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Title: Effect of Different Flower Composts on the Growth of Yard Long Bean (*Vigna unguiculata* subsp. *sesquipedalis*)

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ABSTRACT

The experiment was conducted in the Soil, Water and Environment Discipline, Khulna University, Bangladesh, from May to October 2022 to assess the effect of different flower composts on the yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*) growth. The experiment was arranged in a Complete Randomized Design (CRD) with three replications. Total seven different treatments were applied for the experiment including marigold, rose, and chrysanthemum flower composts at two different doses (1000 kg ha^{-1} and 2000 kg ha^{-1}) and a control. Plant morphological and physiological attributes were measured in the experiment. The study found that the application of marigold flower compost at 2000 kg ha^{-1} (T2) enhanced plant growth attributes such as number of leaves, root length, shoot length, and fresh weight compared to the other treatments and the control treatment. Moisture content (%) varied slightly among the treatments, with the highest value in the control (87.15%) and the lowest in the rose compost at 2000 kg ha^{-1} dose (85.13%). Overall, the findings of this study suggest that the marigold flower compost at 2000 kg ha^{-1} had the most positive impact on the growth of yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*), which shows its potential as a sustainable soil amendment for enhancing plant growth.

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INTRODUCTION

Flower waste is a good source of organic matter which is beneficial for the plant growth and soil health. It can be extracted from the abundant flower waste resources. In Bangladesh, Marigold, Rose and Chrysanthemum are among the most important and commercially grown flowers. Mostly, these flowers are used by various industries, such as medicinal, herbal, perfume, cosmetics and textile industries etc. Other than the use of flowers by various industries, flowers are used during the festival, solemn occasion and also widely used for the wedding ceremony. A large quantity of flower waste is produced in places of worship such as temples, churches, and dargahs because flowers are offered to Gods in almost all religions due to religious beliefs and then discarded (Yadav et al., 2015).

A few religious institutions restrict even collecting flower waste from temple trash and converting it into beneficial goods such as compost (Jadhav et al., 2013). When flower waste is thrown on roadsides or in open areas, it makes the place look dirty and also spoils the overall beauty and impression of the environment. Flowers usually dumped into rivers, oceans, etc. that contaminates the water and have a harmful impact on the aquatic life (Waghmode et al., 2018). The decomposition of this organic matter depletes dissolved oxygen levels, which in turn causes the mortality of fish and other aquatic organisms (Mahindrakar, 2018). Additionally, local drains and water canals that are linked to rivers may also get blocked due to the disposal of flower waste (Maity and Kumar, 2016). Floral waste disposed of in rivers and on land can lead to numerous adverse impacts on ecological components. therefore, proper disposal becomes unavoidable. (Bhati et al., 2021). The decomposition of floral waste occurs at a significantly slower rate compared to kitchen waste (Gurav and Jadhav, 2013). By composting, flower waste can be used to produce fertilizer as it contains micronutrients like iron, manganese, zinc, and copper as well as macronutrients like calcium, phosphorus, potassium, and nitrogen (Sharma et al., 2018). Compost and vermicompost are well-recognized as important sources of plant nutrients among organic fertilizers (Sheata and El-Helaly, 2010; Manivannan et al., 2009). Organic matter, like compost, increases soil biodiversity by inviting in new bacterial and fungal species. (Ahmad et al., 2022). Composting is widely used for the conversion of organic waste into a fertilizing product and it is suitable for use on crops as a fertilizer (Domínguez, 2023).

Beans are an important leguminous vegetable, used for centuries (Brink and Belay, 2006) and fed to humans and animals (El-Fallal et al., 2003). Yard long bean is good source of micronutrients containing iron, zinc, manganese and cobalt (Ano and Ubochi, 2008). Yard long beans contain a wide range of essential nutrients and this offers an opportunity to reduce nutritional deficiencies (Quamruzzaman et al., 2022). Due to its significant impact on the economy, farmers are trying to increase the production to meet the high demand from customers. Inorganic fertilizers are used by almost all of vegetable growers for higher yields due to its easy and rapid availability to plants (Thy and Buntha, 2005). However, over time, it can negatively impact the chemical, physical, and biological characteristics of the soil **(**Albiach et al., 2000**).** Usually, the yard-long bean commonly harvested before full maturity and used as a green vegetable (Peyrano et al., 2016)**.** Additionally, vegetables play an important role in the nation's economy and are essential products of agriculture for human life (Ali et al., 2023). Among organic fertilizer, flower compost is quite good for plant growth. The use of flower composts for plant growth help to preserve natural resources and reduce degradation of ecosystem (Mäder et al., 2002; Francis and Daniel, 2004). Applying flower compost reduces the requirement for expensive and hazardous chemical fertilizers. Flower compost reduces the waste load and makes the surroundings more environmentally friendly.

In Bangladesh, the annual flower waste generation and decomposition data are not available also there is very limited research on flower waste composting and recent national reviews of composting omit floral waste entirely, which shows a significant lack of information regarding this issue (Sultana et al., 2020). But we all are familiar with flower waste. If we can manage these flower wastes properly, it can improve overall soil health and plant growth. A good soil should have at least 2.5% organic matter but in Bangladesh, the majority of soils contain less than 1.5% organic matter, and some soils have even less than 1% (BARC, 2018).

In this study, three flower composts (Rose, Marigold, and Chrysanthemum) were prepared and incorporated with the soil to assess the effects of different flower waste composts on the growth of yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*) by comparing plant attributes with a control, determining the optimal application dose and identifying the most effective compost for maximum productivity.

MATERIALS AND METHODS

The study was conducted to assess the effect of different flower composts on the growth of yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*). Pot experiment was conducted to carry out the experiment, which is an essential part of the study to the ideal scientific investigation.

Experimental area

The experimental site was located between 22°40.841 N and 89°24.660 E. The location lies in the (AEZ-25) (SRDI, 2008). *i.e*. Gangetic tidal floodplain area. The experiment was carried out from May 2022 to October 2022 in the field lab of Soil, Water and Environment Discipline, beside the Life science building, located on the Khulna University campus.

Experimental design

Total 21 pots were used and all the pots were labeled then filled with 3 kg of sieved soil. Pots had no large holes at the bottom to minimize compost loss through leaching. The experiment was arranged in Completely Randomized Design (CRD) with three replications of each treatment. The pot experiment was conducted in the net house of Soil, Water and Environment Discipline in Khulna University.

Flower waste collection and compost preparation

Three different flower waste (Rose, Marigold, and Chrysanthemum) was collected from the Khulna university Shaheed Minar, Kotka monument, and from the “Kaljoyee Mujib” monument after various cultural programs. Total 12 kg of flower waste was collected to make different flower composts. The flower waste was put into separate polythene bags with some water. Some holes in the polythene bags were created so that extra water could drain out and air could pass inside. Then the polythene bags were buried in the soil for 3 months. During this time, some water was given every 3 to 4 days and mixing with a wooden stick to moisten those flower wastes to help in proper decomposition and maintain aeration. Temperature was also monitored during the composting period. After three months, compost samples were brought out from the soil and prepared for using as treatment in the experiment.

Soil sample collection and preparation

The soil for the experiment was collected from the area which is located in front of the Sir Jagadish Chandra Bose Academic Building, Khulna University. Spade was used for collecting the soil. Then soil was air-dried at room temperature and all the plant debris was removed manually, and then crushed by hammer. The soil was sieved through 2 mm sieve. After sieving, the soil was taken into pots for sowing the seeds.

Test crop used for the experiment

Yard long bean **(***Vigna unguiculata* subsp. *sesquipedalis*) was used as the test crop for the experiment. It has gained popularity among the farmers of Bangladesh for its high-yielding potential. Yard long bean hold significant importance as a vegetable in Bangladesh. Yard long bean is a rich and inexpensive source of vegetable protein. It enriches the fertility of the soil by fixing atmospheric nitrogen. It has become an essential component of sustainable agriculture because of its fast-growing habit. It is a highly nutritive vegetable containing a good amount of digestible protein both in pods (23.5-26.3%) and in leaves (Sakthivel et al,. 2020). Yard long bean can be grown throughout the year and can be harvested in a very short time (one month). For vegetable and seed production it is best grown in winter. The seeds were collected from local market.

Treatments and doses for the experiment

Seven treatments were used in the experiment viz. (1) Control, (2) Marigold flower compost at 1000 kg ha^{-1}, (3) Marigold flower compost at 2000 kg ha^{-1}, (4) Rose flower compost at 1000 kg ha^{-1}, (5) Rose flower compost at 2000 kg ha^{-1}, (6) Chrysanthemum flower compost at 1000 kg ha^{-1} (7) Chrysanthemum flower compost at 2000 kg ha^{-1}. To ensure comparability between field application rates and the pot experiment, the compost dose was converted from kilograms per hectare (kg ha^{-1}) to the equivalent amount per pot. Each pot had a surface area of 0.2 m^2 and contained 3 kg of soil. Based on this, a recommended field application rate of 1000 kg ha^{-1} corresponded to 20 g of compost per pot and 2000 kg ha^{-1} corresponded to 40 g of flower compost per pot. Each treatment was replicated three times and two different doses of flower compost were conducted to avoid experimental error. Total 21 pots were used and filled with soil (3 kg/pot) and field capacity moisture was maintained.

Table 1. Treatments and compost doses applied in the experiment

Treatments	**Doses** (kg ha^{-1})
T0 (Control)	0
T1 (Marigold flower compost)	1000
T2 (Marigold flower compost)	2000
T3 (Rose flower compost)	1000
T4 (Rose flower compost)	2000
T5 (Chrysanthemum flower compost)	1000
T6 (Chrysanthemum flower compost)	2000

Sowing the seeds, irrigation and observation

The seeds of yard long bean **(***Vigna unguiculata* subsp. *sesquipedalis*) were sown and then the seeds were covered by soil. Almost all the seeds were germinated within 6 days. After germination, only five plants were kept in each pot. A sufficient amount of water was applied to each pot to ensure sufficient moisture (field capacity) for normal crop growth as described by (Lal and Shukla, 2004). The pots were observed frequently to notice any change in the crop growth and their characteristics. The crop growth was very satisfactory in some treatments. But very few pots showed a lower number of plants. Finally, five randomly selected plants were kept in each pot for analysis.

Data collection

After one month, the plants were collected and washed by distilled water avoiding root loss. For convenience of agronomic observation on the plant characteristics data were collected from plants selected in each pot. Data on plant characteristics were collected as follows:

Morphological attributes of yard long bean

a) Number of leaves/plants: The number of leaves of five plants of each pot was counted and average number was taken and expressed in nos/plant.
b) Shoot length (cm)/plant: Shoot length was measured by using a measuring scale from root level to the tip of the plant. From each pot five plants were measured and averaged and expressed in cm.
c) Root length (cm)/plant: Root length was measured by using a measuring scale from root level to the tip of the longest root at harvest and their average value was taken as the root length in cm.

Physiological attributes of yard long bean

a) Fresh weight/ plant (g): Fresh weight of 5 plants was taken by an electrical balance at laboratory of Soil, Water and Environment Discipline, Khulna University. Their mean value was calculated as fresh weight expressed in g/plant.

b) Dry weight/ plant (g): Five plants from each pot were dried at 65°C for 48 hours, weighted in g/plant by an electrical balance at laboratory of Soil, Water and Environment Discipline, Khulna University and the average value was recorded as g/plant.

c) Moisture content (%): Moisture content was calculated by using fresh weight and oven dry weight and following the formula (Yasmin et al., 2018):

$$\text{Moisture content (\%)} = \frac{Wf - Wo}{Wf} \times 100$$

Where, W_f = fresh weight of the plant sample, W_o = Oven dry weight of the plant sample.

Statistical Analysis

The experiment was conducted in one factor completely randomized design (CRD) with three replications. The factor was flower compost. The collected data on different parameters were represented in bar graph by using Microsoft office excel program and statistically analyzed to explore the effects of different flower composts applications on various parameters, including plant fresh weight, dry weight, moisture content, root length, shoot length and number of leaves following one analysis of variance (ANOVA) technique by using MINITAB 19.0 and the mean differences were adjusted by DMRT.

RESULTS AND DISCUSSION

Morphological attributes of yard long bean

Number of leaves per plant of yard long bean was slightly varied in different treatments and ranged from 7.33 to 13.40 (Fig. 1). The maximum number of leaves per plants of yard long bean was found in T2 (13.40) and the lowest number of leaves per plants of yard long bean was (7.33), found in control treatment. There was no significant difference among T1, T3, T4, T5, and T6. Therefore, the observation was as T2>T4>T1>T3>T6>T5>T0 (Fig. 1). So, the application rate of marigold flower compost to soil at 2000 kg ha^{-1} showed a positive effect on the number of leaves per plant of yard long bean. Similar reports showed that the leaf number was significantly influenced by organic amendments (Kebede et al., 2023). On the basis of the number of leaves per plants the application of marigold flower compost to soil (at 2000 kg ha^{-1}) is the best for uses and it is recommended for the plants.

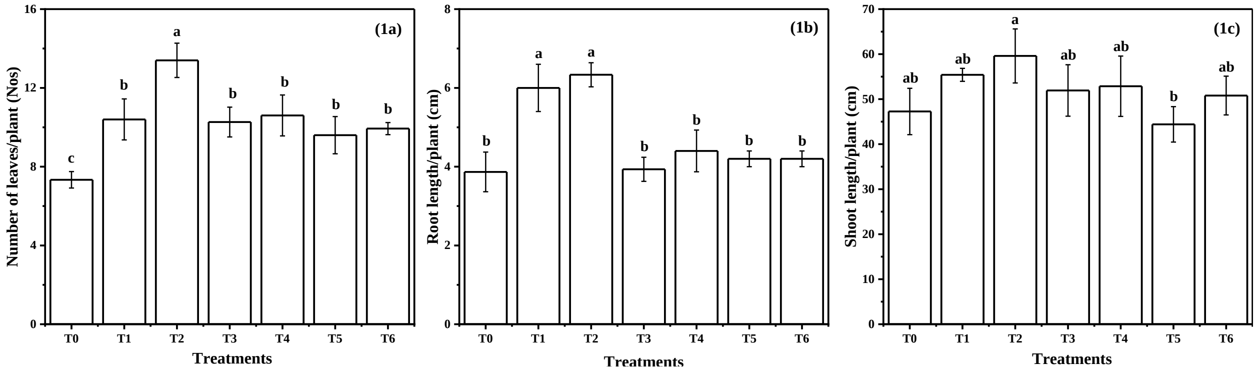

Figure 1. Effect of different flower composts on plant morphological attributes in number of leaves/plant (Nos) (1a), Root length/plant (cm) (1b) and Shoot length/plant (cm) (1c). Values are mean ± standard error (SE), different lowercase letters above the bar denote significant differences among the treatments at *p<0.001* level.

The root length was significantly influenced by different treatments. The maximum root length was found in T2 (6.33 cm) and lowest root length was found in control treatment

(3.87 cm) (Fig. 1). There was no significant difference among the treatments T3, T4, T5 and T6. The root length per plant observation was as T2>T1>T4>T5>T6>T3>T0 (Fig. 1). As the Maximum length of root was found in marigold flower compost at 2000 kg ha^{-1}, it is recommended for the proper growth of yard long bean.

Shoot length is the major important growth contributing parameter of long yard bean. The shoot length of long yard bean was significantly influenced by different treatments. There was a significant variation among the treatments compared to control (Fig. 1). Shoot length was ranged from 59.60 cm to 44.40 cm. The longest shoot length per plant was observed in T2 (59.60 cm) and lowest was observed in T5 (44.40 cm). Therefore, the Length of shoot length per plant observation was as T2>T1>T4>T3>T6>T0>T5. The application of Marigold flower compost at 2000 kg ha^{-1} showed significant increment of shoot length of yard long bean than other treatments applied for the experiment and recommended for the plant application. These Similar findings were also found by (Berova et al., 2010).

Physiological attributes of yard long bean

There was no significant difference between the treatments compared to the control (Fig. 2). Fresh weight per plant was maximum in T2 (12.82 g) and the lowest was observed in control (8.83 g). Therefore, the Fresh weight per plant observation was as T2>T4>T3>T1>T5>T6>T0. The application of marigold flower compost at 2000 kg ha^{-1} showed positive effect than other treatments on the fresh weight per plant of yard long bean (Fig. 2). This result was consistent with the findings of (Liu et al., 2019). Therefore, marigold compost at 2000 kg ha^{-1} is recommended to apply in the field for proper growth of yard long bean.

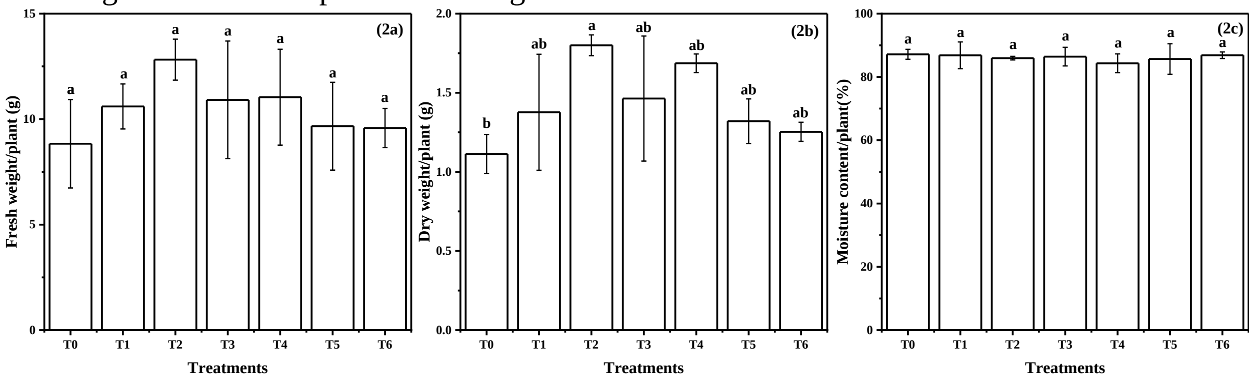

Figure 2. Effect of different flower composts on plant physiological attributes in Fresh weight/plant (g) (2a), Dry weight/plant (g) (2b) and Moisture content/plant (%) (2c). Values are mean ± standard error (SE), different lowercase letters above the bar denotes significant differences among the treatments at *$p<0.001$* level.

The maximum dry weight of plant was found in T2 (1.80 g) and the lowest was observed in control (1.11 g). There was a significant difference in the treatments compared to control (Fig. 2). Therefore, the fresh weight per plant (g) observation was as T2>T4>T3>T1>T5>T6>T0. Similar result sowed by (Izilan et al., 2022) that compost application had significant effects on plant dry weight. Marigold flower compost at 2000 kg ha^{-1} showed a positive effect on the yard long bean on the basis of the plant dry weight per plant (Fig. 2). So, for application, marigold flower compost at 2000 kg ha^{-1} is recommended.

Moisture content per plant varied insignificantly compared to the control and other treatments (Fig. 2). Moisture content (%) ranged from 85.13% to 87.15%. The maximum moisture content (87.15%) was found in T0 and the minimum moisture content was observed (85.13%) in T4. Therefore, Moisture content (%) observation was as T0>T6>T1>T3>T2>T5>T4. So, without application of any treatment to soil was showed positive effect on the moisture content per plant of yard long bean. A previous research work showed similar result found by (Gaikwad et al., 2021).

CONCLUSION

The experiment showed that different flower composts had a positive effect on plant growth. Flower compost could be beneficial in agricultural purposes. It is a sustainable and environment friendly approach. Composting quality should be improved to increase the demand for flower compost. According to the findings, plant growth attributes such as the number of leaves, root length, shoot length, fresh weight, dry weight, and moisture content (%) showed significant increment when flower composts used at different doses compared with the control trial and marigold flower compost at 2000 kg ha^{-1} showed the most productive effect and could be recommended as a potential approach for the plant growth. However, as the experiment was conducted for a short duration of time and did not include yield data, also did not include nutrient characterization of the composts to relate compost quality with plant responses. The findings mainly reflect early growth responses of yard long bean (*Vigna unguiculata* subsp. *sesquipedalis*). Therefore, further long-term evaluations should be carried out to confirm the effects of flower composts on crop yield and overall sustainability under field conditions.

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