EFFECT OF INTEGRATED SOIL FERTILITY MANAGEMENT ON GREENHOUSE TOMATO YIELDS IN SEMI ARIDS OF KITUI.

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ABSTRACT

Globally the demand for food is increasing due to the increase in population. In sub Saharan Africa degrading soils necessitates novel approaches to soil fertility management. The aim of this research was to investigate the effect of application of cattle manure and inorganic fertilizer in tomato production in Kitui County, Kenya. Cattle manure was applied at the rate of 10 ton/ha and mineral fertilizer applied at the recommended rates of 150 kg/ha DAP, 200 kg/ha CAN, and 200kg/ha NPK. The treatments were arranged in a completely randomized design. Tomato growth characteristics and yields were measured and the data subjected to ANOVA using the Genstat 15th Edition (VSN-International, 2012). Both the organic and inorganic soil amendments increased growth and yield of tomato, but this effect was more significant in plots which had the combination of both the organic and inorganic soil amendments. We recommend combination of cattle manure and mineral fertilizer to small holder tomato farmers in semi-arid lands of Kitui.

Keywords: Integrated soil fertility management, tomato, cattle manure

INTRODUCTION

Tomato (*Lycopersiconesculentum*) is classified as a vegetable crop, and like numerous other crops, it has recently received new outlook in technological production. It is the second leading vegetable in Kenya in terms of production and value after potato (Sigei*et al* 2014). Tomato is grown either on open field or under greenhouse technology. Open field production account for 95% while greenhouse technology accounts for 5% of the total tomato production in Kenya (Seminis, 2007). Kenya is among the Africa's leading producer of tomato and is ranked 6th in Africa with a total production of 397,007 tones (FAO, 2012).

Greenhouse tomato production is gaining significance in most parts of semi-arid areas of Kitui, Machakos, and Makueni counties of Ukambani. This is so because with the greenhouse technology, production can be done even when the environmental conditions are unfavorable for outdoor tomato production. This helps many farmers to target production when market prices are competitive.

Most greenhouses in the area use soil as the growing media, hydroponics has not been adapted in the area. Most of the soils in the area are not very fertile and hence tomato yields are not very

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high. Integrated soil fertility management (ISFM) is important in production of vegetable crops which have short production cycles like tomato and require adequate supply of soil nutrients to improve crop productivity and ensure sustainable production (Mfombep et al., 2016). The ISFM is a set of agronomic practices adapted to local conditions to maximize nutrient use efficiency and sustainability (Ngosong et al., 2015).

The aim of this research was to investigate the effect of integrated soil fertility management on improvement of tomato yields production in the semi-arid lands of Kenya.

MATERIALS AND METHODS

Experimental site

The study was conducted in a greenhouse in South Eastern Kenya University (SEKU) farm.

The SEKU farm is located at Kwa Vonza division in the Lower Yatta, Kitui County, 17 Kilometers off Kwa Vonza Market, along the Kitui-Machakos main road. This area is in eco-zone V (Jaetzold and Schmidt 1983). This area is a semi-arid zone with the annual rainfall amount ranging between 400mm-800mm, temperature range is between 14^{o} C- 34^{o} C , latitude 1^{o} 22 57 S, longitude 38^{o} 00 19 E and 1152m above sea level. The soil type of the study area is predominantly sandy to loamy sand texture. This makes them susceptible to erosion and limited capacity to retain water and nutrients. The soils are generally poorly drained and easily eroded by runoff (Borstand De Haas, 2006).

Experimental design and treatments

The experimental design was a completely randomized design with three replications. The plot size was 4m wide and 5 m long. The following were the treatments Control, Cattle manure, Mineral fertilizer and a mixture of Cattle manure and Mineral fertilizer. The test variety was Kilele F1. Seedlings were started in a nursery near the greenhouse. Transplanting was done after thirty days when the seedlings were about 15 cm in height. Cattle manure was obtained from the SEKU farm and was incorporated at the recommended rate of 10 ton/ha in the planting beds and worked in the soil evenly before transplanting. Fertilizer was applied at the recommended rates of 150 kg/ha DAP, 200 kg/ha CAN, and 200kg/ha NPK. Transplanting was done on 19th of December, 2015. Only healthy, vigorous and normal seedlings were selected and transplanted.

Poles of 2.8 m were fixed 4 m apart and 2.2 m high supported the wires stretching horizontally at 0.3m and 2.2 m above the ground. Sisal twines on which single stem of tomato plants were twisted joined the wires. Lateral shoots, senescing or diseased leaves were removed regularly by hand snapping as they appeared.

Tomato pests such as thrips, leaf miners and aphids found to be common were controlled by application of broad spectrum pesticide, Brigade (Bifenthrin 25g/l) at the rate of 2ml/l of water every two weeks. Tomato early and late blights were controlled by application of Ridomil

(40g/kg metaxyl-M+640g/kg mancozeb) at 40g/l of water. Tomato plants that were severely attacked by bacterial wilt were carefully uprooted and destroyed.

Data collection

The main crop physiological measurements done on tomato plants were plant height, stem diameter, fruit diameter and fruit weight. The measurements of plant height and stem diameter were made during the growth stages of the crop while fruit weight and diameter were done at the time of harvesting. Harvesting of tomato fruits was done manually from 70 days after transplanting. An electronic balance (Sartorius) which had an accuracy of ±0.01 g was used to weigh the harvested tomatoes.

Statistical analysis

The data obtained was subjected to analysis of variance (ANOVA) and the treatment means separated by Least Significant Difference (LSD).

RESULTS AND DISCUSSIONS

Effect of treatments on tomato growth characteristics

Tomato growth characteristics were assessed as plant height and stem diameter. The stem diameter ranged from 14.33 mm to 17.97 mm across the treatments (Table 1). Stem diameter was significantly higher under the interaction of cattle manure and mineral fertilizer, followed by sole application of cattle manure and mineral fertilizer treatments, as compared to the control. The plant height also ranged from 2 m to 2.57 m across the treatments. The highest plant height was recorded with the combination of cattle manure and mineral fertilizer treatment (Table 1). This was followed by application of sole cattle manure and mineral fertilizer treatments respectively. The control recorded the lowest plant height.

Table 1: The effect of different integrated soil fertility management treatments on tomato growth characteristics.

Treatment	**Stem diameter (mm)**	**Plant height (m)**
Control	14.33d	2.00c
Cattle manure	17.70b	2.47a
Mineral fertilizer	16.43c	2.30bc
Combined	17.97a	2.57a

Data within column with different letters are significantly different, $p<0.05$

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Effect of treatments on tomato yields

Fruit diameter was significantly ($P<0.05$) influenced by treatments. Combination of cattle manure and mineral fertilizer recorded the highest fruit diameter (62 mm) (Table 2). This was closely followed by sole application of cattle manure and mineral fertilizer. The control recorded the lowest fruit diameter (53.33mm).

Fruit weight was influenced by application of different treatments significantly ($P<0.05$).Combination of cattle manure and mineral fertilizer recorded the highest fruit weight (129.67 g) (Table 2). This was followed by sole application of cattle manure (126.67 g) and sole application of mineral fertilizer (124.00 g). The control had the lowest fruit weight (111.00 g).

Tomato yield was significantly ($P<0.05$) highest under the mixture of cattle manure and mineral fertilizer treatment (4.47 Kg/m^2) (Table 2). This was followed by sole application of cattle manure (4.00 Kg/m^2) and sole application of mineral fertilizer (3.83 Kg/m^2) respectively. The control recorded the lowest tomato yields (3.10 Kg/m^2).

Table 2: The effect of different integrated soil fertility management treatments on tomato yields

Treatment	**Fruit diameter (mm)**	**Fruit weight (g)**	**Yield (Kg/m^2)**
Control	53.33c	111.00d	3.10c
Cattle manure	60.67a	126.67b	4.00b
Mineral fertilizer	58.67b	124.00c	3.83b
Combined	62.00a	129.67a	4.47a

Data within column with different letters are significantly different, $p<0.05$

Application of different integrated soil fertility management measures increased tomato yields as compared to the control. These results are in consistent with findings by Mfombep et al. (2016) and Ngosong et al. (2015) who reported an increase in tomato yields with application ISFM. Application of cattle manure increased the tomato yields more than application of mineral fertilizer. These findings corroborate the findings by Mfombep et al. (2016) who reported increased tomato yields with application of poultry manure as compared to mineral fertilizer. Ngosong et al. (2015) also reported an increase in tomato yields with application of organic residues as compared to application of mineral fertilizer. Combination of cattle manure and mineral fertilizer recorded the highest growth characteristics and tomato yields. These results were in tandem with the findings by Islam et al. (2013); Agegnehu et al. (2014); and Wamari et al. (2016) who reported increased yields with combination of organic and inorganic fertilizers.

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CONCLUSION

Application of cattle manure combined with inorganic fertilizers recorded the highest tomato growth characteristics and consequently the highest tomato yields. The implication is that application of cattle manure combined with inorganic fertilizer effectively synchronized the crop's demand for, and supply of nutrients.

It is recommended that more research be done with other locally available organic amendments. The possibility of combining different organic residues to increase tomato production should also be investigated.

Figure 1: A photo taken inside the greenhouse when the tomatoes were ready for harvesting on 7th April, 2016.

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