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บทความวิจัย

ประสิทธิภาพของปุ๋ยหมักมูลไส้เดือนในการปรับปรุงดินเสื่อมสภาพต่อการเจริญเติบโตของต้นผักบุ้ง (*Ipomoea aquatica* Forsk.)

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ปุ๋ยหมักมูลไส้เดือน

การเจริญเติบโตของพืช

ดินเสื่อมโทรม

ดินเสื่อมสภาพคือดินที่เสื่อมโทรมหรือไม่มีความอุดมสมบูรณ์ ทำให้ความอุดมสมบูรณ์ของดินและความหลากหลายทางชีวภาพลดลง ปุ๋ยหมักมูลไส้เดือนเป็นที่รู้จักในการปรับปรุงคุณภาพดิน ความอุดมสมบูรณ์ การระบายอากาศ และผลิตภัณฑ์ทางการเกษตร ดังนั้นวัตถุประสงค์ของการวิจัยนี้คือการศึกษาผลของสัดส่วนปุ๋ยหมักมูลไส้เดือนต่อการเจริญเติบโตของผักบุ้ง (*Ipomoea aquatica*) โดยการศึกษาใช้สัดส่วนของปุ๋ยหมักมูลไส้เดือนและดิน 4 อัตรา ได้แก่ 0:10 (ไม่มีปุ๋ยหมักมูลไส้เดือน) 1:9, 3:7 และ 5:5 ทำการวัดความยาวลำต้น จำนวนใบ จำนวนกิ่ง น้ำหนักราก และน้ำหนักสด ผลการทดลองพบว่าสัดส่วนปุ๋ยหมักมูลไส้เดือนต่อดินที่อัตรา 5:5 ให้ความยาวลำต้นสูงสุดที่ 19.72 ซม. รองลงมาคืออัตรา 3:7, 1:9, และ 0:10 ซึ่งให้ค่าเฉลี่ย 17.42, 12.94 และ 10.47 ซม. ตามลำดับ ในส่วนของจำนวนใบและจำนวนกิ่ง พบว่าอัตราส่วน 5:5 ให้ค่าจำนวนใบและจำนวนกิ่งสูงสุดที่ 32.92 และ 1.92 ตามลำดับ เมื่อเปรียบเทียบกับกลุ่มทดลองอื่นๆ สำหรับน้ำหนักสดและน้ำหนักราก พบว่าน้ำหนักสูงสุดเฉลี่ยอยู่ที่ 21.29 และ 7.28 กรัม ตามลำดับ ซึ่งแสดงผลในอัตราส่วน 5:5 และมีความแตกต่างอย่างมีนัยสำคัญเมื่อเปรียบเทียบกับกลุ่มทดลองอื่นๆ ดังนั้นการศึกษานี้ชี้ให้เห็นว่าปุ๋ยหมักมูลไส้เดือนสามารถใช้เป็นทางเลือกสำหรับการเลือกใช้ปุ๋ยในการบำรุงดินและพืช และยังส่งเสริมการเจริญเติบโตของผักบุ้งได้อีกด้วย

Introduction

Soil is the most important factor for plant production and crop yield. Fertile soils contribute to food security, high yields for farmers and economic development for the countries. Deteriorated soil is degraded soil or unproductive soil which reduced soil fertility, soil biodiversity, soil structure, and local ecosystems. It caused by many factors such as wind and water erosion, deforestation, overgrazing, farming, use of toxic soil pollutants, overexploitation, industrialization, and urbanization (Irawan & Antriandarti, 2020). There was an important effect on agricultural productivity because the parameters of soil fertility such as organic matter, nutrients, and microorganisms in soil have been lost. Soil

fertility is the ability of soil to nourish plant growth and optimize crop yield which supposed to essential plant nutrients uptake and favorable chemical, physical, and biological characteristics for plant growth (Rabot et al., 2018). Thus, macronutrients, micronutrients, and microorganisms in soil were used by plants. It affected to the soil fertility. It is known that vermicompost improves soil property, soil fertility, aeration capacity, and agricultural products (Alwaneen, 2016; Oyege, & Bhaskar, 2023). Vermicompost is a soil amendment and a biocontrol agent (Joshi et al., 2015). Vermicompost contains macronutrients (nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur), micronutrients (boron, chlorine, copper, iron,

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manganese, molybdenum, and zinc), vitamins, enzymes, antibiotics, hormones, and saprophytic microorganisms to sustain soil fertility and plant growth (Geremu et al., 2020; Erdawati et al., 2021). Vermicompost was retaining the nutrients for a long time, gave a high water-holding capacity and high percentage of humic acids in soil compared to conventional compost (Theunissen et al., 2010; Elissen et al., 2023). Although in drought stress, vermicompost was an effective fertilizer to improve soil properties and nutrient availability for plants yield (Feizabadi et al., 2021). Therefore, the usage of vermicompost to the degraded soil was beneficial because it was increasing the soil organic matter composition, nutrient content, and soil microorganisms (Mahmud et al., 2018). At present, vermicompost has been widely used in the crop fields which produced high crop yields and soil amendment as reported in wheat (Hafez et al., 2021), *Amaranthus* (Uma & Malathi, 2009), tomato and cabbage (Goswami et al., 2017), pineapple (Mahmud et al., 2018), rapeseed (Feizabadi et al., 2021), vegetable crops (Theunissen et al., 2010), strawberry (Zuo et al., 2018), cucumber (Tith et al., 2021) and potato, spinach and turnip (Ansari, 2008). In addition, the use of vermicompost can improve the quality of the plants and save the soil from all the ill effects of pollution. It was noted that the use of vermicompost could slightly reduce heavy metal contamination or chemical residue in soil and agricultural products (Shetinina et al., 2019). Also, the application of vermicompost and drum compost in combination with recommended chemical fertilizer promoted crop growth, yield, product quality, and storage

longevity of tomato and cabbage plants (Goswami et al., 2017). Moreover, it was reported that the use of vermicompost mixed with biochar could be eliminated the detrimental effects of soil salinity and water stress on wheat growth (Hafez et al., 2021). Moreover, the usefulness of vermicompost was not only increased soil amendment and plant growth but also used as an organic pond fertilizer to improve water quality and survival rate of catfish fry (*Clarias* sp.) (Erdawati et al., 2021). Therefore, the objective of this research was to examine the effect of vermicompost ratios on morning glory (*Ipomoea aquatica*) growth such as plant height, leaf number, branch number, fresh weight, and root weight grown in deteriorated soil.

Materials and methods

Pot experiment

In order to evaluate the efficacy of vermicompost ratios on plant growth, morning glory (*Ipomoea aquatica*) was chosen. A pot experiment was conducted in natural condition at Faculty of Agriculture and Life Sciences, Chandrakasem Rajabhat University, Bangkok Thailand. This experiment was conducted in June, 2021. The deteriorated soil or used soil was used in this research and sterilized by one week exposure to sunlight before reusing the soil. The vermicompost was derived from Chai Nat province. The experiment was conducted in completely randomized design (CRD) with four different vermicompost ratios (vermicompost : soil) such 0:10 (no vermicompost), 1:9, 3:7 and 5:5. Four replicates for each treatment and each pot with three morning glory seedlings. Plants were watered every day.

Data collection

For measuring growth and yield parameters, all plants were recorded plant height, leaf number, branch number, root weight and shoot weight. Plant height was

measured every three days after sowing 14 days. Leaf number, branch number, and fresh weight were recorded at harvesting day (4 weeks after germination).

Data analysis

Data were expressed as means \pm standard deviation (SD). All data were statistically analyzed by statistical software. Significant differences among different treatments were carried out via analysis of variance (ANOVA) using Duncan's Multiple Range Test (DMRT) at significance level of 95% ($p < 0.05$).

Results and Discussion

Application of vermicompost ratios to improve deteriorated soil or used soil was significantly presented on morning glory growth. Data in table 1 indicated that four different ratios of vermicompost to soil were gave significantly the growth rate of morning glory when compared to the control (0:10, no vermicompost). The plant height was measured every three days until the harvest. The result was found the highest plant presented in vermicompost ratio 5:5 with 19.72 ± 0.23 cm plant⁻¹ followed by vermicompost ratio 3:7 and 1:9 (17.42 ± 0.38 and 12.94 ± 0.36 cm plant⁻¹ respectively) (Table 1). The branch number and leaf number were in line with plant height. The vermicompost ratio 5:5 showed high significant morning glory growth of leaf and branch number (32.92 ± 3.60 and 1.92 ± 0.17 number plant⁻¹ respectively). Meanwhile, no vermicompost gave the lowest vegetative growth of morning glory (Figure 1A). Regarding the morning glory yield, data in table 2 presented that the shoot weights of morning glory plants tended to increase by increasing dose of vermicompost. The highest shoot weights of morning glory were not significantly affected which obtained by application the vermicompost to soil in 5:5 and 3:7 with 21.29 ± 4.40 and 19.73 ± 3.88 g plant⁻¹, respectively. Also, the root fresh weight was not significantly enhanced by vermicompost to soil in 5:5 and 3:7 with

7.28 ± 1.73 and 7.16 ± 1.49 g plant⁻¹, respectively (Table 2), while control (no vermicompost) treatment gave the lowest in shoot weight (Figure 1B). The result indicated that vermicompost could be used for soil amendment in deteriorated soil or unproductive soil.

As the results, plant growth and yield were significantly affected by applied different ratios of vermicompost to deteriorated soil. Similar results were noted that the vermicompost application could promote tomato plant growth and improve soil fertility (Stepanova et al., 2020). The results were similar to those reported by Barroso et al. (Barroso et al., 2021), who found that a combination of chicken manure and vermicompost improved the growth and productivity of kangkongs. Also the growth of *Amaranthus* plant, the vermicompost had promoted *Amaranthus* growth better than chemical fertilizer in plant height, shoot length, branch number, leaf number, leaf length, seeds number, and root length (Uma & Malathi, 2009). However, vermicompost could be combined with biochar which enhanced soil quality, increased nutrient uptake, and stimulated soil chemical properties. The treated soil was significantly presented soil properties in relative water content, chlorophyll content, stomatal conductance, cytotoxicity, proline content, growth, and yield in wheat crop (Hafez et al., 2021). Vermicompost has positive influence on the soil with high percentage of organic matter and available nitrogen, phosphorous, and potassium of soil (Uma & Malathi, 2009). Moreover, the vermicompost helps to optimize the physical properties of soil and increases the activity of microorganisms in the soil (Stepanova et al., 2020). Soil analysis revealed that vermicompost applied soil had higher organic matter and available nitrogen than chemical fertilizer applied soil. The use of vermicompost to soils increased their microbial biomass and dehydrogenase activity. To ward an increasing plant growth and yields (Uma & Malathi, 2009). In

addition, the application of vermicompost alone could be promoted an excellent plant growth performance and given the low total cost more than treated with chemical fertilizer in produce pineapple plants. It was suggested that the usage of vermicompost as the single source of nutrients was not suitable for sandy loam soil, but could be used as addition to sustain the soil health, soil fertile, and soil structure for agricultural sustainability (Mahmud et al., 2018). Same as the other organic fertilizers, it was reported by Hitinayake et al. (2018), the morning glory

growth and yield were affected by using cattle slurry mixed with compost. There were presented with high fresh weight and dry weight of the leaves. Also onion plant, organic cattle manure gave the highest values of vegetative growth (fresh and dry weight of bulb and leaves, bulb diameter and plant length) (Shedeed et al., 2014). Moreover, organic fertilizers have been an appropriate nutrient supply was major to reach high yields and good taste of tomato fruits (Heeb et al., 2006).

Table 1 Effect of vermicompost ratio on morning glory growth at 28 days

Vermicompost : Soil	Plant height (cm plant ⁻¹)	Branch number plant ⁻¹	Leaf number plant ⁻¹
Control (0:10)	10.47±0.45 ^{d1/}	0.00±0.00 ^c	11.33±1.36 ^d
1 : 9	12.94±0.36 ^c	1.09±0.42 ^b	19.17±1.00 ^c
3 : 7	17.42±0.38 ^b	1.58±0.32 ^a	26.08±2.69 ^b
5 : 5	19.72±0.23 ^a	1.92±0.17 ^a	32.92±3.60 ^a

^{1/}Number is averaged of 4 replications, followed by a letter. Different letter means there is a significant difference at $p<0.05$ by Duncan's Multiple Range Test.

Table 2 Effect of vermicompost ratios on morning glory yield at 28 days

Vermicompost : Soil	Fresh weight (g plant ⁻¹)	
	Shoot	Root
Control (0:10)	3.26±0.69 ^{c1/}	1.23±0.32 ^c
1 : 9	10.66±2.85 ^b	3.53±1.43 ^b
3 : 7	19.73±3.88 ^a	7.16±1.49 ^a
5 : 5	21.29±4.40 ^a	7.28±1.73 ^a

^{1/}Number is averaged of 4 replications, followed by a letter. Different letter means there is a significant difference at $p<0.05$ by Duncan's Multiple Range Test.



Figure 1 Comparison of the vermicompost ratios to deteriorated soil on morning glory plants for 28 days (A) and vegetative growth and root system (B)

Conclusion

From the results, it can be concluded that the application of vermicompost at ratio 5:5 (vermicompost : soil) produced good yield of morning glory (*Ipomoea aquatica*) with highest quality of plant height, leaves number, branch number and fresh weight. It

was a significant difference compared to the other treatments. As a result, vermicompost may be a preferable option for morning glory and other crop cultivation.

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Research article

Efficiency of vermicompost in improving deteriorated soil for the growth of Morning Glory (*Ipomoea aquatica* Forsk.)

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ABSTRACT

Deteriorated soil refers to soil that has been degraded or rendered unproductive, leading to reduced fertility and biodiversity. Vermicompost is known to enhance soil quality, fertility, aeration, and agricultural productivity. Therefore, the objective of this research was to examine the effect of different vermicompost-to-soil ratios on the growth of morning glory (*Ipomoea aquatica*). The study evaluated vermicompost-to-soil ratios of 0:10 (no vermicompost), 1:9, 3:7, and 5:5. Measurements included stem length, number of leaves, number of branches, root weight, and shoot weight. The results showed that the 5:5 vermicompost-to-soil ratio produced the greatest stem length at 19.72 cm, followed by 3:7, 1:9, and 0:10 ratios at 17.42 cm, 12.94 cm, and 10.47 cm, respectively. In terms of the number of leaves and branches, the 5:5 ratio also yielded the highest values, with averages of 32.92 and 1.92, respectively, compared to the other treatments. The highest shoot and root weights were observed at the 5:5 ratio, averaging 21.29 g and 7.28 g, respectively, showing a significant difference compared to the other treatments. Therefore, this study indicates that vermicompost can be used as a biofertilizer to promote the growth of morning glory.

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