Effect of cattle manure on growth and yield of carrot (*Daucus Carota* L.) under Jimma condition

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**ABSTRACT**

So far, research has been conducted to know the effect of cattle manure fertilizer on growth and yield of carrot under Jimma condition. Experiment was conducted at Jimma University College of Agriculture and Veterinary Medicine at horticulture garden during 2016 cropping season under irrigation condition. Experiment was laid out in randomized complete block design and cattle manure applications with four treatments (0, 5, 10 and 18 tons per hectare) were used. Each treatment was replicated three times. Data was collected from five randomly taken plants per plot. The finding revealed that application of cattle manure on carrot showed a highly significant effect for growth parameters (plant height, canopy diameter, root length and root diameter). Application of cattle manure at 10 tons ha⁻¹ increased carrot root weight by 48.8 % compared to the non-fertilized control treatment. Therefore, this finding would be a base for future research to be conducted.

**Key words:** Carrot, Cattle manure, Growth, Yield.

**INTRODUCTION**

Although, carrot crop has many potentialities and widely cultivated since long time in our country Ethiopia, yet its yield per acre remains very low. Many production problems like faulty nutrient application and the type of fertilizer, lack of recommended spacing, irrigation problems, date of planting, have been some of the factors, which contributed to the low productivity of carrot in our country. The type and the way producers are applying fertilizer is one of the major serious problems in carrot production (Hailu *et al.* 2008). It has been reported that excessive amounts of inorganic fertilizers are being applied to vegetables in order to achieve a higher yield (Abou *et al.*, 2012). However, the use of inorganic fertilizers alone may cause problems for human health and the environment. In addition, the cost of inorganic fertilizers is getting expensive and therefore farmers in Ethiopia could not afford to buy it for vegetable crop production. Under this situation utilization of locally available resources like organic matter is going to be meaningful for improving soil structure, microbial biomass and there by contributing for improving yield and crop productivity of carrot in the country. Therefore, utilization of locally produced cattle manures by vegetable producers may increase crop yields with less use of chemical fertilizer. In recent times, the study showed that organically grown fruits or vegetables contain more mineral and vitamins than conventionally grown ones (Bourn and Prescott, 2002). Report by Abou *et al.*, (2012) showed that vegetative growth and yield of different crops were increased with addition of organic cattle manure. Several attempts have been made to increase yield potential of root crops neglecting carrot. In addition, previous research was only concerned with the use of inorganic fertilizers. However, this type of fertilizers if endlessly used by farmers it results in loss of soil fertility and soil health. Continuous use of inorganic fertilizer for crop production will affect the sustainability of environment and as well as the human health. In this context, the use of organics and bio fertilizers like farmyard manure (FYM), poultry manure, cattle manure and Azospirillum is gaining more importance for getting higher yield and quality. Cattle manure being bulky organic material releases the soil compactness and improves the aeration in addition to the supply of essential plant nutrients and organic matter and increase soil microbial establishment along with accumulation of excess humus content (Greene, 2007). Organically produced fruits, vegetables, food crops fetch much higher value not only in the international market but also in the domestic market. They are known to be devoid of any residues, thereby having positive impact on environment and human health. The research pertaining to the use of organics and bio fertilizers in vegetable crops particularly in carrot is very much limited (Leclerc *et al.*, 1991; Warman and Harvard 1996; Warman and Harvard, 1998 ; Stone, 1998). Specific recommendation about the use of organic fertilizer (cattle manure) are lacking in our country Ethiopia. So far, hardly any research has been conducted to see the effect of cattle manure fertilizer on yield and yield component of carrot under Jimma condition. Therefore, the current experiment was aimed at determining the influence of cattle manure on growth and yield of carrot.

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MATERIALS AND METHODS

The experimental area is situated in South Western part of the country Oromia Regional State, Jimma zone located at 352 km from Addis Ababa at 7°33’N latitude, 36°57’S longitude and altitude of 1710 m above sea level. Particularly experiment was conducted at Jimma University College of Agriculture and Veterinary Medicine, Department of Horticulture and Plant Sciences at Horticultural garden during 2016 cropping season under irrigated condition. The crop was stayed on the field for three months starting from March 30, 2016 to May 26, 2016. The area received an annual rainfall of 1500 mm. The maximum and minimum temperatures of the area are 26.7°C and 11.4°C, respectively. The soil of the area is characterized by reddish brown clay loam soil with its pH ranges from 5.07 to 6.0 (BPEDORS, 2000).

Experimental design and treatments: For this experiment, randomized complete block design (RCBD) was used. The experiment consists of single factor experiment (Cattle manure application at different rate). The research was conducted on an experimental area of 25.85 m² having 12 plots. The area of a single plot was (1.5 m × 0.8 m), is equal to 1.2 m². The space between plots and blocks were 0.5 and 1m, respectively. Cattle manure at different rates (0, 5, 10 and 18 tons Ha⁻¹) were used as treatments. Each treatment was replicated three times and treatments were randomly assigned to experimental plots. A plot consisted of five rows with eight plants each, which made up 32 plants per plot. See the description of the treatments in the Table 1.

Data Collected: During data collection, five plants were randomly taken from each plot. Growth responses like plant height (cm), Canopy diameter (cm), Root length (cm), Root diameter (mm), Root Volume (ml) and Fresh weight (kg), Root Diameter (mm) Canopy Diameter (cm), Root length (cm) and Root weight (kg ha⁻¹) were recorded using tape meter, caliper, electronic balance and water displacement method.

Plant height (cm): Plant height was recorded using tape meter from the base of the carrot plant to the tip of the carrot plant and the average plant height was taken.

Canopy Diameter (cm): Canopy diameter was measured in both x and y direction from the widest portion and the average canopy diameter was calculated.

Root length (cm): The length of the root was measured in five randomly selected plants at harvest from the base of the plant to the top of the root and average root length was expressed in centimeter.

Table 1: Treatments symbol and definitions

| Treatments symbol | Definitions |
|-------------------|-------------|
| T1                | 0, control treatment |
| T2                | 5 tons per hectare, cattle manure |
| T3                | 10 tons per hectare, cattle manure |
| T4                | 18 tons per hectare, cattle manure |

Table 2: Growth of carrot as influenced by cattle manure application

| Cattle manure Application rate (ton Hα⁻¹) | PH(cm plot⁻¹) | CD(cm plot⁻¹) | RL(cm plot⁻¹) | RD (mm plot⁻¹) | RV(ml plot⁻¹) |
|-----------------------------------------|---------------|---------------|---------------|----------------|--------------|
| T4 (18)                                 | 62.83a        | 32.807a       | 18.20a        | 26.037a        | 34.633b      |
| T3 (10)                                 | 48.867a       | 53.503a       | 31.33a        | 38.95a         | 59.800a      |
| T2 (5)                                  | 46.767b       | 30.667b       | 19.70b        | 26.06b         | 33.067b      |
| T1 (0)                                  | 49.833b       | 32.180b       | 19.20b        | 25.995b        | 30.533b      |
| CV%                                     | 6.88          | 8.56          | 3.27          | 9.97           | 20.15        |
| LSD (0.05)                              | 7.16          | 6.38          | 1.44          | 5.83           | 15.91        |
| R²                                       | 0.86          | 0.95          | 0.99          | 0.88           | 0.87         |
| PV                                       | 0.005         | 0.0003        | <0.001        | 0.0036         | 0.0129       |

RESULTS AND DISCUSSION

Effect of cattle manure application on growth of carrot

Plant height: Application of cattle manure on carrot showed a highly significant effect (P<0.0055) in average plant height (cm plot⁻¹). Average plant height (cm plot⁻¹) significantly differed between control (0) and 18 tons Hα⁻¹ of cattle manure application (LSD 0.05=7.16). However, application of cattle manure at 0, 5, and 10 tons Hα⁻¹ did not significantly differ in average plant height (Table 2). The highest and the lowest average plant height were recorded for 18 and 5 ton Hα⁻¹ cattle manure application that was 62.83 and 46.77 cm Plot⁻¹, respectively. Application of cattle manure at 18 ton Hα⁻¹ increased plant height by 26.09 % compared to the non-fertilized control treatment (Table 2). The highest plant height at 18 tons Hα⁻¹ cattle manure application was obtained probably because of organic matter improves soil structure and encourages root growth which intern promote plant physiology laboratory, JUCAVM, Ethiopia.
growth. Probably application of organic matter improved up takes of nutrients by the plant. Findings of the current study support this arguments (Levy and Taylor, 2003; Jeptoo et al., 2012).

**Canopy diameter:** Application of cattle manure on carrot showed a highly significant effect ($P=0.0003$) in average canopy diameter (cm plot$^{-1}$). The average canopy diameter (cm plot$^{-1}$) significantly differed between control (0), and 10 tons ha$^{-1}$ application of cattle manure. Similarly, significant difference in average canopy diameter (cm plot$^{-1}$) was observed between 5 and 10; between 18 and 10 tons ha$^{-1}$ of cattle manure application. The average canopy diameter (cm plot$^{-1}$) significantly differed between control (0), and 10 tons ha$^{-1}$ application of cattle manure. Similarly significant difference in average root diameter (mm plot$^{-1}$) was observed between 5 and 10; between 18 and 10 tons Ha$^{-1}$ of cattle manure application (Table 2). However, application of cattle manure at 0, 5 and 18 tons ha$^{-1}$ did not significantly differed in average root diameter ($LSD 0.05=6.38$). The highest and lowest canopy diameter were recorded at 10 and 5 tons ha$^{-1}$ cattle manure application, which was 53.5 and 30.67 cm, respectively. The highest canopy diameter was obtained at 10 tons ha$^{-1}$ cattle manure application. Application of cattle manure at 10 tons ha$^{-1}$ increased carrot canopy diameter by about 66 % compared to the non-fertilized control treatment (Table 2). This might be because of cattle manure treatment probably improved the physical soil properties and increased the level of soil nutrition, which improved canopy growth of the carrot plant. This is in agreement with the findings of other scholars who reported that cattle manure application improved vegetative growth of carrot plant (Dawuda et al., 2011).

**Root length, root diameter and root volume:** Application of cattle manure on carrot showed a highly significant effect ($P=0.0000$) in average root length (cm plot$^{-1}$). The average root length (cm plot$^{-1}$) significantly differed between control (0) and 10 tons ha$^{-1}$ application of cattle manure (Table 2). But application of cattle manure between (0) and 5; between (0) and 18 tons ha$^{-1}$ did not significantly differed in average root length ($LSD 0.05=1.442$). Application of cattle manure at 10 tons ha$^{-1}$ increased carrot root diameter by about 50 % compared to the non fertilized control treatment. Application of cattle manure on carrot showed a significant effect ($P=0.0129$) in average root volume (ml plot$^{-1}$). The average root volume (ml plot$^{-1}$) slightly differed between control (0), and 10 tons ha$^{-1}$ application of cattle manure. Similarly, significant difference in average root volume (ml plot$^{-1}$) was observed between 5, and 10; between 18 and 10 tons Ha$^{-1}$ of cattle manure application (Table 2). However, application of cattle manure at 0, 5 and 18 tons ha$^{-1}$ did not significantly differed in average root volume ($LSD 0.05=15.908$). The highest and lowest root length (cm plot$^{-1}$) was observed at 10 and 18 tons Ha$^{-1}$ cattle manure application which was 31.33 and 18.22 cm, respectively (Table 2). The highest and lowest root diameter (mm plot$^{-1}$) was obtained at 10 and 0 tons ha$^{-1}$ application of cattle manure which was 38.95 and 25.99 mm, respectively (Table 2). Application of cattle manure improved vegetative growth and increased root diameter, root size in carrot reported by Dawuda et al., (2011) which was in agreement with our findings.

**Effect of cattle manure application on yield of carrot**

**Root weight and fresh weight (Root + Above ground fresh weight):** Application of cattle manure on carrot showed a highly significant effect ($P=0.0036$) in average root diameter (mm plot$^{-1}$). The average root diameter (mm plot$^{-1}$) significantly differed between control (0), and 10 tons ha$^{-1}$ application of cattle manure. Similarly significant difference in average root diameter (mm plot$^{-1}$) was observed between 5, and 10; between 18 and 10 tons Ha$^{-1}$ of cattle manure application (Table 2). However, application of cattle manure at 0, 5 and 18 tons ha$^{-1}$ did not significantly differed in average root diameter ($LSD 0.05=5.8292$). Application of cattle manure at 10 tons ha$^{-1}$ increased carrot root diameter by 63.18 % compared to the non-fertilized control treatment. Application of cattle manure on carrot showed a highly significant effect ($P=0.0003$) in average root diameter (mm plot$^{-1}$). The average root diameter (mm plot$^{-1}$) significantly differed between control (0), and 10 tons ha$^{-1}$ application of cattle manure. Similarly significant difference in average root diameter (mm plot$^{-1}$) was observed between 5, and 10; between 18 and 10 tons Ha$^{-1}$ of cattle manure application (Table 2). However, application of cattle manure at 0, 5 and 18 tons ha$^{-1}$ did not significantly differed in average root diameter ($LSD 0.05=6.38$). The highest and lowest root diameter (mm plot$^{-1}$) was recorded at 10 and 5 tons ha$^{-1}$ cattle manure application, which was 38.95 and 25.99 mm, respectively (Table 2). Application of cattle manure improved vegetative growth and increased root diameter, root size in carrot reported by Dawuda et al., (2011) which was in agreement with our findings.
significant effect ($P=0.0260$) in mean root weight (kg ha$^{-1}$). Average root weight (kg ha$^{-1}$), significantly different between control (0) and 10 tons ha$^{-1}$ of cattle manure applications. Similarly, significant difference in average root weight (kg ha$^{-1}$) was observed between 5, and 10; between 18 and 10 tons ha$^{-1}$ of cattle manure application (see figure 1 below). But application of cattle manure at 0.5 and 18 tons ha$^{-1}$ did not significantly differ in average root weight ($LSD \ 0.05=1.4697$). The highest and lowest root weight was obtained at 10 and 5 tons ha$^{-1}$ cattle manure applications, which were 536 and 302 Kg ha$^{-1}$, respectively (Figure 1). Application of cattle manure on carrot showed a significant effect ($P=0.0265$) in average fresh weight (kg ha$^{-1}$). The average fresh weight (kg ha$^{-1}$) significantly differed between control (0), and 10 tons ha$^{-1}$ application of cattle manure. Similarly significant difference in average fresh weight (kg ha$^{-1}$) was observed between 5 and 10; between 18 and 10 tons ha$^{-1}$ of cattle manure application (Figure 2). But application of cattle manure at 0.5 and 18 tons ha$^{-1}$ did not significantly differed in average fresh weight ($LSD \ 0.05=32.723$). The highest and the lowest fresh weight was obtained at 10 and 5 tons ha$^{-1}$ cattle manure applications which was 1128.5 and 668.20 Kg ha$^{-1}$, respectively (Figure 2).

Organic manure have been shown to supply the required plant nutrient, improve soil structure and water holding capacity, increase microbial activity and at the same time promote plant growth and productivity (Jeptoo et al., 2012). This argument is supported by the current findings.

**CONCLUSION**

Finding about the use of cattle manure under jimma condition revealed that application of cattle manure on carrot showed a highly significant effect for all growth parameter. In addition application of cattle manure on carrot showed a significant effect on both root weight and fresh weight ($P=0.026$ and $P=0.0265$), respectively. From this finding, we conclude that application of cattle manure at 10 tons Ha$^{-1}$ increased both growth and yield of carrot except for plant height. Application of cattle manure at 10 tons ha$^{-1}$ increased carrot root weight by 48.8% compared to the non-fertilized control treatment. Specific recommendation about the use of cattle manure are lacking in our country Ethiopia. Therefore, this finding would be a base for future research to be conducted during different seasons in different regions in our country to come up with right recommendations about the use of cattle manure for carrot production.