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Katedra agroenvironmentální chemie a výživy rostlin

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE
Department of Agroenvironmental Chemistry and Plant Nutrition

Sborník z 29. mezinárodní konference

RACIONÁLNÍ POUŽITÍ HNOJIV

zaměřené na nové trendy
ve výživě a hnojení zemědělských plodin
v souvislosti se změnami v technologiích pěstování

Proceedings of the 29th International Conference on

REASONABLE USE OF FERTILIZERS

dedicated to new trends
in nutrition and fertilization of crops
related to changes in cultivation technologies

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3. In the experimental field area, each of the methods used showed quite considerable variation in the field in terms of the assessed parameters measured by each of the selected methods.
4. A realistic evaluation of the methods could be made by assessing the quality and quantity of the yield obtained at each of the 49 sites.
5. The prototype research carried out is the basis for the development of a model measurement methodology for precision fertiliser advice and the creation of a database which could result in other solutions for precision agriculture.

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EFFECT OF DIFFERENT PROPORTION OF FISH SLUDGE ON pH AND EARTHWORMS NUMBERS IN VERMICOMPOST

(Vliv různého zastoupení akvakulturního kalu na pH a počet žížal ve vermikompostu)

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Abstract

The objective of this study was to find out the effect of different mixtures of wastes with proportion of fish sludge on pH and related effect of earthworms numbers. The experiment included eight treatments with three replications at different mixtures of wastes. The treatments were as following: (T1: fish sludge (100%), T2: fish sludge (25%) + egg boxes (75%), T3: fish sludge (90%) + lettuce (10%), T4: fish sludge (40%) + egg boxes (50%) + lettuce (10%), T5: fish sludge (100%) + earthworms, T6: fish sludge (25%) + egg boxes (75%) + earthworms, T7: fish sludge (90%) + lettuce (10%) + earthworms, T8: fish sludge (40%) + egg boxes (50%) + salad (10%) + earthworms). pH values were optimal in all treatments and ranged between 6.41±0.08 and 7.30±0.04. The highest value was in T4. In general, presence of earthworms reduced the pH, and the highest effect of earthworms was in T8 which mean that earthworms caused reducing pH for 1 point compared to control.

Key words: fish sludge; vermicompost; C/N; pH; earthworms

Earthworms play significant role in stimulating the process of composting [1]. Vermicomposting is the process of recycling organic material through the digestion of annelid worms such as *Eisenia fetida* or *Eisenia andrei* [2]. There are many materials used in vermicomposting [3]. Fish sludge and cow dung were used in vermicomposting [4], and it is very important because large volumes of aquaculture sludge are discharged from ponds, resulting in eutrophication and degradation of the regional environments [5]. Porto *et al.* [6] used the compost produced from discarded fresh plant food in production of lettuce. The earthworms were used for recovering the nutrients from organic solid residues [7]. This research focused on the effect of use new mixtures of waste materials (fish sludge, cardboard (egg boxes) and lettuce) in different percentages on pH, and the numbers of earthworms in product.

Material and methods

Preparation of composts and vermicomposts:

Two groups of processed materials were prepared. Half consisted of control treatments that did not contain earthworm substrate; the other half was supplemented from the side with a substrate (grape marc, apple pomace and wood sawdust with earthworms of *Eisenia andrei*). (T1: fish sludge (100%), T2: fish sludge (25%) + egg boxes (75%), T3: fish sludge (90%) + lettuce (10%), T4: fish sludge (40%) + egg boxes (50%) + lettuce (10%), T5: fish sludge (100%) + earthworms, T6: fish sludge (25%) + egg boxes (75%) + earthworms, T7: fish sludge (90%) + lettuce (10%) + earthworms, T8: fish sludge (40%) + egg boxes (50%) + salad (10%) + earthworms). Tries in size of (40×40×12) cm were used to put the different mixtures.

The experiment was carried out in a specially adapted laboratory with controlled conditions placed at the experimental station of Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague in Cerveny Ujezd.

Samples collection and analytical methods

Compost and vermicompost samples were after 6 months from the start. The following parameters were analyzed for each sample – pH and numbers of earthworms. For the measurement of pH, the samples of solid compost and vermicompost were mixed with deionized water (1:5 w/v). The laboratory instrument WTW pH 340 I was used for the determination of pH. For total carbon and nitrogen determination, the CHNS Vario MACRO Cube analyzer (Elementar Analysensysteme GmbH, Germany) was used and it was done before starting. The analysis of average and standard deviation was done using Excel programme.

Results and discussion

C/N ratio of components before the start

Different mixtures mean different initial C/N. This ratio is an important factor for carrying out composting [8], and the initial C/N ratios in compost from straw and manure influences microbial quality [9]. The results of Azis *et al.* [10] have shown that samples with and without soil performed better with initial C/N ratios of 10:1 and 25:1. So the measurements of C/N ratio are important for results explanation.

The C/N ratios for different initial materials in our experiment ranged between (6.47 and 178.34) as following: (fish sludge: 6.48±0.08; lettuce: 8.33±0.20; egg box: 178.34±34.20; fish sludge + lettuce: 6.47±0.02; fish sludge + egg box: 22.62±9.40; fish sludge + lettuce + egg box: 34.20±9.10).
The highest value of initial material belonged to egg boxes which was 178.34±34.20 and there were close values in fish sludge and mixture of fish sludge and lettuce.

Numbers of earthworms

The earthworms numbers (> 3 cm) in vermicomposting samples were as following: fish sludge: 13±4; fish sludge + lettuce: 8±6; fish sludge + egg box: 41±12; fish sludge + lettuce + egg box: 6±7. The treatment of fish sludge + egg box has the highest numbers of earthworms. It could be because the ratio of initial C/N (22.6) was little approved with results of Dume *et al.* [11] who showed that vermicompost with an 18:1 C/N ratio outperformed compost and demonstrated the highest earthworm population.

The low numbers of earthworms in the two treatments which contained lettuce could be because of high moisture content (95%) that promotes the formation of anaerobic conditions [12] causing earthworm mortalities [13]. Some particular factors have been shown to be important in inhibiting earthworm biomass increase, such as high C/N ratios that is why there is low value for earthworms numbers in T8 (fish sludge + lettuce + egg box) [13].

pH values

Low values in pH can be noticed in vermicompost samples compared to compost samples, except T6 (fish sludge + egg box). This does not agree with Ferlian *et al.* [14] who found that earthworms generally increase soil pH due to decreases in organic layers.

The presence of earthworms resulted in a 25% increase in CO_2 emission [15] and in the case of presence of moisture as in treatments contained lettuce the result could be carbonic acid (H_2CO_3) causing decreasing of pH compared the control. pH values in treatments ranged between 6.41±0.08 and 7.30±0.04 (Table I) which consider optimal values. A pH range of either 7 or nearly 7 is most suitable for plant growth [16] and it is observed from the literature that soil pH conditions required for microbial activity range from 5.5–8.8 [17].

I. pH of different treatment after 6 months

Control (compost)	pH	Vermicompost	pH
fish sludge	6.58±0.11	fish sludge	6.41±0.08
fish sludge + lettuce	6.89±0.16	fish sludge + lettuce	6.67±0.04
fish sludge + egg box	6.56±0.11	fish sludge + egg box	6.70±0.10
fish sludge + lettuce + egg box	7.30±0.04	fish sludge + lettuce + egg box	6.33±0.04

Conclusion

pH values were optimal in all treatments and ranged between 6.41±0.08 and 7.30±0.04. The lettuce in the initial materials caused lower earthworms numbers, so it could indicate fast decomposition and thus lack of earthworms in later period of vermicomposting.

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KOMPOSTOVÁNÍ A VERMIKOMPOSTOVÁNÍ SMĚSÍ ČISTÍRENSKÝCH KALŮ A NASÁVANÉ KARTONÁŽE

(Composting and Vermicomposting of the Mixtures of Sewage Sludges and Moulded Pulp)

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Abstract

Moulded pulp is a material used in the packaging of fragile products or for the production of recyclable tableware. Sewage sludge is commonly used in the Czech Republic as a source of nitrogen in the production of compost. Composting and vermicomposting of their pre-composted mixtures showed a decrease in the content of the total nitrogen. There was also a decrease in nitrate nitrogen content. The $N\text{-}NH_4^+/N\text{-}NO_3^-$ ratio increased with the age of the layers of composting and vermicomposting piles. Adding new layers from continuously pre-composted piles of sludge and moulded pulp mixtures does not appear to be the best solution for research purposes, however, this model is typical for the practice of vermi/composting plants.

Key words: composting; vermicomposting; sewage sludge; moulded pulp

Ročně se na celém světě vyprodukuje 2,01 mld. tun tuhého komunálního odpadu. V současné době je věnovaná velká pozornost zejména plastovým odpadům na jedno použití a jejich negativním vlivům na životní prostředí. Rozšíření plastových výrobků bylo v posledních několika desetiletích mimořádné [1]. Razantní snížení používání těchto plastů přináší nová evropská legislativa, která od roku 2021 zakazuje všem unijním státům prodej plastových výrobků na jedno použití [2]. Tento zákaz vede ke zvyšování poptávky po alternativních produktech, které jsou šetrnější k životnímu prostředí. Technologie, která je schopna nahradit plastové výrobky pro jedno použití, se nazývá vakuové tvarování nasáté papírové suspenze sítovými formami – nasávaná kartonáž [3].

Nasávaná kartonáž je materiál známý déle než sto let, který nachází uplatnění při balení křehkých výrobků, kde poskytuje nejen obalovou, ale také fixační funkci, dokáže pohlcovat vibrace a otřesy a zároveň je dostatečně pevný a stoprocentně recyklovatelný. Hlavními surovinami pro výrobu nasávané kartonáže jsou přírodní celulózová nebo lignocelulózová vlákna, která sestávají především z celulózy, ligninu a hemicelulózy [4]. Většina z nich je biologicky odbouratelná a má menší dopad na životní prostředí. Některé z těchto složek tak mohou poskytnout cenný materiál např. pro výrobu kompostu, čímž je usnadněno využití nasávané kartonáže v každodenním životě [5,6].