf area, leaf dry weight, root length, root number, total yield, number of fruits/plant, chlorophyll content.

Studies showed that vermicompost improved the nutrient content of cress plants. The reason might be that vermicompost contains plant nutrients including N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu and B, the uptake of which has a positive effect on plant nutrition, photosynthesis, the chlorophyll content of the leaves and improves the nutrient content of the different plant components (roots, shoots and the fruits) (Theunissen *et al*., 2010). Similarly was found that the perusal of the data revealed that Parthenium Vermicompost applied at 5 t ha^{-1} enhanced the food quality of eggplants (Seethalakshmi, 2011). Accordingly application of vermicompost increased micro and macro nutrients, carbohydrate (%) and protein (%) content and improved the quality of the fruits and seeds. Studies suggested that treatments of humic acids, plant growth promoting bacteria and vermicomposts can be used for a sustainable agriculture discouraging the use of chemical fertilizers (Joshi *et al*., 2015). Vermicomposts uses as a source of organic manure in supplementing chemical fertilizer is becoming popular among the farmers of the country, increase in crop yield and nutrient uptake due to application of vermicompost (Seethalakshmi, 2011).

Conclusions

Cress growth parameters are showing that best growth substrates to grow this plant are treatments 1 and 2. The nutrient content of cress plants shows that best suitable growth substrate is treatment 3.

It can be summarized that for cress the best growth substrate, regarding growth parameters and nutrient content, is treatment 3: 25% vermicompost, peat, gravel, light gravel.

Acknowlegements

Experiments were financed by Estonian Company K. Compos.

Conflict of interest

Experiments were financed by Estonian Company K. Compos.

Author contributions

Study conception and design MO – 100%.
Acquisition of data MO – 100%.
Analysis and interpretation of data MO – 100%.
Drafting of the manuscript MO – 100%.
Critical revision and approve the final manuscript MO – 100%.

References

Adhikary, S. 2012. Vermicompost, the story of organic gold: A review. – Agric. Sci., 3:905–917.

Barik, T., Gulati, J.M.L., Garnayak, L.M, Bastia, D.K. 2011. Production of vermicompost from agricultural wastes. – Agric. Reviews, 31(3):172–183.

Dunn, K. L. 2011. Vermicompost better than fertilizer. – American Agriculturist, April, p. 14.

Joshi, R., Singh, J., Vig, A.P. 2015. Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth, yield and quality of plants. – Rev in Environ. Sci. and Bio/Technology, 14(1):137–159.

Medany, M. 2011. Vermiculture in Egypt: Current Development and Future Potential. – Food and Agriculture Organization of the United Nations Regional Office for the Near East. E. Yahia (Ed.). Cairo: Egypt, 99 pp.

Mistry, J. 2015. Vermicompost, a best superlative for organic farming: a review. – J. Adv. Studies in Agric., Biol. and Environ. Sci., 2(3): 38–46.

Seethalakshmi, S. 2011. Response of Eggplant (*Solanum melongena* L.) To Integrated Nutrient Management Amended Soil. – Int. J. Sci & Eng. Res., 2(8):1–8.

Sinha, R.K., Herat, S., Chauhan, K., Valani, D. 2009. Earthworms vermicompost: a powerful crop nutrient over the conventional compost & protective soil conditioner against the destructive chemical fertilizers for food safety and security. – Am-Euras. J. Agric. Environm. Sci., 5(S):14–22.

Sinha, R.K., Hahn, G., Soni, B.K., Agarwal, S. 2014a. Sustainable Agriculture by Vermiculture: Earthworms and Vermicompost Can Ameliorate Soils Damaged by Agrochemicals, Restore Soil Fertility, Boost Farm Productivity and Sequester Soil Organic Carbon to Mitigate Global Warming. – Int. J. Agric. Res. Rev., 2(8):99–114.

Sinha, R.K., Patel, U., Soni, B.K., Li, Z. 2014b. Earthworms for safe and useful management of solid wastes and wastewaters, remediation of contaminated soils and restoration of soil fertility, promotion of organic farming and mitigation of global warming: A review. – J. Environm. Waste Manag., 1(1):011–025.

Theunissen, J., Ndakidemi, P.A., Laubscher, C.P. 2010. Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. – Int. J. Phys. Sci., 5(13):1964–1973.

Tringovska, I., Dintcheva, T. 2012. Vermicompost as Substrate Amendment for Tomato Transplant Production. – Sustain Agric Res., 1(2):115–122.