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## Research Article

# Effect of Cow Manure Vermicompost on Some Growth Parameters of Alfalfa and Vinca Rosa Plants

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## Abstract

**Background:** Dairy industry is flourishing in Saudi Arabia to provide milk and milk products to local population. Presently there are about four major dairy industries in different regions of Saudi Arabia. Also, these dairy industries are producing huge quantities of cow manure which seems to have significant impact on the environmental. Besides, the crop germination is considerably affected by the heat produced from fresh cow manure during decomposition process. To avoid this, cow manure vermicompost is being produced with different types of earthworms for using as planting material. **Methodology:** The present study utilized vermicompost prepared by an earthworm known as *Eisenia fetida* by a local industry as promising potting material. A greenhouse study was conducted with a total of five treatments of different ratios of vermicompost and sandy soil. Two test crops namely alfalfa and vinca rosa were studied for treatment evaluation. Mean plant height and fresh biomass increased significantly with increasing proportion of cow manure vermicompost with sandy soil. **Results:** The results showed that use of cow manure vermicompost has a lot of potential for the development of landscape and house hold plants. **Conclusion:** In conclusion, cow manure vermicompost showed significant effect on plant growth both for the alfalfa and vinca rose. However, further studies are needed to determine cow manure vermicompost commercial application on cost effective basis.

**Key words:** Cow manure vermicompost, sandy soil, alfalfa, vinca rose, plant height, fresh biomass

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Generally, organic matter is added to soil to increase its fertility and to improve the physical structure for increased agricultural production. Previously, many investigators have reported beneficial uses of organic matter due to the presence of plant growth nutrients<sup>1-4</sup>. Land productivity was increased considerably with the addition of farm yard manure and other agricultural wastes<sup>5</sup>. Arancon *et al.*<sup>6</sup> found high growth of different plant parameters with the addition of vermicompost compared to those treated with inorganic fertilizers<sup>7-10</sup>. Furthermore, high contents of nitrate was found in plant tissue with increasing rate of vermicompost application<sup>11-18</sup>. Torkashvand *et al.*<sup>19</sup> found that the increased addition of cow manure compost in the cultivation bed as compared with the inorganic fertilizers increased most growth characteristics of the plant.

Dairy industry is flourishing in Saudi Arabia to meet milk and milk products requirements of its community. As such a large amount of raw cow manure is being produced which can create serious environmental hazards and health issues if disposed without treatment. Normally, cow dung (defined as dairy manure) is added to soil as a source of plant nutrients<sup>20</sup>. Generally, it is considered as a source of organic matter and fertilizer to increase the fertility and water holding capacity of sandy soils. Based on the findings of Hashemimajid *et al.*<sup>21</sup>, bovine manure containing high concentrations of potassium, phosphorus and nitrogen is considered as a potential source of fertilizer and plant growth medium. It is also an admitted fact that fresh manure adversely affects the growing plants due to increase in soil temperature after application due to decomposition. Fresh dairy manure can cause rapid immobilization of nutrients specially the nitrogen which can damage the young plants being highly susceptible to excess nitrogen in soil<sup>21</sup>. Arancon and Edwards<sup>22</sup> concluded that substitution of vermicompost at lower rates with other composts tends to enhance plant growth of different crops.

A review of literature showed that a very little has been accomplished on the use of cow manure vermicompost as potting material in Saudi Arabia. The main objective of study was to evaluate the available vermicompost by mixing with sandy soil on the growth and performance of alfalfa and vinca rosa plants to determine the optimum potting mixture for landscape and nursery plants.

## MATERIALS AND METHODS

The study was conducted in a greenhouse under controlled environmental conditions at Muzahmiah Research

station, King Abdulaziz City for Science and Technology (KACST) during 2015 season.

**Collection of cow manure vermicompost:** Cow manure vermicompost (prepared by using *Eisenia fetida* earthworm) was collected from a local progressive dairy industry in Riyadh, Saudi Arabia. The Cow Manure Vermicompost (CMV) was used in different proportions with a sandy soil. The sandy soil was collected from a location near the KACST research station. The total salinity of saturated soil extract (ECe) was 1.9 dS m<sup>-1</sup> and the Sodium Adsorption Ratio (SAR) was 1.5. There were a total of five treatments of vermicompost and soil with three replications of each treatment. Each treatment mixture was thoroughly mixed to obtain homogeneous mixture of vermicompost and soil before filling the experimental pots. The detail of various experimental treatments is given below:

No. of treatments	Vermicompost	Sandy soil
T-1	0	100
T-2	25	75
T-3	50	50
T-4	75	25
T-5	100	0

The study was carried in plastic containers of 25 × 25 × 30 cm<sup>3</sup> size with alfalfa and vinca rosa plants. The physical and chemical composition of cow manure vermicompost is presented in Table 1.

**Sowing of test crops:** Two crops namely alfalfa and vinca rosa were selected for treatment evaluation. Two grams of Alfalfa seeds and 10 seeds of vinca rosa were sown manually in each pot. Tap water from the greenhouse (total salinity of 1200 mg L<sup>-1</sup>) was used for irrigation. All the pots were irrigated to bring the mixture (vermicompost and soil) to field capacity. Later on, all the experimental pots were irrigation at 50% depletion of soil moisture by weighing the pots before and after each irrigation. The deficit in soil moisture was met by applying the required amount of irrigation water. The experiment was run for a total period of three months.

Table 1: Chemical composition of experimental cow manure vermicompost

Parameters	Vermicompost
Electrical conductivity (dS m <sup>-1</sup> )	1.53
pH	6.95
Cation-exchange-capacity (meq/100 g)	41.5
Organic matter (%)	65.5
Total nitrogen (%)	0.185
Available phosphorus (P) (mg L <sup>-1</sup> )	375
Available potassium (K) (mg L <sup>-1</sup> )	985
Magnesium (Mg) (mg L <sup>-1</sup> )	265
Calcium (Ca) (mg L <sup>-1</sup> )	745

**Plant growth measurements:** Plant growth characteristics namely plant height and fresh biomass were recorded after terminating the experiment.

**Statistical data analysis:** The data were analyzed by analysis of variance (ANOVA) as given in SAS<sup>23</sup>.

## RESULTS

### Vermicompost vs plant height

**Plant height of alfalfa:** Mean Plant height ranges from 55-85 cm in different treatments. The plant height increased significantly with increasing proportion of vermicompost with the soil (Table 2). The plant height was significantly different among various vermicompost treatments. The maximum and minimum plant height of 85 and 55 cm was obtained in T-5 and T-1, respectively. Mean Plant height was not significantly different between T-1 and T-3, between T-2 and T-4 as well as between T-4 and T-5 treatments at 5% level of significance. However, the plant height was significantly different between T-3 and T-4 treatments. It was observed also that plant height increased significantly with increasing ratio of vermicompost and soil in potting mixture. This increase in plant height may be due to high concentration of plant nutrients in cow manure vermicompost thus causing more plant growth as compared to the soil having very low initial fertility.

**Fresh biomass of alfalfa:** Mean fresh biomass yield was 65-123 g per pot in different treatments (Table 2). The biomass yield increased significantly with increasing ratio of cow manure vermicompost to soil. Mean maximum fresh biomass yield of 123 g was obtained in T-5 (100% vermicompost) and the minimum fresh biomass yield of 65 g was in T-1 control 100% sandy soil. It was noticed that mean fresh biomass yield was not significantly different among T-1, T-2 and T-3 treatments. But the biomass yield was significantly higher in T-4 and T-5 than all other treatments. On the other

hand, the fresh biomass yield was not significantly different between T-4 and T-5 treatments. Overall, the fresh biomass yield increased with increasing proportion of vermicompost with the sandy soil. The results indicated that fresh biomass yield of alfalfa showed continuous increasing with addition of vermicompost.

**Plant height of vinca rosa:** The range of mean plant height was 32-67 cm in different experimental treatments (Table 2). A comparison of data showed that plant height was significantly different in different treatments. Also, there was no significant difference in plant height between T-1 and T-2, between T-3 and T-4 treatments, but a maximum plant height of 67 cm obtained in T-5 was significant than all other treatments. This suggests that plant height increased with increasing proportion of vermicompost with soil due to nutrients from vermicompost to plant for their growth.

**Fresh biomass of vinca rosa:** Mean fresh biomass of vinca rose ranged from 23-89 g per plant in different treatments (Table 2). Mean fresh biomass yield was not significantly different between T-1 and T-2 as well as between T-3 and T-4 treatments. However, the yield was significantly higher in T-5 than all other treatments. This showed that growth of vinca rose increased with increasing proportion of cow manure vermicompost with soil. This also suggests that it may prove useful for landscape development utilizing locally produced cow manure vermicompost rather depending on the imported peat-moss or other similar planting materials. Overall, production of cow manure vermicompost may help save sizable amount of foreign exchange.

## DISCUSSION

In the present study, plant height and fresh biomass yield increased with the addition of cow manure vermicompost to soil. Results of this study are in agreement with those of Getnet and Raja<sup>24</sup> who reported that plant height, biomass and other plant growth parameters increased significantly with addition of vermicompost. Many other researchers showed significant increases in plant growth parameters with vermicompost application in *Pisum sativum*<sup>25</sup> and hyacinth beans<sup>26</sup>. The positive influence of cow manure vermicompost on plant growth in this study is in agreement with the results of Suhane<sup>27</sup> and Canellas *et al.*<sup>28</sup> who stated that cow manure vermicompost supplies essential nutrients to plants for stimulating growth as well as increase the organic matter contents of soil beneficial for higher plant production. More recently, Kashem *et al.*<sup>29</sup> found that addition of vermicompost

Table 2: Effect of vermicompost treatments on plant height

Treatments	Plant height (cm)		Fresh green matter (g)	
	Alfalfa	Vinca rosa	Alfalfa	Vinca rosa
1	55 <sup>a</sup>	32 <sup>a</sup>	65 <sup>a</sup>	23 <sup>a</sup>
2	65 <sup>a</sup>	37 <sup>a</sup>	79 <sup>a</sup>	45 <sup>a</sup>
3	72 <sup>ab</sup>	46 <sup>b</sup>	82 <sup>a</sup>	51 <sup>b</sup>
4	78 <sup>b</sup>	53 <sup>bc</sup>	89 <sup>b</sup>	63 <sup>bc</sup>
5	85 <sup>bc</sup>	67 <sup>d</sup>	123 <sup>c</sup>	89 <sup>d</sup>
Mean	71	47	87.6	54.2
SD	11.59	13.80	21.63	24.27

Figures in a column followed by the same letter are not significantly different at  $S_{0.05}$

showed significant effect on the growth of tomato plant when combined with inorganic fertilizer. They also observed better plant growth in vermicompost amended soil due to improvement in soil fertility. Whereas, Shadanpour *et al.*<sup>30</sup> observed higher plant growth in a potting mixture containing 60% vermicompost and 30% sand and 10% soil. They also reported that plant growth was better in cow manure vermicompost than peat. Also, application of vermicompost and compost showed positive effect on the growth of many plants<sup>31-33</sup>. The study results were also identical with the findings of Joshi *et al.*<sup>34</sup> who reported that the growth of wheat (*Triticum aestivum*) was significantly more in vermicompost treated soil compared to control treatment.

### CONCLUSION

Plant height and fresh biomass increased significantly with increasing proportion of cow manure vermicompost with sandy soil. The results proved that use of vermicompost for the development of landscape and house hold plants has lot of potential for the application of cow manure compost thus minimizing the harmful environmental impact expected from land disposal of untreated cow manure in the vicinity of commercial dairy industries in Saudi Arabia. In conclusion, cow manure vermicompost showed significant effect on plant growth both for the alfalfa and vinca rose. However, further studies are needed to determine cow manure vermicompost commercial application on cost effective basis.

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