Research article

Feasibility Study of Using Vermicompost Extract on Seed Germination on Green Romaine (*Lactuca sativa* L. var. Jericho) and Green Batavia (*Lactuca sativa* L. var. Concept) Lettuce

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Abstract Agriculture sector is under pressure in producing more foods in order to feed the growing population. Vegetable production is also the important part to solve the problem in the agricultural market. Nowadays, organic productions are in demand in order to promote health awareness and food safety. Vermicompost extract is liquid biofertilizers which able to boot up plant nutrients and plant productions. Thus, this study was conducted to investigate the effect of vermicompost extract on germination of green Romaine (*Lactuca sativa* L. var. Jericho) and green Batavia (*Lactuca sativa* L.var. Concept) and to identify the treatment which is suitable to enhance seed germination. The experiment was arranged in a Complete Randomized Design with 3 replications in the petri dish. The concentration of vermicomposting extract was diluted to (0, 25, 50, 75 and 100%) to irrigate seeds. Seed germination, root length, shoot length, seed vigor index, fresh weight, and dry weight were measured after 13 days of seed germination. The seed germination percentage of green Romaine and Batavia lettuce were significantly ($p<0.05$) increased up to (86-95%) and (87-95%) when irrigated with 100% vermicomposting extract as compared to control. In conclusion, using 100% vermicomposting extract as the nutrient source could enhance seedling growth.

Keywords vermicomposting extract, seed germination, green Batavia lettuce and green Romaine lettuce

INTRODUCTION

The food processing industries are one of the most essential activities in the agriculture market due to rapid economic growth. During food processing, industries produce a huge amount of organics waste such as food and vegetable. It has been observed that this organic waste can cause disease, air pollutant and water pollutant. However, the waste contains organic and inorganic nutrients which can recycle to use in the agricultural field. Therefore, eco-friendly and sustainable technology are needed to manage organic waste. Many publications have been established that organic waste can be used and converted into humus as vermicomposting. It is an important source for plant nutrients such as N, P, and K which can enhance the plant development (Garg and Gupta, 2011). Presently, more focus has been given to vermicomposting technique. This technology uses the assistance of earthworm to stabilize the organic waste material and produce microorganism-rich medium that enhances the process of composting. After the vermicomposting, an aqueous extract of vermicompost may contain a series of bioactive molecules as well as microbial population which may be enhanced during the production of extracts. For instance, mineral nutrients and biologically active metabolite such as humic acid and plant regulators present in vermicompost would be extracted during the brewing cycle and those compounds also improve root development, nutrient

uptake, and plant growth (Ancuta et al., 2013). Moreover, Lettuce is one of the essential vegetables in agricultural market; nevertheless, producers always supply a lot of chemical fertilizers which are not friendly to the environment and human health since they apply over limited of chemical fertilizer. Vermicompost extract is liquid organic fertilizer which also can boot up the lettuce production as well as promote health awareness and food safety since the organic productions are in demand in the market. Vermicompost extract has been studied for its effect on seed germination. Several studies have assessed on vermicompost water extract on seed germination and seed growth of tomato and lettuce (Ancuta et al., 2013). Lazcano et al. (2010) demonstrated that vermicompost extract can enhance seed germination maritime pine (*Pinus pinas* Ait). Ievinsh (2011) also reported vermicompost extract treatment differently affect to seed germination, seedling growth physiological of vegetable species. Esteban et al. (2017) also studied the effect of germination of Saluyot (*Corchorus olitorius*). There are many studies focus on the effect of vermicompost extract on seed germination but most of them conducted with different kinds of vegetables. Therefore, The study "feasibility study of using vermicomposting extract on seed germination and seedling green Romaine (*Lactuca sativa* L. var. Jericho) and green Batavia lettuce (*Lactuca sativa* L.var. Concept)" will be raised to study in this paper.

OBJECTIVE

The objective of this paper was to investigate the effect of vermicompost extract on seed germination and seed performance of green Romaine (*Lactuca sativa* L. var. Jericho) and green Batavia lettuce (*Lactuca sativa* L.var Concept) and to identify the treatment which is suitable to enhance seed germination.

METHODOLOGY

Vermicomposting Preparation

Vermicomposting was prepared with the reference (Iwai, 2011). The substrate of vermicompost was composed of soil, cow manure, rice husk ash, vegetable in proportion ration 4:4:1:3 w/w. The vegetable was collected from waste yard from the Si Mueng Thong market locates in Khon Kaen province. Roi et series soil was sampled in the agricultural file, located in Khon Kaen University. Cow manure was collected at cow farm located in the Khon Kaen University. Rice husk ash was collected in agronomy section located in the university. Vermibed was conducted with pot size 15 cm wide and 30 cm length with the 19 cm high. Pre-compost was 15 days to avoid thermophilic stage (increased temperature above cause earthworm death in vermicomposting process) and earthworm species (*Eisenia fetida)* was introduced to the substrate by using 150 earthworms per pot with the moisture content 80 to 90%. After the pre-compost processing, vermicomposting was manually turn up to 12 weeks.

Vermicompost Extract

Vermicompost extract was prepared as described by Archana et al. (2009). Briefly, vermicompost was extracted with tap water in ration 1:4 (w/v) by using the aerated method. Water was allowed to stand for 24 h for passive chlorine before mixing. Vermicompost was put in cheesecloth and mixture with tape water using aquarium air pump for 72 h. For fresh solution was kept for each treatment.

Seed Germination Experiment

Seed germination experiment was conducted for 13 days at Ecotoxicology Laboratory, Department of Land Resource and Environment, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand. The experiment was conducted as a Completely Random Design (CRD)

with three replications. Lettuce verities Roman (*Lactuca sativa* L. var. Jericho) and Batavia (*Lactuca sativa* L.var. Concept) were sterilized with deionized water for 15 minutes to remove microbe from the seed. Fifty seeds from each varieties were put on Whatman Grade 181 No. 1 filter papers in 9 cm Petri dishes and treated with different concentration of vermicompost extract (0, 25, 50, 75 and 100%), and then incubated at 25 ^{o}c in dark cycle for 3 three days and 12 hours light cycle for 10 days in an incubator. After completed of seed germination, seeding from each treatment was measured for germination percentage, root length, shoot length, seedling vigor index, fresh weight, and dry weight.

Seed Germination Percentage Estimation

The total number of seed germination percentages were calculated following (Manisha and Angoorbala, 2015).

$$\text{Germination (\%)} = \frac{\text{Total number of seed germinated in particular treatment}}{\text{Total number of seed treated in particular treatment}} \times 100$$

Root and Shoot Length Estimation

The root and shoot length of seed germination was measured in the centimeter scale.

Fresh and Dry Weight Estimation

Fresh and dry weight was measured using an Ohaus PA 2102 electronic balance. After fresh weight measurement, seeding weight was placed in a hot air oven for 80 ^{o}c for 24 hours.

Seeding Vigor Index

Seed germination, root length, and shoot length were used to calculate seed vigor index, which followed the formula (Abdul Baki and Anderson, 1973).

Vigor index= (Mean root length + Mean shoot length) x Percentage germination

Statistical Analysis

The Statistic 10 software (version 10, USA) was used to analyze the data including the analysis of variance (One Way ANOVA). Treatment means were compared using least significance difference (LSD) at $P< 0.05$.

RESULTS AND DISCUSSION

The results of seed germination of green Romaine (*Lactuca sativa* L. var. Jericho) and Batavia (*Lactuca sativa* L. var. Concept) were shown in Table 1 and Table 2. Different concentration of vermicomposting extract has different effect on seed germination of green Romaine and Batavia lettuce. It showed that 100% of vermicomposting extract got higher germination 95 and 95% of Romaine and Batavia lettuce. The result was similar with finding of Ancuta et al. (2013) that germination increased when the seed was soaked in vermicomposting extract compared with seeds soaked with water and it was also reported that water-soluble bioactive substances such as humic acids, phytohormones or microbial metabolites present in vermicompost extract could be responsible for earlier emergence, increased seed germination percentage and seedling growth. Esteban et al. (2017) reported that microbial activity in vermicompost could result in the production of significant quality of plant growth regulators such as IAA, gibberellins, and cytokinins.

Table 1 Effect of vermicomposting extract of green Romaine seed germination (GM), roots length (RL), shoots length (SL), seeding vigor index (SVI), fresh weight (FW) and dry weight (DW)

Treatments	GM (%)	SL(cm)	RL(cm)	SVI	FW (g)	DW(g)
0%	86d	0.560c	2.660b	276.910b	0.736c	0.026c
25%	90c	0.566bc	4.620b	469.960b	0.956b	0.053b
50%	92b	0.566bc	7.546a	746.430a	1.046ba	0.060b
75%	92b	0.586b	8.286a	821.720a	1.046ba	0.073a
100%	95a	0.653a	8.520a	875.400a	1.146a	0.076a
F value	**	ns	**	**	**	**

Values in same letters in the columns are not significantly different (LSD test, p≤ 0.05), Asterisks (**) show significant differences at the 0.01 level, Asterisk (*) shows significant differences at the 0.05 level, and (ns) shows no significant differences between treatments

Table 2 Effect of vermicomposting extract of green Batavia seed germination (GM), roots length (RL), shoots length (SL), seeding vigor index (SVI), fresh weight (FW) and dry weight

Treatments	GM (%)	SL(cm)	RL(cm)	SVI	FW (g)	DW(g)
0%	87d	1.346b	3.380b	412.790a	0.863c	0.050b
25%	90c	1.526ab	3.593b	460.800a	0.996bc	0.066a
50%	92b	1.586a	5.953a	693.680b	1.136ba	0.071a
75%	92b	1.586a	6.566a	755.440b	1.176ba	0.073a
100%	95a	1.653a	6.380a	765.870b	1.196a	0.076a
F value	**	ns	**	**	*	**

Values in same letters in the columns are not significantly different (LSD test, p≤ 0.05), Asterisks (**) show significant differences at the 0.01 level, Asterisk (*) shows significant differences at the 0.05 level, and (ns) shows no significant differences between treatm

The longest root and shoot length of Romaine and Batavia (2.660, 3.380, 560, and 1.346 cm, respectively) were reported with 100% vermicompost extract. Esteban et al.(2017) also reported that vermicompost can promote ecomorphological characters such as plant high and length. Moreover, vermicompost can be able to supply balanced the nutrients to the roots and stimulate growth and increase the organic matter content including humic substances that affect nutrient accumulation and promote the root growth. 100% of vermicompost extract showed the highest vigor index of Romaine and Batavia (875.4 and 765.87) which indicated that 100% vermicomposting extract promoted healthy and vigorous seeding response compared with other treatments. Esteban et al. (2017) also indicated that vermicompost extract could produce healthy and vigorous growth of seeding. 100% vermicompost extract also showed higher in fresh weight and dry weight of both lettuce verities (1.146, 1.196, 0.07, 0.076 g, respectively). It was also reported that when the shoot and root were healthier, the plant weight will be heavier (Hussain et al., 2013). The result also similar with the finding of Zaller (2007) reported that vermicompost extract can promote the tomato biomass production and it was also suggested that vermicompost not only stimulate the plant growth but also effect inhibition of plant pathogen, rhizosphere micro floral, nutrient uptake and beneficial of microorganism.

CONCLUSION

From this study, it could be concluded that vermicompost extract was influenced the seed germination of green Romaine (*Lactuca sativa* L. var. Jericho) and green Batavia (*Lactuca sativa* L. var. Concept) and 100% vermicompost extract showed the best result compared with other treatments since this concentration enhance seed germination percentage, shoot length, root length, seed vigor index, fresh weight and dry weight of Romaine and Batavia seeds. Therefore,

vermicompost extract could be used as the alternative organic fertilizer to improve the seedling growth and crop production in the field.

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