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Vermistabilization of Corn Cob Husk and Seed Germination Bioassay of *Vigna Unguiculata* for Quality Assessment of Vermicompost

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Abstract

Vermistabilization is a process where composting earthworm species are used to convert organic waste materials into humus-like substances called vermicompost. The present study involved two experiments to explore the vermistabilization potential of corn cob husk and quality assessment of vermicompost produced through seed germination bioassay of *Vigna unguiculata*. The first experiment was arranged as two factor – factorial completely randomized design with three replicates. Factor one was the size of corn cob husk pieces (two levels; ≤ 2 cm and 2-4 cm) while the factor two was the ratio between cow dung (CD) to corn cob husk (CH) pieces (four levels; 75% CD + 25% CH, 50% CD + 50% CH, 25% CD + 75% CH and 100% CH). A simple randomized design was employed for the second experiment to assess the quality of the vermicompost using the aqueous solutions, with deionized water serving as a control. The bio converting agent of the present study was red earthworms (*Eisenia fetida*). Two-way ANOVA was used to analyze the qualitative data of the first experiment while one-way ANOVA was used in the second experiment. Weight of end-substrate and vermicompost, substrate reduction rate (%), live biomass of earthworms, changes of live biomass of earthworms (%) nitrogen content (N%), pH,

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electrical conductivity (EC), total dissolved solids (TDS) and salinity of the vermicompost together with the quality parameters of color and odor were recorded at 75 days after establishment of the first experiment.

Relative seed germination (RSG%), relative radicle growth (RRG%) and germination index (GI%) were calculated three days after seed sowing in the second experiment. Results revealed that the interaction effect between two factors significantly affected the live biomass of the earthworms, N%, EC and TDS of the vermicompost. Apart from pH, other parameters measured in the first experiment were influenced either by factor one or two. When looking at the quality aspects, only the color of the vermicompost varied significantly among treatments. According to the results of the germination bioassay, RSG%, RRG% and GI% were significantly different among treatments ($P<0.05$). Overall, the highest efficacy on and greater quality of the vermicompost were recorded when preparing substrate by mixing with 75% of CD with the particle size of CH < 2 cm. Vermicomposting has thus been shown to be an effective technique for handling CH when mixing with CD. However, converting CH without combining it with CD seems ineffective.

Keywords: Bioassay, corn cob husk, cow dung, *Eisenia fetida*, vermicomposting

Introduction

Corn (*Zea mays* L.) is one of the major staple cereals and contributes around 20% of the food calories of human diet in many countries (Shiferaw *et al.,* 2011). In addition, corn is recognized as a multi-purpose crop widely used to produce biofuels, animal feed, and many industrial items (Erenstein *et al*., 2022). Global corn production in 2022 was 1,163 million thousand tones (FAOStat, 2022). In Sri Lanka, total corn production in 2021 was 472,444 tons while the cultivated extent was 106,757 ha (AgStat, 2022). Therefore, corn plays an important role in food and nutrition security (Grote *et al*., 2021) in local context. In corn farming, 50% of the output is used as grains, and the other 50% is made up of waste like stalks, leaves, husks and panicles (Castillo-González *et al.*, 2021). Large quantities of corn cob husks and other by-products of the corn industry are accumulated during the processing of corn (Yan *et al*., 2022). Agro-industrial debris that has been processed is not disposed correctly while the common techniques include burning, dumping, or unplanned landfilling, which leads to environmental contamination, increase in greenhouse gas emissions and climate change. Biotransformation techniques could be used to convert organic waste materials into valuable fertilizer or soil amendments (Pieła *et al.*, 2020). Corn cob husk is recognized as an organic waste material which has no proper disposal method other than heaping in the ground for decomposition. The least valued by-product of the corn industry is corn cob husk which contain 10% to 14% total fiber (Setyaningsih *et al*., 2019). Except fiber, cellulose, hemicellulose, lignin, protein and ash content were 382 g, 445 g, 66 g, 19 g and 28 gkg^{-1} of dry matter, respectively (Hang and Woodams, 2000).

Composting methods are widely recognized as inexpensive and safe alternatives to improper disposal of organic waste which leads to a release of pollutants into the environment (Pan *et al*., 2015; Awasthi *et al*., 2020). During the vermistabilization process, earthworms break down different organic materials such as kitchen waste, agricultural leftovers and animal manure into vermicompost that is rich in plant nutrients (Prapaharan *et al.*, 2023). This process is also referred to as vermicomposting where organic waste materials are converted into humus-like compounds through the digestion of earthworms. Vermicomposts are humus-like substances and black in color that are commonly used as an organic fertilizer or soil amendment (Vicentin *et al*., 2021). Vermicomposting is a non-thermophilic and energy saving technique that quickly converts organic waste into vermicompost (Ramnarain *et al*., 2018). Epigeic types of earthworms generally identified as surface-dwelling earthworms are commonly used for the vermistabilization process. *Eisenia fetida* and *Perionyx excavatus* (Suthar and Singh, 2007) are two popular epigeic types of earthworm species used for vermicompost production in tropical countries (Ramnarain *et al*., 2018; Wijeysingha and Fernando, 2021). Vermicompost is one of the main types of fertilizer in organic farming due to its simple manufacturing procedures, outstanding qualities and environmental safety (Ramnarain *et al.*, 2018). Vermicompost enhances the growth and productivity of many field crops including vegetables, fruit crops and flowers (Nagavallemma *et al.*, 2004).

It is important to use stable and mature composts for agricultural soils (Kebrom *et al*., 2018). Maturity and stability of composts and vermicompost can be monitored through seed germination bioassays (Hase and Kawamura 2012; Young *et al*. 2016). Ievinsh (2011) stated that the early growth of some crop species could be sensitive to negative effects of vermicompost. Furthermore, vermicompost extracts had negatively influenced the radical growth of newly germinated seeds. The present study was conducted with the aim to find out the feasibility of vermistabilization of corn cob husk alone and by mixing with cow dung and assessing the quality of the vermicompost through seed gemination bioassay of cowpea (*Vigna unguiculata*).

Materials and methods

The present study consisted of two experiments; the first experiment was conducted to examine the vermistabilization potential of corn cob husks and the second experiment was conducted to assess the quality of the vermicompost through *V. unguiculata* seed germination bioassay. This research was conducted at the Faculty of Agriculture, University of Ruhuna from June to December 2023, under shade house conditions. The area is in the low country wet zone and receives an annual average rainfall of about 2500 mm. The annual average air temperature of the area is 26 – 30 ˚C and relative humidity is about 80%.

For the first experiment, the earthworm species of *E. fetida* (red earthworm) was used as a bioconversion agent and collected close to the cattle shed of the faculty farm. One month before starting the experiment, earthworms were collected and multiplied in the substrate prepared by mixing cow dung, banana peels and vegetables. Many scientists used cow dung as the growth medium for the multiplication process of earthworms (Devi and Khwairakpam, 2020). Water was added as needed during the process. The temperature of the substrate ranged from 25 °C to 28 °C during the multiplication process. Corn cob husks were collected along the roadsides and allowed to dry under partial sunlight for 3-4 days to remove the moisture. Then, the dried corn cob husks were cut into pieces smaller than 2 cm and between 2-4 cm in size. The experiment was conducted in plastic vermireactors having a capacity of 10 L with small drainage holes at the bottom. A two–factor factorial completely randomized design was used to arrange the experiment with three replicates. Factor one (F_1) of the experiments was the size of corn cob husk (CH) pieces while factor two (F_2) was the ratio between cow dung (CD) to CH pieces. There were two levels in factor one and four levels in factor two (Table 1). Therefore, the total number of treatment combinations was eight. The combination of treatments was randomly assigned in 24 containers. About 100g of bedding materials was placed at the bottom of reactors and 20g of *E. fetida* was introduced into the bedding material of each reactor. Before preparing substrates for the study, the moisture content CD and CH was recorded by oven- drying the materials. The dry matter content of the CD and CH used in the study were 60% and 88%, respectively. According to the treatment, the reactors were filled with a mixture of CD and CH up to a 250g dry basis and then covered with nets. After one week, 10g of wilted Gliricidia leaves (*Gliricidia sepium*), 20g of fruit peels and 20g of vegetable peels were added to each reactor on dry basis.

At the end of the experiment, 75 days after establishment, earthworms were manually separated from the end-substrate and weight was recorded. The vermicompost was separated from the end-substrate using a 2 mm sieve and undigested materials were removed. The live biomass of earthworms and the weight of the vermicompost harvested in each reactor were recorded. An aqueous solution was prepared by vermicompost to measure pH, electrical conductivity (EC), total dissolved solid (TDS) and salinity according to

Wijeysingha and Fernando (2021). The color and odor of the vermicompost were taken as qualitative measurements as described by Prapaharan *et al.* (2023). Live biomass changes of earthworms (%) (Prapaharan *et al*, 2023) and substrate reduction rate (Tschirner and Simon, 2015) were calculated using equations 1 and 2. Nitrogen content (%) of the vermicompost was analyzed using the Kjeldahl method (Lynch and Barbano, 1999).

Table 1. Details of the treatment combinations prepared using two factors (size of the corn cob husk pieces and the ratio between cow dung and corn cob husk) used in the first experiment

Size of the corn cob husk pieces (F_1)	**Ratio between CD and CH (dry weight basis) (F_2)**			**Treatments denoted as**
		CD %	**CH%**	
Size of pieces < 2 cm (S1)	R_1	75	25	S_1R_1
	R_2	50	50	S_1R_2
	R_3	25	75	S_1R_3
	R_4	0	100	S_1R_4
Size of pieces 2 – 4 cm (S2)	R_1	75	25	S_2R_1
	R_2	50	50	S_2R_2
	R_3	25	75	S_2R_3
	R_4	0	100	S_2R_4

As control treatment of 100% cow dung with three replicates was maintained in addition to the treatment combinations mentioned in the table.

$$Change\ of\ live\ biomass\ of\ EWs\ (\%) = \left[\frac{(Initial\ weight\ of\ EWs - End\ weight\ of\ EWs)}{Intial\ weight\ of\ EWs}\right] x100$$

Equation (1)

EWs; earthworms

$$Substrare\ reduction\ rate\ (\%) = \left[\frac{(Initial\ weight\ of\ substrate - End\ weight\ of\ substrate)}{Intial\ weight\ of\ substrate}\right] x\ 100$$

Equation (2)

In the second experiment, seeds of cowpea var. Dhawala were used for testing the quality and maturity of vermicompost through seed germination bioassay. The viability of the seeds of cowpea was tested before starting the experiment and reported as 100%. Eight treatment combinations were considered as pre-defined treatments and simple randomized design was employed with five replicates. Seed germination bioassay was repeated two times and data were presented as an average value of both trials. Ten cowpea seeds were set to germinate on filter paper wetted with 4 ml aqueous solutions prepared using vermicompost harvested in different treatments and deionized water (control) in Petri dishes incubated at 28 °C. After three days, relative seed germination (RSG), relative radicle growth (RRG) and germination index (GI) were calculated using equations 3 - 5 as shown below (Suthar and Sharma, 2013; Kebrom *et al*., 2019).

$$RSG\% = \frac{Number\ of\ germinated\ seeds\ in\ aqueous\ extracts}{Number\ of\ germinated\ seeds\ in\ deinozed\ water\ (Control)} \times 100 \quad \text{……..Equation (3)}$$

$$RRG\% = \frac{Radicle\ length\ of\ germinated\ seeds\ in\ aqueous\ extracts}{Radicle\ length\ of\ germinated\ seeds\ in\ deinozed\ water\ (Control)} 100 \quad \text{Equation (4)}$$

GI%= RSG x RRG x 100%……………………Equation (5)

Statistical analysis

Using SAS software, the quantitative data were statistically analyzed via Two-Way ANOVA at 5% significance level. With the use of the Minitab 17 program, the Friedman test was used to assess the qualitative data. Dunnett's test was used to compare treatment means with the control treatment for weight of end-substrate, weight of vermicompost (< 2mm particle size), substrate reduction rate, live biomass of earthworms and N%. Non-normally distributed data of the live biomass of earthworms, weight of vermicompost, pH, EC, TDS and salinity data were transformed using Log transformation procedure. The results reported as RSG%, RRG% and GI% in the second experiment of seed germination bioassay were average values of two repeated trials and analyzed via One-Way ANOVA. Means of RSG%, RRG% and GI% were separated by Duncan's Multiple Range Test (DMRT).

Results and discussion

The interaction effect between two factors (F_1 x F_2) did not significantly influence the weight of the end-substrate (P>0.05) of the experiment one. However, only factor two, the ratio between cow dung (CD) and corn cob husk (CH), significantly affected the weight of the end-substrate (P<0.01). Accordingly, the greater weight of end-substrate was recorded in the growth substrate prepared by 100% CH (Table 2). Plate 1 shows the overall appearance of the end-substrate in different treatment. There was no significant interaction between two factors (F_1 x F_2) on the weight of vermicompost of ≤ 2mm in particle size, but the effects of single factors were significant (Table 1). The greater weight of vermicompost was recorded by S_1R_1 (168.47g), where we used CH pieces of >2 cm and the mixture was prepared by adding 75% of CD and 25% of CH. Earthworms can break down cow dung more readily than plant materials. So, even though the corn cob husk had an impact, the weight of the vermicompost harvest went up when more cow dung was added. Sinha *et al* (2002) found that earthworms can easily consume cow dung and similar materials that have started to break down a bit, it helps earthworms convert them into useful stuff more effectively. Vermicompost production using epigeic compost worms as *E. fetida*, can be enhanced effectively by supplementing the organic wastes used for vermicomposting with cow dung (Yadav and Garg, 2019). Therefore, it can be suggested that the rate of the bioconversion process of corn cob husk may be enhanced by mixing it with cow dung. The substrate reduction rate was not significantly affected by the interaction between two factors (F_1 x F_2). However, it was significantly influenced by the ratio between CD and CH. The substrate reduction rate increased when increasing the proportion of cow dung in the substrate. The substrate made of more corn cob husk had the lowest reduction rate. This may be due to less palatability of the mixture for earthworms due to the availability of more corn cob husk which contains fibrous materials. The interaction between factors 1 and 2 had a significant impact on nitrogen content (N%) of the vermicompost harvested after 75 days of establishment. The greater value of 1.0% was recorded in the treatment S_1R_1, where substrate consisted of 75% of CD and 25% of CH in ≤ 2mm in size. The least N% (0.2%) was observed in the treatments prepared by 100% of CH.

S_1R_1 **S_1R_2** **S_1R_3** **S_1R_4**

S_2R_1 **S_2R_2** **S_2R_3** **S_2R_4**

Plate 1. Appearance of the end-substrate in different treatment combinations. S denotes the size of corn cob husk pieces (two levels; ≤ 2 cm and 2-4 cm) and R denotes the ratio between cow dung (CD) to corn cob husk (CH) (four levels; 75% CD + 25% CH, 50% CD + 50% CH, 25% CD + 75% CH and 100% CH).

Live biomass of earthworms is the live part of the research. There was a significant interaction (P<0.01) between the size of pieces of CH and the ratio between CD and CH on net live biomass production (g) (Figure 2a) and change of live biomass of earthworms (%) (Figure 2b). The highest live biomass was found in S_1R_3, where the pieces of CH were small ($\leq$ 2 cm), and the mixture contained an equal amount of CD and CH (50%). Live biomass at the end of the experiment was significantly lower than the amount that was introduced to the rectors at the beginning of the study. Therefore, negative change of live biomass at the end of the study in all treatments was observed.

Table 2. Weight of end-substrate, vermicompost of ≤ 2mm in size, substrate reduction rate and nitrogen content of vermicompost in different treatments at 75 days after establishment of the first experiment

Treatments	**Weight of end substrate (g)**	**Weight of vermicompost (≤ 2 mm in particle size) (g)**	**Substrate reduction rate (%)**	**Nitrogen content of vermicompost (%)**
S_1R_1	181.4 ±10.4	168.5±09.7	60.1±3.5	1.0±0.09
S_1R_2	197.1 ±12.9	130.4±10.4	56.2±2.5	0.8±0.06
S_1R_3	210.5 ±14.2	90.0 ±12.1	53.2±5.4	0.5±0.02
S_1R_4	237.9 ±09.5	87.3 ±09.5	50.1±7.6	0.2±0.02
S_2R_1	187.4 ±17.4	149.3±11.4	58.4±8.5	0.8±0.04
S_2R_2	215.8 ±22.4	119.7±10.6	52.0±5.6	0.6±0.06
S_2R_3	236.4 ±14.3	78.6 ±11.5	47.5±8.5	0.4±0.07
S_2R_4	242.3 ±13.9	62.4 ±10.5	46.1±6.5	0.2±0.09
P (F_1)	*NS**	*<0.05*	*NS**	*<0.05*
P (F_2)	*<0.01*	*<0.01*	*<0.01*	*<0.05*
P (F_1 x F_2)	*NS**	*NS**	*NS**	*<0.01*

**NS*- Not significant at 5% probability level

The red worm, *E. fetida,* is good at thriving on different organic foods and can handle a wide range of abiotic condition (Devi and Khwairakpam, 2020). The number of earthworms in an area depends on the availability of their food and the amount of nitrogen, which can lead to faster growth and more cocoon production in earthworms (Gajalakshmi and Abbasi, 2004). Pre-composting can enhance the bioconversion efficiency of CH in the present study. As Gunadi *et al*. (2002) mentioned that the pre-composting process of organic waste reduces unfavorable compound available in the substrate for earthworms. Furthermore, since bioconversion is fast and quick when the substrate material is small, it may be claimed that the decrease of the particle size of CH is also feasible.

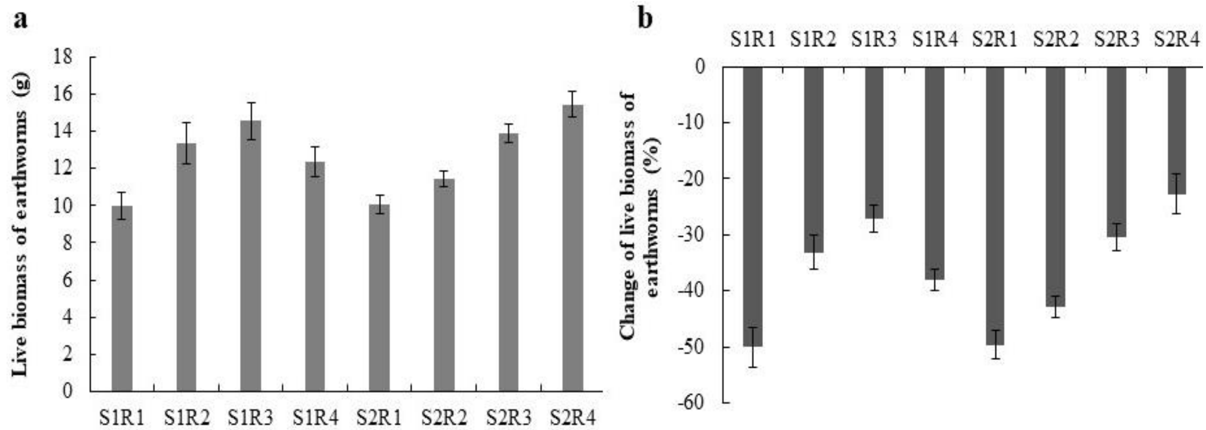

Figure 2. Treatment effect on (a) live biomass of earthworms (g) and (b) change of live biomass of earthworms (%) at 75 days after establishment of the experiment. The standard error of the mean is presented as error bars.

The pH of the vermicompost was not affected significantly either by the interaction of two factors or single factors. It was in a homogenous group and ranged from 6.23 to 6.76 (Table 3). According to the Sri Lanka standards for compost, the pH value should be in between 6.5 – 8.5. The pH values of the vermicompost produced in most of the treatments of the present study were in the optimum range. However, three treatments out of eight (S_1R_4, S_2R_1 and S_2R_2) had slightly acidic values. Composting earthworms preferred to grow and reproduce under neutral pH value. They cannot survive pH lower than 5 and greater than 9. However, lower pH values promote fungal growth in compost piles (Hanc and Chadimova, 2014). The EC of the vermicompost produced in different treatments was affected by the interaction of two factors (P<0.01). (Table 3). The greatest EC was measured in S1R1 treatment where the substrate was prepared by mixing 75% of CD and 25% of CH (CH pieces of $\leq$ 2 cm). The lowest EC was reported in the vermicompost harvested in S1R4 treatment (100% CH pieces of $\leq$ 2 cm). It is recommended to have EC of 400 $mScm^{-1}$ or less than that for compost produced in Sri Lanka (Sri Lanka standard, 2019). Therefore, all treatments of the present study produced vermicompost lower than the maximum level.

There was a significant interaction (P< 0.05) between two factors on the TDS of the vermicompost. TDS stands for the combined organic and inorganic materials found in a mixture (Yadav and Garg, 2019). The lowest total dissolved solids (TDS) value was found in S1R4 (1.24 ppt), where there was 100% of CH ≤ 2 cm pieces (Table 3). The TDS value of the all treatments ranged from 1.24 - 2.0 ppt. Only factor two (ratio between CD and CH) affected significantly on the salinity of the vermicompost prepared by various treatments of the present study. It ranged from 1.71 to 2.8 ppt. All the values are small and therefore they are suitable to use as vermicompost.

The color of the vermicompost was significantly influenced only by factor 2 (ratio between CD and CH). The black color vermicompost was observed when treatments were prepared by adding 50% and 75% of cow dung. However, the odor of the vermicompost was not significantly influenced by either the interaction effect of two factors or single factors of the study.

Table 3. pH, EC, TDS and salinity of the vermicompost in different treatments with the standard error of the means of the first experiment

Treatments	**pH value**	**EC ($mScm^{-1}$)**	**TDS (ppt)**	**Salinity (ppt)**
S_1R_1	6.5 ± 0.2	399.5 ± 87.5	2.0 ±0.5	2.8 ± 0.7
S_1R_2	6.8 ± 0.2	304.7 ± 54.5	1.5 ±0.4	2.2 ± 0.5
S_1R_3	6.6 ± 0.3	270.7 ± 34.5	1.4 ±0.5	2.0 ± 0.4
S_1R_4	6.4 ± 0.4	246.4 ± 67.2	1.3 ±0.2	1.7 ± 0.5
S_2R_1	6.3 ± 0.4	346.9 ± 43.2	1.7 ±0.4	2.4 ± 0.2
S_2R_2	6.2 ± 0.3	361.7 ± 71.4	1.7 ±0.2	2.3 ± 0.3
S_2R_3	6.7 ± 0.2	317.6 ± 43.8	1.6 ±0.1	2.3 ± 0.2
S_2R_4	6.6 ± 0.5	363.9 ± 40.7	1.3 ±0.3	1.8 ± 0.4
P (F_1)	*NS**	*NS**	*NS**	*NS**
P (F_2)	*NS**	<0.001	<0.01	<0.001
P (F_1xF_2)	*NS**	<0.01	<0.05	*NS**

**NS- Not significant at 5% probability level*

Table 4 shows the mean differences of the weight of vermicompost, N% of vermicompost, live biomass of earthworms, pH, EC, TDS and salinity of aqueous solution of vermicompost when compared with the values of the vermicompost prepared using only cow dung. N% of the control treatment (100% CD) was 1.1%. According to that all treatments had negative values for weight of vermicompost and N content (%) suggesting that the control treatment is still better than the treatment combinations of the present experiment for vermicompost production and N%.

According to the results of the second experiment, relative seed germination, relative radicle growth and germination index were significantly different among treatments (P<0.01). The greater relative see germination (%) of cowpea (*Vigna unguiculata*) was recorded in S_1R_1 (143%) and S_1R_2 (129%) treatments while the lowest values of 71% was observed in S_2R_4 treatment (Figure 3). The relative seed germination was doubled in S_1R_1 treatment compared to the lowest value. The S1R1 and S1R2 had significantly greater relative seed germination compared to the control treatment of deionized water. These results suggested the suitability of the aqueous solution prepared from the vermicompost for those two treatments of the first experiment for seed germination. Furthermore, it might be due to the absence of seed gemination inhibitors in the vermicompost. It is important to study the safety and suitability of soil organic amendments before applying those materials into the soil, as soil chemical, physical and biological properties are modified and altered by such applications (Kebrom *et al*., 2019). With organic soil amendments, unwanted materials such as heavy metals and different types of salts could be added into the soil. Therefore, biological assessment could be useful to evaluate the suitability of soil organic substances. However, according to Araújo and Monteiro (2005), chemicals and nutrients in the aqueous solution of compost may not be absorbed by the seed, instead internally stored materials are used for germination. Therefore, seed germination is considered as a less sensitive method to study chemical toxicity of organic substances. Three treatments had significantly high values for relative radicle growth of cowpea as 187% (S_1R_2), 167% (S_1R_1 and S_1R_3). The lowest relative radicle growth was reported by S_2R_4 treatment (80%). The greatest value of relative radicle growth was almost twice as high as the lowest value (Figure 3). High values of relative radicle growth indicate the suitability of pH, EC, TDS and salinity levels together with nutrient availability for seed germination. The S_1R_1 and S_1R_2 treatments showed the greatest germination index of cowpea as 238% and 240%, respectively which is four times higher than the lowest value reported by S_2R_4 (58%) (Figure 4). According to Ievinsh (2011), evidence is available for crop species dependence on seed germination in relation to vermicompost extracts. Furthermore, it was found that low to moderate concentration of vermicompost extracts stimulate the hypocotyl growth of the seed and radicle growth was susceptible to the negative effects of vermicompost.

Table 4. Mean comparison of the treatment combinations with control treatment (100% cow dung) for weight of vermicompost, N% of vermicompost, live biomass of earthworms, pH, EC, TDS and salinity of aqueous solution of vermicompost

Treatment comparison	**Weight of vermicompost (<2 mm particle size) (g)**	**N content (N%)**	**Live biomass of earthworms (g)**	**pH**	**EC (mS/cm)**	**TDS (ppt)**	**Salinity (ppt)**
S1R1 Vs Control	-21.53*	-0.1	-0.44	0.09	4.80	-0.161	-0.40
S1R2 Vs Control	-49.59*	-0.2*	2.95*	0.45	-99.57*	-0.62	-1.03
S1R3 Vs Control	-89.96*	-0.6*	4.14*	0.29	-133.65*	-0.76	-1.16
S1R4 Vs Control	-93.71*	-0.9*	1.96*	0.32	-157.96*	-0.91	-1.49
S2R1 Vs Control	-0.67	-0.3*	-0.35	0.02	-57.46*	-0.43	-0.83
S2R2 Vs Control	-50.33*	-0.5*	1.01	-0.08	-42.66*	-0.48	-0.90
S2R3 Vs Control	-31.38*	-0.7*	3.48*	0.12	-86.77*	-0.51	-0.93
S2R4 Vs Control	-87.57*	-0.9*	5.03*	0.32	-40.35*	-0.84	-1.37

Remarks: Significant Comparisons, according to Dunnett's test at 5% probability level, are indicated by *

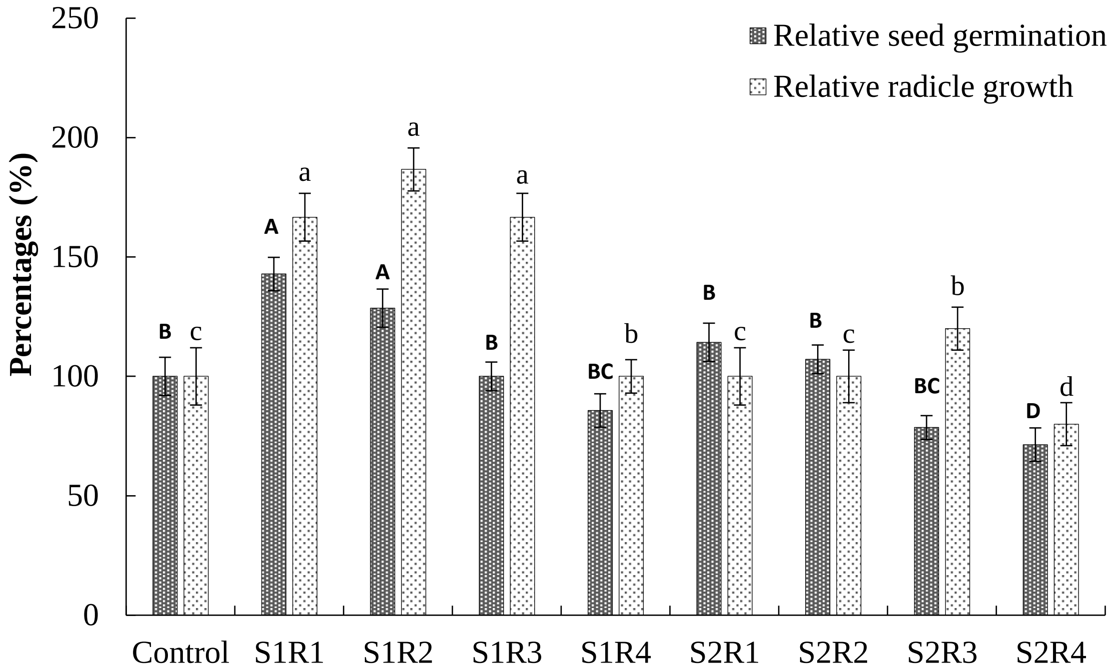

Figure 3. Relative seed germination and relative radical growth of cowpea (*Vigna unguiculata*) as affected by different treatments and control (deionized water). The means presented in the graph are the average values of two trials of seed germination. Error bars represent the standard error of the mean.

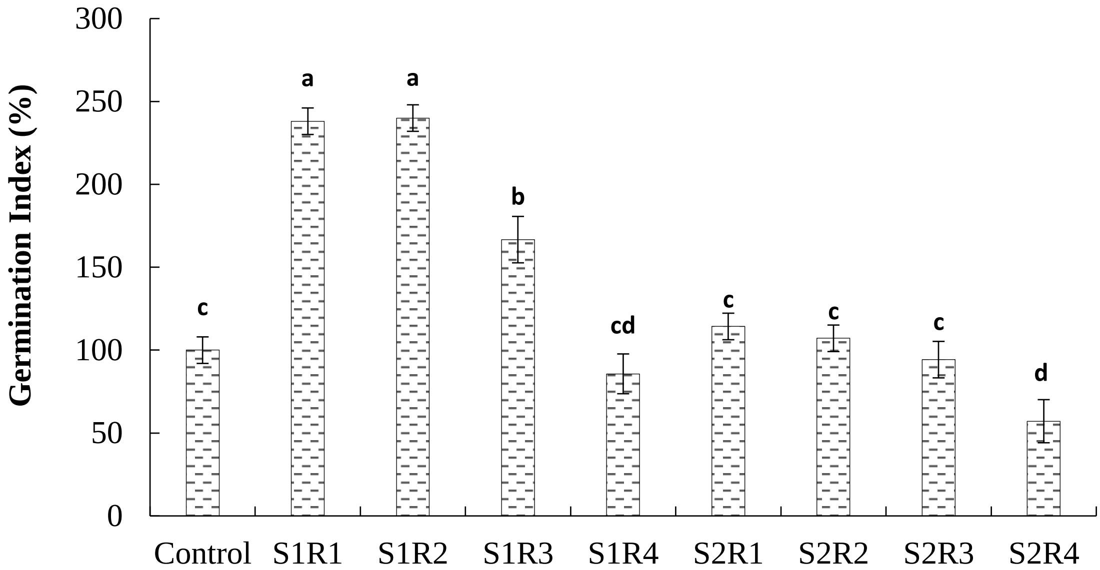

Figure 4. Germination index of cowpea (*Vigna unguiculata*) as affected by different treatments and control (deionized water). The means presented in the graph are the average values of two trials of seed germination. Error bars represent the standard error of the mean.

There was no significant correlation found between parameters of the seed germination bioassay and pH, EC and salinity of the aqueous solution of the vermicompost in the present study.

Conclusion

According to the findings of the present study it can be concluded that corn cob husk can be converted into a valuable organic fertilizer, vermicompost, by mixing with appropriate amount of cow dung. The interaction between the two experimental factors; cob husk size and the cow dung to corn cob husk ratio had an impact on various characteristics of the vermicompost produced, while certain other traits were affected solely by individual factors. The substrate prepared by mixing 75 of cow dung with corn cob husk reported better performance than other ratios. Furthermore, it can be concluded that only corn cob husk could not convert successfully using vermicomposting technique due to high availability of carbon and fiber. According to the performance of seed germination bioassay, vermicompost prepared by mixing high proportion of cow dung (75 to 50%) with small pieces of corn cob husk resulted in a good quality vermicompost for agriculture use. Furthermore, it can be suggested that the substrates which reported unsatisfactory performances for *E. fetida* should be partially decomposed before adding to the vermi-reactors to get better performances. In addition to that, by reducing the size of the pieces of corn cob husk, it could be possible to enhance the decomposition process through vermicompost production.

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