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Response of okra (*Abelmoschus esculentus*) to cow dung compost in central Vietnam

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ABSTRACT

Okra an important vegetable crop is fairly high in vitamins and minerals and is eaten raw and present in everyday dishes of Vietnam. Nowadays, organic farming is a trend which fetches higher value for farmers while is also safe from chemical fertilizers and pesticides. Organic cultivation of okra though cow dung is yet to be explored before adoption. The field experiment was conducted in the winter-spring season of 2020 at Huong An commune, Huong Tra town, Central Vietnam to investigate the effects of levels of compost made from cow dung on the growth, yield of okra plants and soil property. Five different doses of cow dung compost (0, 2, 4. 6, 8 tons/ha) were applied to the soil. Growth, yield components and yield were investigated. The results indicated that cow dung compost had a positive effect on the growth and yield of okra. The application of 6 and 8 tons of cow dung compost recorded the highest pod yields of 6.5 and 6.6 tons/ ha, respectively. The soils decomposed with cow dung compost resulted in increased organic matter content thus improving the soil physical and chemical properties. Cow dung compost may be recommended to farmers for organic okra production.

Key words : Compost, cow dung, okra, soil property, yield

INTRODUCTION

Vegetables are important sources of many nutrients, including fiber, mineral and vitamin. Despite having many types of vegetables with different production methods in the market, there are some products unsafe for consumer's health due to the abuse of agrochemicals. Therefore, organic farming systems are becoming more and more focused on many countries worldwide, especially in developing countries. Organic farming is a non-chemical cultivation system and organic sources are reused (Willer and Lernoud, 2019). Organic agricultural products increasingly meet consumer demand because of the food safety as well as benefits of environmental protection.

Okra, *Abelmoschus esculentus* (L.) Moench, belonging to the family Malvaceaisan important vegetable crop in the world (Awodun, 2007; Ufere *et al.*, 2013; Maiti and Singh, 2021; Ivin *et al.,* 2022) including Vietnam (Dao *et al.*, 2021). The immature fruits and leaves of okra are used as soup and makes everyday dishes richer, more diverse and attractive, but it also provides us with a fairly high amounts of vitamins and minerals (Kumar *et al.*, 2013a; Nguyen *et al.*, 2019; Mutshekwa *et al.*, 2019).

As a tropical crop, okra can be grown in Vietnam all round the year. However, its potential could not be utilized fully due to lack of proper agronomic management practices like variety, nutrients and water management (Trinh *et al.*, 2020; Pham *et al.*, 2020; Dao *et al.*, 2021). There are many factors that affect the growth, yield and quality of okra of which soil nutrient is the main one (Kumar *et al.*, 2013b; Fagwalawa and Yahaya, 2016).

Fertilization plays a major role among cultural practices for increase crop production and improve soil fertility (Afe and Oluleye, 2017). Using chemical fertilizers contanting high nutrient concentrations is the quickest and surest way of boosting crop production due to its rapidly available and released for plant uptake, but their continuous cause in high cost, nutrient imbalance, soil acidity and not able to sustain crop yield (Amhakhiam and Isaac, 2016; Afe and Oluleye, 2017; Burlutskiy *et al.*, 2020). Organic manure normally

deriving from animal or plant sources can improve soil fertility by activating soil microbial biomass. Applying ornanic manure enhanced root initation increased root growth and development and promoted good soil structure and increases the water holding capacity of the soil, biologically it enhances the growth of useful soil organisms (Fahramand *et al.*, 2014; Singh *et al.*, 2019).

Previous studies revealed that cow drung application increased the yield components, yield and quality of okra, and improved the soil physical condition, nutrient and organic matter. (Ofosu-Anim *et al.*, 2006; Tiamiyu *et al.*, 2012; Gudugi, 2013). The objectives of this study were to determine effect of cow drung compost on the growth development, and yield of okra. The research results provide a full understanding of use of compost for organic okra production in central Vietnam.

MATERIALS AND METHODS

The field experiment was conducted in winter-spring season from January to April 2020 at Huong An commune, Huong Tra town, Thua Thien Hue province, Central Vietnam (16°46'37" N; 107°51'19" E, mean sea-level: 15 m) with five application levels of 0, 2, 4, 6, 8 tons/ha of cow dung compost. The soil at experimental field can be characterized as Haplic Acrisols. The weather parametters of the experiment period were daily recorded with an ATMOS-41 complex weather station (max temp: 35°C; min temp: 18°C; aveg temp: 28.5°C; rainfall: 118.5 mm; huminity: 85.6%).

Cow dung was colected from cow farm. Making a compost from cow dung was using hot composting method with raw materials of 1 m^3 of cow dung supplemented with 400 g of EMUNIV, 1 kg of molasses and 3.5 kg of lime powder. The composting block was stacked by layers with the height of 0.3 m for each layer. Every compost layer was sprayed with lime solution, molasses and EMUNIV and stired well. The height of the composting block was 1.2 m including 4 layers of materials. Outside was covered with a tarpaulin. The compost was mixed every 10 days, and EMUNIV was added every 20 days after incubation. The temperature of the composting block was 45 - 50°C with a moisture content of about 40%. 75 days old compost was used for the expriment.

Table 1. Nutrients concentration of cow dung compost used in this experiment.

Parameters	Unit	Concentration
Moisture	%	71.4
N	Mg/kg	13.13
P_2O_5	Mg/kg	1.80
K_2O	Mg/kg	1.42
CaO	Mg/kg	14.30
MgO	Mg/kg	6.90
C: N ratio	-	21.67

Nutrient concentration of the organic manure used in this experiment was listed in Table 1.

The experiment was under randomized complete block design (RCBD) with four replications. The area of each plot was 20.0 m^2 (5.0 m × 4.0 m). The okra var. Cao San was individually sown in row of 75 cm × 75 cm spacing. The whole amount of compostwas applied as basal. No chemical fertilizers and pesticides were applied on the field. Five plants in each plot were randomly selected for recording observations on agronomic traits including plant height, number of leaves, canopy diameter, days for first flowering, days for first harvest, yield components and yield.

Soil samples from the experiement plots up to the depth 0 - 20 cm were collected before sowing and after harvesting. All soil samples were analysed at the Laboratoty of Soil Science, University of Agriculture and Forestry, Hue University.

Data were analyzed using Statistix 10.0 (Analytical Software, Tallahassee, FL, USA). To compare the differences in agronomic traits and yield among treatments, one-way ANOVA was used. In all cases, $P<0.05$ was considered to be significant.

RESULTS AND DISCUSSION

Fertilization impact on growth duration of crop plants. This indicator helps farmers to arrange proper crop calendars for their crops to avoid unsuitable conditions and to meet market's requirement. Table 1 shown that growth times required for first flowering and first pod harvest of okra were signicantly different among the application levels of cow dung compost. The growth time from sowing to the first flowering of okra ranged between 41.3 and 48.7 days with shorter in cow dung compost treatments over a control. Similarly, time required for the first pod harvest was also shorter in cow dung compost treatments,

Table 2. Effect of cow dung compost on plant height, leaf number and growth time of okra.

Treatment Compost (t/ha)	Days required for 1st flowering	Days required for 1st harvest	Plant height (cm)	No. of leaf/plant	Canopy diameter
0	48.7a	55.7a	82.2e	20.0c	78.1e
2	47.3b	53.7b	87.0d	20.5c	82.6d
4	44.3c	52.7b	91.6c	21.9b	90.6c
6	41.7d	48.7c	98.2b	23.3a	98.5b
8	41.3d	48.3c	114.6a	23.9a	108.71
LSD (P=0.05)	1.3	1.7	3.39	0.80	2.01

Mean with the same letters within the same column are not significantly different by one way ANOVA, P<0.05.

ranged from 48.3 and 55.7 days after sowing. Muqtadir *et al.* (2019) reported that applied with high levels of organic manure resulted in decrease in days to first flowering and days to first pod harvest of okra. However, days to first harvest of okra plants were not significant different when applied ornanic fertilizers (Mateo *et al.*, 2010). Therefore, how to apply cow dung compost as an organic fertilizer with reasonable levels leading to the best growth time of okra is an important issue.

Cow dung compost appication with different levels had significant effect on plant height and number of leaves of okra. An increase in cow dung compost application level increased plant height (P<0.05) (Table 1). Plant treated with high levels of 6 and 8 tons/ha of cow dung compost was highest in both plant height of 98.1 and 114.6 cm, respectively. Our results are in agreement with the results of some authors who reported that organic fertilizer significantly positive affected on plant height of okra (Amhakhiam and Isaac, 2016; Afe and Oluleye, 2017).

The number of leaves of okra plants ranged between 20.0 and 23.9 leaves/plant and the canopy diameter ranged between 78.1 and 108.7 cm. The higher number of leaves and larger canopy diameter were obtained by higer application levels of cow dung compost (P<0.05) (Table 2). Gudugi (2013) reported that the application 15 - 20 tons/ha of cow dung increased leaf number of okra. Moreover, the growth response of okra on compost applied treatment performed better than the raw materials as cow dung because the compost was quite high nutrient content as compared to raw manure (Adebayo *et al.*, 2013). Therefore, cow dung compost can be potential as an organic fertilizers for okra production.

Yield is a main trait targeted to improve crop productivity. Therefore, yield is the key trait used to evaluate the performance of okra to fertilizers. Fertilization obtains higher yields indicating that it is more likely adapting with local farmers (Nguyen and Tran, 2020). The number of pods, pod weight, pod length and pod dinameter and pod yield were significant effected by cow dung compost (P<0.05) (Table 3). The pod yield was ranged between 3.6 and 6.6 tons/ha. The application of 6 and 8 tons of cow dung compost gained the highest pod yields of 6.5 and 6.6 tons/ha, respectively. On contrary, a low yield of 3.6 tons/ha was found in case of the control treatment. These observations were consistent with the findings of a number researchers (*e.g.*, Gudugi 2013; Amhakhiam and Isaac, 2016; Fagwalawa and Yahaya, 2016; Afe and Oluleye, 2017) who revealed that ornanic manure application had

Table 3. Effect of cow dung compost onyield and its components of okra

Treatment Compost (t/ha)	No. of pods/ plant	Weight of a pod (g)	Pod length (cm)	Pod diameter (cm)	Pod yield (t/ha
0	8.2e	26.9d	17.2d	2.2b	3.6d
2	8.7d	27.1d	17.4d	2.3ab	4.5c
4	9.3c	27.9c	18.7c	2.4a	5.5b
6	9.7b	29.6b	22.3b	2.4a	6.5a
8	9.9a	31.4a	23.3a	2.4a	6.6a
LSD (P=0.05)	0.23	0.48	0.89	0.17	0.87

Mean with the same letters within the same column are not significantly different by one way ANOVA, P<0.05.

Table 4. Soil properties of the experimental site before sowing and after harvesting.

Characteristics	Before planting	After harvesting				
		Control	2 tons compost	4 tons compost	6 tons compost	8 tons compost
Sand (%)	51.7	50.9	50.7	50.2	50.1	49.6
Silt (%)	24.2	24.8	24.5	24.7	24.8	24.2
Clay (%)	24.1	24.3	24.8	25.1	25.1	25.2
Organic carbon (%)	1.30	1.28	1.32	1.34	1.33	1.36
Total N (%)	0.08	0.08	0.09	0.09	0.10	0.10
Total P (%)	0.050	0.046	0.051	0.052	0.052	0.055
Total K (%)	0.050	0.050	0.053	0.055	0.053	0.056
Available K (mg/kg)	5.0	5.2	5.2	5.3	5.2	5.4
Available P (mg/kg)	3.2	3.2	3.4	3.3	3.3	3.5
CEC (meq/100 g)	9.0	9.3	9.3	9.2	9.6	9.7
pH	4.73	4.75	4.75	4.78	4.78	4.76

a positive effect on pod yield of okra.

As the soil was low in organic cacbon content (Table 1), the postitive effect of cow dung compost on okra plants could be due to the contribution make by organic manure to fertility status of the soil (Table 1). Increasing macro and micro-nutrient and improving the physio-chemical properties of the soil (Table 4) by decomposing cow dung compost into the soil could resulted in high growth and yield of okra plants.

CONCLUSION

It is concluded that cow dung compost had a positive effect on the development, growth and yield of okra. Application at the level of 6 - 8 tons/ha of cow dung compost was optimal levels produced highest growth and yield. The soils decomposed with the organic fertilizer were increased organic matter and improved both soil physical and chemical properties. As results, the organic fertilizer may be recommended to farmers to apply for organic okra production. However, further continuously field experiments are necessary to reach reliable conclusions.

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