Vietnam Journal of Agricultural Sciences

p-ISSN 2588-1299
e-ISSN 3030-4520

VJAS 2026; 9(3): 3053-3062
https://doi.org/10.31817/vjas.2026.9.3.01

The Effects of Vermicompost Leachate from Different Composting Materials on Growth and Yield of Cucumber

Thieu Thi Phong Thu[1*], Nguyen Anh Tuan[1] & Nguyen Van Giang[1]

Faculty of Agonomy, Vietnam National University of Agriculture, Hanoi 12400, Vietnam

Abstracts

This study aimed to identify suitable composting materials for producing high-quality vermicompost leachate (VL) and to evaluate its effects on cucumber plants. The research consisted of two experiments. The experiment 1 investigated the effects of composting materials on vermicomposting efficiency. The experiment 2 evaluated the effects of VL concentrations on the growth and yield of cucumber. The experiment 1 consisted of three composting treatments using different substrates, namely cow manure combined with water spinach, household organic waste, and coatbutton flowers (*Bidens pilosa* L.). The results showed that the treatment using cow manure combined with water spinach (VL1) had the best performance, generating VL with the highest electrical conductivity (EC) (1958 µS cm^{-1}) and the greatest number of adult earthworms after composting (494 individuals). The experiment 2 using VL1-VL included treatments of C0-1 (applied water only, NF), C0-2 (applied fertilizer according to the recommended cultivation protocol, CF), C1 (applied 10% VL), C2 (applied 15% VL), and C3 (applied 20% VL). The results showed that increasing the concentration of the VL1 vermicompost leachate significantly improved growth parameters, including plant height, stem diameter, leaf area, dry biomass, and yield. Notably, the treatment with 20% VL1-VL produced growth and yield values comparable to the control treatment using 100% chemical fertilizer. These findings contribute to promoting the conversion of agricultural by-products into useful inputs for crop production, thereby helping to reduce organic waste and environmental pollution.

Received: April 17, 2026
Accepted: August 8, 2026

Correspondence to
Thieu Thi Phong Thu
ttpthu@vnua.edu.vn

ORCID
Thieu Thi Phong Thu
https://orcid.org/0000-0003-0762-0301

This work is licensed under the Creative Commons Attribution 4.0 License.

Keywords

Cucumber, earthworm, vermicompost liquid

Introduction

Crop and livestock farming generate large quantities of by-products that can be reused to increase soil organic matter and

fertility, supply nutrients to crops, and contribute to reducing environmental pollution (Bian *et al*., 2019; Nguyen *et al*., 2021; Waqas *et al*., 2023; Al-Tawarah *et al*., 2024). Vermicomposting is a method that utilizes a wide range of organic by-products from agricultural production such as livestock and poultry manure, crop and processing residues, and organic household waste. Moreover, using earthworms for composting helps aerate the composting pile and accelerates the decomposition of organic matter without the need for turning or mixing, while also preventing unpleasant odors.

The products of vermicomposting are vermicompost and VL, which are rich in macro and micronutrients in forms that are readily available to plants. VL is a product formed when water carries nutrients, organic substances, and microorganisms present in worm excretions, mucus, worm bodies, and the accumulated materials in earthworm-decomposed organic matter. It is collected from the vermicomposting container and used as an organic fertilizer for crops. VL derived from heterogeneous composting substrates demonstrates enhanced mineralization and nitrification rates, accompanied by increased beneficial enzymatic activities, thereby contributing significantly to improved plant growth and development (Cai *et al*., 2022). VL is used as a liquid biofertilizer, both for soil application and as a foliar spray (Shafique *et al*., 2021). Gutiérrez-Miceli *et al.* (2017) demonstrated that vermicompost leachate increased the growth and nutrient content of sugarcane plants. Churilova & Midmore (2019) showed that VL could be a complete liquid fertilizer for hydroponically grown pak choi in the tropics. The study by Wongkiew *et al*. (2023) showed that VL improved the yield of lettuce and enhanced the response of keystone microorganisms for organic degradation and nutrient cycling in a bioponics system. Alabi *et al*. (2023) indicated that VL stimulated growth and increased the yield of tomato.

Currently in Vietnam, the primary materials used for vermicomposting are mainly livestock manures, such as cattle and pig manure. Methods for producing VL from various agricultural by-products and household organic waste aimed at both reducing waste and generating organic fertilizers rich in nutrients have rarely been reported. In addition, Vietnam has an agriculture system with predominantly small-scale sectors, where farms and household operations account for a large proportion. Therefore, the method of collecting VL could be widely applied and achieve high efficiency. Household and farm organic waste can be effectively treated through the natural biological activity of earthworms without generating unpleasant odors or causing environmental pollution.

Cucumber (*Cucumis sativus* L.) is a widely cultivated fruit vegetable with high economic value that is grown extensively in Vietnam. This crop not only meets domestic consumption demand but also makes a significant contribution to agricultural export revenue. However, cucumber cultivation still depends heavily on chemical fertilizers and pesticides. The excessive use of these chemicals not only degrades soil quality but also reduces agricultural product quality and poses risks to food safety. In response to the growing demand for safe food, it is necessary to study the use of VL for environmentally friendly cucumber cultivation. This study aimed to identify suitable composting materials for producing high-quality VL and to evaluate its effects on cucumber plants. The results were expected to provide a scientific basis for applying VL in safe and sustainable cucumber production, contributing to reducing the use of chemical fertilizers and promoting green agricultural production.

Materials and Methods

Experiment site, plant materials, and cultivation practices

The vermicomposting and pot experiment of VL application on cucumber were conducted from February to September 2025 in a greenhouse at the Faculty of Agronomy, Vietnam National University of Agriculture. A hybrid earthworm strain obtained from Thai Thuy Farm was used to convert organic residues, including water spinach, household organic waste (brassica, kohlrabi, and cabbage), and *Bidens pilosa*. The brassica cultivars PD29 and

PD518 (mustard green), provided by Phu Dien company, were used in the germination experiments to assess the toxicity of the VL in experiment 1. The baby cucumber cultivar Prado F1, supplied by Bejo Zaden of the Netherlands, was used for experiment 2.

Experimental design, treatments, and parameters

Experiment 1: Research on the effects of composting materials on VL

The first experiment consisted of three treatments: VL1 (15kg of cow manure + 15kg of water spinach), VL2 (15kg of cow manure + 15kg of household organic waste, namely cabbage, kohlrabi, and brassica), and VL3 (15kg of cow manure + 15kg of coat button flowers). Each treatment was prepared using plastic composting containers with a capacity of 200L, equipped with a drainage valve at the bottom. The materials inside the containers were arranged in layers. The bottom layer consisted of small gravel (3-5cm in diameter) with a thickness of 15cm, followed by a 15cm layer of yellow sand. Agricultural residues were placed above the sand layer, followed by a layer of cow manure. Finally, about 400 earthworms were introduced into the top layer of each container. The composting containers were kept in a dry and shaded area, maintaining moisture at approximately 50-60%. Each treatment was replicated twice.

The measured parameters were decomposition time (days), total volume of the VL (L), physicochemical properties of the VL, and total mass of the vermicompost (kg) after complete decomposition of the composting materials. The toxicity of the VL was evaluated through a seed germination bioassay of mustard green conducted in petri dishes under laboratory conditions. The germination parameters recorded were germination rate (%), root length (mm), shoot length (mm), and the germination index (GI).

Experiment 2: Effects of different VL concentrations on the growth and yield of cucumber

A one-factor pot experiment was arranged in a randomized complete block design with three replications. The treatments were C0-1 (applied water only, NF), C0-2 (applied fertilizer according to the recommended cultivation protocol, CF), C1 (applied 10% VL), C2 (applied 15% VL), and C3 (applied 20% VL). Each replication consisted of 10 pots, with one cucumber plant grown in each pot. In treatment C0-1, plants were irrigated with water only and received no fertilizer. In treatment C0-2, plants were fertilized with 25 tons of well-decomposed manure, 120kg N (Urea), 90kg P_2O_5 (superphosphate), and 120kg K_2O (KCl) per hectare. The VL of the VL1 treatment from experiment 1 was used in experiment 2. The same VL1 vermicompost leachate volume of the C1, C2, and C3 treatments was applied by foliar spraying and root drenching to the cucumber plants every five days. The growing medium consisted of soil and rice husk ash at a volumetric ratio of 4:1. Seedlings at 21 days old were transplanted into pots with dimensions of 34cm × 29cm.

The measured parameters were plant height (cm), stem diameter (mm), SPAD index, leaf area (LA) (dm^2 $plant^{-1}$), fresh weight (g $plant^{-1}$), dry weight (g $plant^{-1}$), and individual yield (g $plant^{-1}$). Leaf area and dry weight were measured at three growth stages: the first flowering stage, the first fruit harvest, and the final harvest. LA was determined according to the formula: LA= A2/A1, where A2 is the weight of whole fresh leaves of one plant (g) and A1 is the weight of $1dm^2$ of fresh leaves (g). The shoots were cut at 5cm from the base to determined fresh weight, then oven-dried at 80°C for 48h to determine the dry weight. The largest leaves were used to determine the SPAD value with a chlorophyll meter (SPAD–502, Konica Minolta Sensing Inc., Osaka, Japan). The stem base diameter was measured at a point 5cm above the ground surface using a caliper.

Statistical analysis

Analysis of variance was used to test for statistical differences between the means of the indicators of the germination test, agronomic characteristics, LA, dry weight, and yield of cucumber, followed by Tukey's honestly significant difference (HSD) test at 5%

significant level. The statistical analyses were performed using Statistix software (version 8.0, Analytical Software, Tallahassee, FL, USA).

Results and Discussion

Effects of composting materials on the efficiency of vermicomposting

Temperature of vermicompost containers

Figure 1 shows that the temperature changes of all the vermicomposting containers were similar. The temperature increased rapidly in the first days, then slowly reduced in the following days until the end. Although the ambient temperature was low and unstable, the temperatures in the composting containers remained high and stable throughout the vermicomposting process. The average temperature in the vermicomposting containers of the VL1 treatment was higher than that of the VL2 and VL3 treatments in the initial days. This may have been because the VL1 vermicomposting containers were adequately moistened and the decomposition of organic matter occurred vigorously (Charnay, 2005). The temperature in all the vermicomposting containers then gradually decreased from the ninth day of composting due to a decline in air temperature and the partial decomposition of the organic materials. Enebe & Erasmus (2023) reported that maintaining the reactor temperature within the range of 15-25°C is essential for effective waste decomposition by earthworms. Therefore, the temperature changes in this study showed that all the treatments maintained suitable temperatures for the growth and efficient activity of earthworms.

The physicochemical properties of VL

Table 1 shows that different vermicomposting materials effected the physicochemical properties of the VL. The pH values ranged from 7.0 (VL2) to 7.6 (VL3). Vermicomposts with a pH range of 6.0-8.5 are suitable for soil application (Hogg *et al*., 2002). The EC showed significant differences among the three treatments. VL1 had the highest EC, reaching 1958 µS cm^{-1}, which was higher than VL2 (1490 µS cm^{-1}) and VL3 (1422 µS cm^{-1}). The pH and EC results were also consistent with those reported by Katiyar *et al*. (2023). The increase in EC could be attributed to a higher concentration of soluble salts in readily available forms, resulting from the mineralization of the feed mixtures by earthworms and microorganisms (Kaviraj & Sharma, 2003). Although all the experimental treatments were irrigated with 1 litter of water per container per day, the amount of vermicompost leachate collected differed. Specifically, VL1 produced the lowest volume (26L), possibly because water spinach, with its hollow stems, is readily decomposed by earthworms and microorganisms, leading to faster moisture loss through evaporation. VL3 produced the second-highest volume of leachate (28.7L). VL2 yielded the highest volume (29.1 litters), possibly due to the high moisture content of the vegetables. The mature number of earthworms increased in all treatments, with the highest in VL1 (494 individuals), followed by VL2 (472 individuals), and the lowest in VL3 (426 individuals). In addition, visual observations revealed a large number of cocoons and juvenile earthworms in the vermicompost. This indicates that all the treatments created favorable conditions for earthworm growth, development, and reproduction.

Effects of VL derived from different organic materials on the germination parameters of mustard green cultivars

The results in **Table 2** show that all three treatments using vermicompost leachate had greater germination parameters compared to the control for the two tested mustard green cultivars. For the PD518 cultivar, among the leachate treatments, VL1 produced the highest root length (3.13cm), followed by VL2 (1.93cm), while VL3 had the lowest root length (1.85cm). VL1 had the greatest shoot length, reaching 4.74cm. This was followed by VL3 (3.34cm), while VL2 had the lowest shoot length (3.05cm). The treatments using vermicompost leachate also resulted in higher germination rates compared to the control. The highest germination rate (96.7%) was observed in VL1 and VL3. The control treatment had the lowest germination rate (83.0%), while VL2 achieved 93.3%. The germination index was 280.62 for VL1, 167.69 for VL2, and 164.39 for VL3. For the PD29

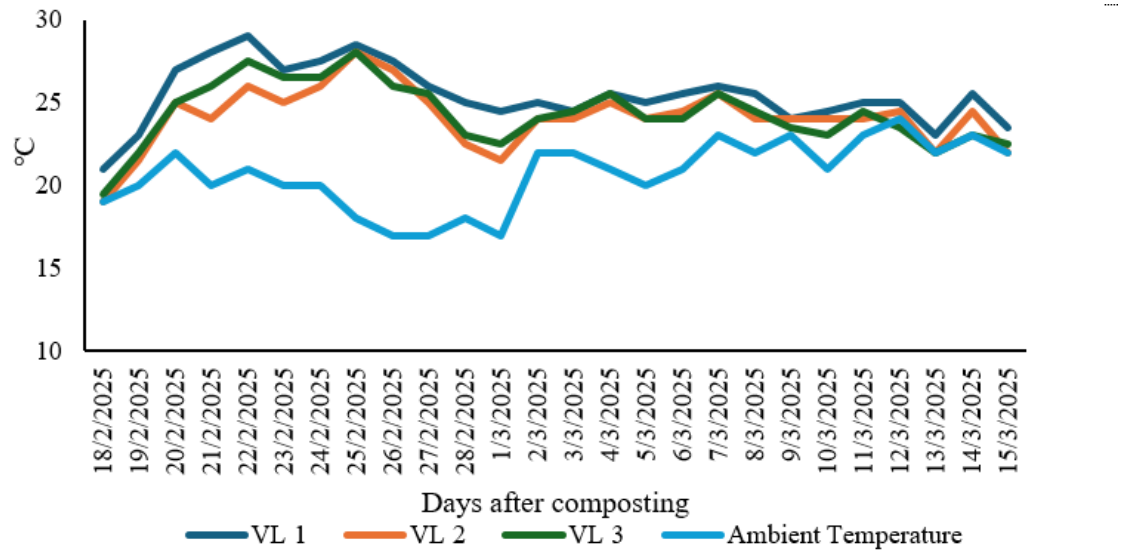


Figure 1. Daily temperature of vermicomposting containers

Table 1. Effects of composting materials on the efficiency of vermicomposting

Physicochemical properties	VL1	VL2	VL3
Decomposition time (days)	26	26	26
Total volume of irrigated water (L)	25	25	25
Total volume of vermicompost leachate (L)	26.0	29.1	28.7
Total mass of vermicompost (kg)	15.8	18.3	16.4
pH	7.3	7.0	7.6
EC (µS cm^{-1})	1958	1490	1422
Initial number of earthworms (individuals)	400	400	400
Number of earthworms after the experiment (individuals)	494	472	426

Note: VL1: 15kg cow manure + 15kg water spinach; VL2: 15kg cow manure + 15kg household organic waste (cabbage, kohlrabi, brassica); VL3: 15kg cow manure + 15kg coatbutton flowers (Bidens pilosa).

cultivar, among the treatments using vermicompost leachate, VL1 produced the greatest root length (3.5cm), followed by VL3 (2.69cm), while VL2 had the lowest root length (2.55cm). A similar trend was observed for shoot length: VL1 showed the highest value (4.22cm), followed by VL3 (2.84cm), and VL2 had the lowest value (2.71cm). VL1 achieved the highest germination rate (100.0%), while the control had the lowest (83.0%). The germination rates of VL3 and VL2 were 96.7% and 93.3%, respectively. The germination index of mustard greens when using vermicompost leachate was 212.95 for VL1, 142.9 for VL2, and 158.64 for VL3. The germination rates and germination indexes in the treatments using vermicompost leachate were higher than 90% for both brassica cultivars. These results indicate that the vermicompost had reached maturity (Mathur *et al*., 1993a; 1993b), and that the vermicompost leachates derived from different feedstocks in this study were non-toxic and exerted positive effects on the growth of *Brassica* spp. Compost is considered free of phytotoxic effects when the germination index exceeds 80% (Zucconi *et al*., 1981; Siles-Castellano *et al*., 2020).

Effects of different concentrations of VL on the growth and yield of baby cucumber

Effects of different concentrations of VL on the agronomic traits of baby cucumber

The effects of different concentrations of VL on the plant height, stem diameter, and SPAD index of baby cucumber are presented in **Table 3**.

Table 2. Effects of VL derived from different organic materials on the germination parameters of mustard green cultivars

Treatments	Root length (cm)	Shoot length (cm)	Germination rate (%)	Germination index
		PD29 cultivar		
VL1	3.50^{a}	4.22^{a}	100.00^{a}	212.95^{a}
VL2	2.55^{b}	2.71^{b}	93.30^{a}	142.90^{ab}
VL3	2.69^{b}	2.84^{b}	96.70^{a}	158.64^{b}
H_2O	2.00^{b}	2.15^{b}	83.00^{a}	-
Tukey HSD $_{0.05}$	0.70	0.46	-	-
CV (%)	9.25	5.28	-	-
		PD518 cultivar		
VL1	3.13^{a}	4.74^{a}	96.7^{a}	280.62^{a}
VL2	1.93^{b}	3.05^{bc}	93.3^{a}	167.69^{b}
VL3	1.85^{b}	3.34^{b}	96.7^{a}	164.39^{b}
H_2O	1.33^{c}	2.15^{c}	83.0^{a}	-
Tukey HSD $_{0.05}$	0.43	1.08	-	-
CV (%)	7.44	11.49	-	-

Note: VL1: 15kg cow manure + 15kg water spinach; VL2: 15kg cow manure + 15kg household organic waste (cabbage, kohlrabi, brassica); VL3: 15kg cow manure + 15kg coatbutton flowers (Bidens pilosa). Values within the same column followed by the same superscript are not significantly different, whereas those with different superscripts are significantly different at the 95% confidence level.

Table 3. Effects of different concentrations of VL on the agronomic traits of baby cucumber

Treatments	Plant height (cm)	Stem diameter (mm)	SPAD value
CT1 (NF)	147.8^{e}	6.54^{a}	39.38^{d}
CT2 (CF)	179.4^{b}	6.91^{a}	50.66^{a}
CT3 (10% VL)	159.5^{d}	6.74^{a}	44.53^{c}
CT4 (15% VL)	172.5^{c}	6.90^{a}	48.81^{b}
CT5 (20% VL)	183.8^{a}	6.94^{a}	51.54^{a}
Tukey $HSD_{0.05}$	1.98	0.65	1.30
CV (%)	0.42	3.37	0.98

Note: Values within the same column followed by the same superscript are not significantly different, whereas those with different superscripts are significantly different at the 95% confidence level. SPAD = Soil Plant Analysis Development.

The results in **Table 3** show that plant height differed significantly among the treatments at the 95% confidence level. Treatment CT5 (20% vermicompost leachate) resulted in the tallest plant height (183.8cm). Treatment CT2 (chemical fertilizer) ranked second (179.4cm), followed by CT4 (172.5cm) and CT3 (159.5cm). The shortest plant height was observed in CT1 (147.8cm). The stem diameter of the baby cucumber did not differ significantly among the treatments. It ranged from 6.54mm to 6.94mm. Treatment CT5 produced the largest stem diameter (6.94mm), followed by CT2 (chemical fertilizer) with 6.91mm. Treatment CT1 (no fertilizer) had the smallest stem diameter (6.54mm). The SPAD index of the baby cucumber was highest in CT5 (51.54), which was comparable to CT2 (50.66) and significantly higher than the other treatments (CT1: 39.38; CT3: 44.53; CT4: 48.81). These results indicate that the application of VL positively affects the agronomic traits of baby cucumber. Increasing the concentration of foliar-applied VL to 20% enables the crop to achieve a plant height, stem diameter, and SPAD index comparable to those obtained under standard chemical fertilizer

application. Gutiérrez-Miceli *et al*. (2017) indicated that increasing the VL concentration increased the plant height and stem diameter of sugarcane. VL has also been show to increase the morphometric parameters in *M. spicata* and *R. officinalis* plants (stem length, root length) (Loera-Muro *et al*., 2021).

Effects of different concentrations of VL on leaf area (LA) of baby cucumber

The results in **Table 4** show that nutrient application had a significant effect on the LA of the baby cucumber at different growth stages. The lowest LA was recorded in the treatment without chemical fertilizer or VL application across all three observed stages. When comparing nutrient-supplied treatments, leaf area in CT2 (chemical fertilizer) was the highest at the flowering stage, equivalent to CT5 (20% vermicompost leachate) at the fruiting stage, and ranked second after CT5 at the end of the growth stage. The results also indicate that increasing the concentration of VL enhanced the LA of the baby cucumber plants, with the 20% concentration producing the highest LA among the leachate treatments. These findings suggest that chemical fertilizer promotes plant growth more effectively at the early stage, whereas VL exerts a more sustained effect toward the later growth stages of baby cucumber. Chinsamy *et al*. (2014) reported that VL increased the LA of tomato under temperature and water stress. Gutiérrez-Miceli *et al*. (2017) demonstrated that increasing the application rate of VL also led to an increase in the number of leaves in sugarcane. The foliar area of *M. spicata* has also been shown to increase significantly in a VL treatment compared with an inorganic treatment (Loera-Muro *et al*., 2021).

Effects of different concentrations of VL on the fresh and dry weight of baby cucumber plants

The results of the effects of different concentrations of VL on the fresh and dry weights of the baby cucumber plants are shown in **Table 5**. The results show that the fresh and dry weights of the baby cucumber at different growth stages were significantly affected by the nutrient treatments. The lowest fresh and dry weights were observed in the non-fertilized treatment (CT1) at all three sampling times. At the flowering and fruiting stages, the highest fresh and dry weights were recorded in CT2 (100% chemical fertilizer), followed by CT5, CT4, and CT3. At the end of the growth stage, the highest fresh and dry weights were obtained in CT5 (20% VL), followed by CT2, CT4, and CT3. Thus, increasing the concentration of the VL enhanced the fresh and dry weights of the baby cucumber. Application of the VL at a 20% concentration resulted in fresh and dry weights comparable to those achieved with conventional chemical fertilization. Ayyobi *et al.* (2016) reported that VL from cattle manure increased pod number and plant dry weight of French

Table 4. Effects of different concentrations of VL on LA of baby cucumber

Unit: $dm^2 plant^{-1}$

Treatments	Leaf area		
	Flowering stage	Fruiting stage	End of the growth stage
CT1 (NF)	12.55^{d}	25.56^{c}	30.76^{e}
CT2 (CF)	29.21^{a}	45.92^{a}	46.99^{b}
CT3 (10% VL)	16.05^{c}	29.79^{b}	34.32^{d}
CT4 (15% VL)	17.14^{c}	31.61^{b}	40.80^{c}
CT5 (20% VL)	19.66^{b}	47.12^{a}	55.82^{a}
Tukey $HSD_{0.05}$	2.11	2.43	1.92
CV (%)	3.97	2.39	1.63

Note: Values within the same column followed by the same superscript are not significantly different, whereas those with different superscripts are significantly different at the 95% confidence level.

Table 5. Effects of different concentrations of vermicompost leachate on the fresh and dry weights of baby cucumber plants

Unit: g plant^{-1}

Treatments	Fresh weight		Total fresh weight	Dry weight		Total dry weight
	Leaf	Fruit and stem		Leaf	Fruit and stem	
			Flowering stage			
CT1 (NF)	21.32	57.7	79.02^{e}	2.27	6.16	8.43^{e}
CT2 (CF)	56.45	127.85	184.30^{a}	6.45	14.61	21.06^{a}
CT3 (10% VL)	29.47	78.7	108.17 ^{d}	2.72	7.23	9.95^{d}
CT4 (15% VL)	33.18	82.03	115.22^{c}	3.72	9.28	13.00^{c}
CT5 (20% VL)	39.76	102.65	142.42^{b}	4.27	10.18	14.45^{b}
Tukey HSD $_{0.05}$	-	-	2.3	-	-	1.35
CV (%)	-	-	0.65	-	-	3.58
			Fruiting stage			
CT1 (NF)	48.04	119.83	167.87^{e}	5.1	12.74	17.84^{e}
CT2 (CF)	94.59	250.09	344.67^{a}	13.27	37.67	50.95^{a}
CT3 (10% VL)	61.02	177.34	238.36^{d}	7.05	20.74	27.19^{d}
CT4 (15% VL)	62.6	192.99	255.39^{c}	7.25	23.69	30.94^{c}
CT5 (20% VL)	101.68	214.9	316.58^{b}	13.44	28.41	41.86^{b}
Tukey HSD $_{0.05}$	-	-	4.11	-	-	2.99
CV (%)	-	-	0.55	-	-	3.13
			End of the growth stage			
CT1 (NF)	68.14	156.68	224.81^{e}	7.33	16.67	24.00^{e}
CT2 (CF)	105.74	272.45	378.19^{b}	14.71	37.38	52.09^{b}
CT3 (10% VL)	77.38	205.4	282.78^{d}	9.65	25.61	35.26^{d}
CT4 (15% VL)	84.56	234.57	319.13^{c}	11.56	32.1	43.66^{c}
CT5 (20% VL)	119.7	300.73	420.43^{a}	17.23	43.19	60.42^{a}
Tukey HSD $_{0.05}$	-	-	3.94	-	-	2.5
CV (%)	-	-	0.43	-	-	2.06

Note: Values within the same column followed by the same superscript are not significantly different, whereas those with different superscripts are significantly different at the 95% confidence level.

dwarf bean (*Phaseolus vulgaris* L.). In another experiment, dry and fresh foliar weights of M. spicata showed significant increases in the VL treatment compared with the inorganic treatment (Loera-Muro *et al.*, 2021).

Effects of different concentrations of VL on fruit number and yield of baby cucumber

The results in **Table 6** show that the number of fruits per plant and the yield of the baby cucumber were significantly affected by nutrient application. Increasing the concentration of the VL significantly increased the number of fruits, fruit weight, and yield of the baby cucumber. Among the treatments, application of VL at a 20% concentration produced the highest values for these parameters, comparable to CT2 with conventional chemical fertilization. Thus, foliar application of VL had a positive effect on the

Table 6. Effects of different concentrations of VL on fruit number and yield of baby cucumber

Treatments	Number of fruits (number plant^{-1})	Fruit weight (g fruit^{-1})	Individual yield (g plant^{-1})
CT1 (NF)	4.33^{c}	81.72^{d}	348.54 ^{d}
CT2 (CF)	6.43^{a}	90.74^{a}	593.16^{a}
CT3 (10% VL)	4.43^{c}	84.71^{c}	368.91^{c}
CT4 (15% VL)	4.86^{b}	86.96^{b}	426.44^{b}
CT5 (20% VL)	6.62^{a}	90.64^{a}	602.19 ^{a}
Tukey $HSD_{0.05}$	0.25	1.50	19.62
CV (%)	1.68	0.61	1.49

Note: Values within the same column followed by the same superscript are not significantly different, whereas those with different superscripts are significantly different at the 95% confidence level.

number of fruits, fruit weight, and yield of the baby cucumber. Research results on several crops have shown that vermicompost leachate positively influences plant growth and enhances the yield and quality. Ansari (2008) reported that VL from cattle manure and paddy straw increased the yield of spinach (*Spinacia oleracea*), onion (*Allium cepa*), and potato (*Solanum tuberosum*). García-Santiago *et al*. (2025) reported that maize grain yield differed depending on the type of VL used, with most treatments significantly enhancing yield, averaging about 61% higher than the control.

Conclusions

Vermicomposting materials composed of cow manure and water spinach provided favorable conditions for earthworm development and showed superior agronomic performance and higher EC compared with other substrates (cow manure and household organic waste or coatbutton flowers). Increasing the concentration of the leachate derived from this substrate combination exerted positive effects on plant growth and yield. Application of this leachate at a concentration of 20% resulted in the highest values for the growth and yield parameters of cucumber among the tested treatments. Specifically, plant height, stem diameter, SPAD index, leaf area, total dry weight, and yield reached 183.8cm, 6.94mm, 51.54, 55.82 dm² plant^{-1}, 60.42 g plant^{-1}, and 602.19 g plant^{-1}, respectively.

Achnowledgments

The authors acknowledge the funds provided by Vietnam National University of Agriculture under the project of T2025-1-2, named *"Effects of composting materials from agricultural by-products and organic household waste on vermicompost leachate and its application to cucumber"*.

References

Alabi O. D., Arthur G. D., Coopoosamy R. M., Naidoo K. K., Mbanjwa S. T. & Tshapha L. P. (2023). Vermicompost leachate a viable bio-stimulant for tomato growth and yield (*Solanum lycopersicum*). Indian Journal of Agricultural Research. 58(1): 139-144. DOI:10.18805/IJARe.AF-750.

Al-Tawarah B., Alasasfa M. A. & Mahadeen A. Y. (2024). Efficacy of compost and vermicompost on growth, yield and nutrients content of common beans crop (*Phaseolus vulgaris* L.). Journal of Ecological Engineering. 25: 215-226.

Ansari A. A. (2008). Effect of Vermicompost and Vermiw ash on the Productivity of Spinach (*Spinacia oleracea*), Onion (*Allium cepa*) and Potato (*Solanum t uberosum*). World Journal of Agricultural Sciences. 4 (5): 554-557.

Ayyobi H., Hassanpour E., Alaqemand S., Fathi S., Olfati J. A. & Peyvast G. (2014). Vermicompost Leachate and Vermiwash Enhance French Dwarf Bean Yield. International Journal of Vegetable Science. 20(1): 21-27.

Bian B., Hu X., Zhang S., Lv C., Yang Z., Yang W. & Zhang L. (2019). Pilot-scale composting of typical multiple agricultural wastes: Parameter optimization and mechanisms. Bioresource Technology. 287: 121482.

Cai L., Gong X., Ding H., Li S., Hao D., Yu K., Ma Q., Sun X. & Muneer M. A. (2022). Vermicomposting with

food processing waste mixtures of soybean meal and sugarcane bagasse. Environmental Technology and Innovation. 28: 102699.

Charnay F. (2005). Composting of urban waste in developing countries: Development of a methodological approach for sustainable compost production. PhD dissertation, University of Limoges, France.

Chinsamy M., Kulkarni M. G. & Van Staden J. (2014). Vermicompost leachate reduces temperature and water stress effects in tomato seedlings. HortScience. 49(9): 1183-1187.

Churilova E. V. & Midmore D. J. (2019). Vermiliquer (vermicompost leachate) as a complete liquid fertilizer for hydroponically-grown pak choi (*Brassica chinensis* L.) in the tropics. Horticulturae. 5: 26.

Enebe M. C. & Erasmus M. (2023). Vermicomposting technology - A perspective on vermicompost production technologies, limitations and prospects. Journal of Environmental Management. 345: 118585.

Gutiérrez-Miceli F. A, García-Gómez R. C., Oliva-Llaven M. A., Montes-Molina J. A. & Dendooven L. (2017). Vermicomposting leachate as liquid fertilizer for the cultivation of sugarcane (*Saccharum* sp.). Journal of Plant Nutrition. 40(1): 40-49. DOI: 10.1080/01904167.2016.1193610

García-Santiago J. C., Sánchez-Vega M., Pérez-Hernández H. & Méndez-López A. (2025). Effect of vermicompost leachate type on corn growth, yield and quality. Tropical and Subtropical Agroecosystems. 28: 109.

Hogg D., Eavoino E., Caimi V., Amlinger F., Devliegher W., Brinton W. & Antler S. (2002). Comparison of Compost Standards within the EU, North America and Australia; The Waste and Resources Action Programme (WRAP): Oxford, UK.

Katiyar R. B., Sundaramurthy S., Sharma A. K., Arisutha S., Khan M. A. & Sillanpää M. (2023). Optimization of engineering and process parameters for vermicomposting. Sustainability. 15: 8090.

Kaviraj & Sharma S. (2003). Municipal solid waste management through vermicomposting employing exotic and local species of earthworms. Bioresource Technology. 90: 169-173.

Loera-Muro A., Troyo-Diéguez E., Murillo-Amador B., Barraza A., Caamal-Chan G., Lucero-Vega G. & Nieto-Garibay A. (2021). Effects of Vermicompost Leachate versus Inorganic Fertilizer on Morphology and Microbial Traits in the Early Development Growth Stage in Mint (*Mentha spicata* L.) And Rosemary (*Rosmarinus officinalis* L.) Plants under Closed Hydroponic System. Horticulturae. 7(5):100.

Mathur S. P., Dinel H., Owen G., Schnitzer M. & Dugan J. (1993a). Determination of compost maturity. II. Optical density of water extracts of compost as a reflection of their maturity. Biological Agriculture and Horticulture. 10: 87-108.

Mathur S. P., Owen G., Dinel H. & Schnitzer M. (1993b). Determination of compost maturity. I. Literature review. Biological Agriculture and Horticulture. 10: 65-86.

Nguyen H. S., Bui T. P. L. & Ngo D. M. (2021). The current status of agricultural wastes and residuals management and recycling in Vietnam. FFTC Agricultural policy platform (FFTC-AP) – Food and Fertilizer technology center for Asian and pacific region. Retrieved from https://ap.fftc.org.tw/article/2786 on March 15, 2026.

Shafique I., Andleeb S., Aftab M. S., Naeem F., Ali S., Yahya S., Ahmed F., Tabasum T., Sultan T., Shahid B. & Khan A. H. (2021). Efficiency of cow dung based vermi-compost on seed germination and plant growth parameters of Tagetes erectus (*Marigold*). Heliyon. 7(1): e05895.

Siles-Castellano A. B., López M. J., López González J. A., Suárez-Estrella F., Jurado M. M., Estrella-González M. J. & Moreno J. (2020). Comparative analysis of phytotoxicity and compost quality in industrial composting facilities processing different organic wastes. Journal of Cleaner Production. 252: 119820.

Waqas M., Hashim S., Humphries U. W., Ahmad S., Noor R., Shoaib M., Naseem A., Hlaing P. T. & Lin H. A. (2023). Composting Processes for Agricultural Waste Management: A Comprehensive Review. Processes. 11: 731.

Wongkiew S., Polprasert C., Noophan P. L., Koottatep T., Kanokkantapong V., Surendra K. C. & Khanal S. K. (2023). Effects of vermicompost leachate on nitrogen, phosphorus, and microbiome in a food waste bioponic system. Journal of Environmental Management. 339: 117860.

Zucconi F., Pera A., Forte M. & De Bertolli M. (1981). Evaluating toxicity of immature compost. BioCycle. 22: 54-57.