Comparative studies on the effects of different fertilizers on the growth and yield of *Lycopersicon esculentum* Mill.

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Abstract

The research work was carried out to analyse the effects of different organic fertilizers on the growth and yield of tomato plants. Tomato plants were raised and grown in the green house with different combinations of organic fertilizers (cow dung, ground nut cake, biomeal and bone meal). The vegetative growth parameter, reproductive/yield parameters were recorded. Quantitative estimation of photosynthetic pigments and major primary metabolites like protein and sugar were also carried out. From the results of this experiment, it was concluded that the different organic fertilizers showed different effects on the growth and yield of tomato plants. Moreover, among the different organic fertilizers used, cow dung fertilizer was found to be the most suitable fertilizer for tomato which was evident from the results obtained in the project work.

Key words: Fertilizer, cow dung, biomeal, photosynthetic pigment, growth parameters, phenological parameters

Introduction

Agriculture is the first and the most important pursuit of civilization. Every nation has to focus on the agriculture sector in order to fulfill the needs of the poor to the rich in a nation. Research to improve the way of cultivation and yield is done by every developed and developing country. The fertilizers are combinations of natural or synthetic compounds which are applied to the soil in order or supply one or more plant nutrients essential to the growth of plants. The nutrient required for the plants are classified as per the elements. The fertilizers we use are classified based on the nutrients they provide.

Organic fertilizers are the fertilizers with the biological origin and they are eco-friendly. Inorganic fertilizers are the fertilizers which are synthetic in origin. The use of chemical or inorganic fertilizers in the farmland caused the improvement in the economy and quantity of food crops. But the fact which was unseen for a long period of time is the effect on environment. Tremendous use of inorganic fertilizers resulted in the accumulation of salt in the soil and it in turn forced the plant to spend more energy to take the water from the soil and this may lead in the low yield or the complete wilting of plant (Liu *et al*., 2014).

So the technologist re-thought upon it and concluded that the traditional farming is good and it just need some advanced technology and not the chemicals alone. So a shift can be seen in the last few decades to the conventional organic farming. Organic farming can be designed as a system of farming in which the biological driven fertilizers are used to achieve the products which create an eco-friendly environment.The organic fertilizers play an important role in

enhancing the physical properties of the soil, like bulk density, microbial activities, water absorption and nutrient availability to the plant (Mohanty *et al*., 2006).

Nowadays, research is done in majority of the crops to find out the most suitable organic farming method. In the present project work we used tomato as our experimental crop which is an important vegetable in our day to day life. In the project work a comparative study on the effects of different organic fertilizers on the growth and yield of tomato is carried out.

Materials and methods

Plant material

Tomato (*Lycopersicon esculentum*. var. *anagha* Mill.) belongs to the family Solanaceae. The seeds of tomato were procured from Kerala Agricultural University, Mannuthy, Thrissur.

Methods

Preparation of rain shelter, potting and raising of seedlings

The rain shelter in the MES Asmabi college campus was used for the current research work. It was cleaned and made ready for the experiments. Polythene bags of 22x22 cm were used for the research. The bags were filled with different organic fertilizers and soil in 1:1 ratio. Controls were maintained with only soil as potting medium. The seeds of tomato were sown in seed germination trays with moistened coir pith. The seedlings of four leaves stage were transplanted to polythene bags. Plants were watered regularly.

Measurement of vegetative growth parameters

Shoot length of the seedlings at regular intervals (two weeks) was measured by using graduated scale. The numbers of nodes in the seedlings under different treatments were recorded periodically. The Samples (seedlings) were weighed using electronic balance. For fresh weight and dry weight measurements, the seedlings were blotted and wrapped separately in paper boats. Fresh weight of the samples was determined by weighing them immediately after wrapping. For dry weight measurements, the samples were kept in hot air oven at 100˚C. After 48 hours the samples were allowed to cooled and then weighed.

Measurement of reproductive growth parameters and yield

The major reproductive parameters which were analyzed include number of flowers, number of fruits and fruit weight. For counting the number of flowers and fruits, regular monitoring of the plants were made and the number of flowers and fruits were recorded at regular intervals (two weeks). The weight of the fruits was recorded with the help of an electronic balance.

Physiological and biochemical parameters

Various physiological parameters were measured by using standard protocols. Estimation of chlorophyll and carotenoids were done according to the method of Arnon (1949). The total soluble sugar content was estimated according to Dubois *et al*. (1956). Total protein content of the plant material was estimated using Folin–Ciocatteau reagent according to the method of Lowry *et al*. (1951).

Statistical analysis

Data from observations were recorded and analyzed in the Microsoft

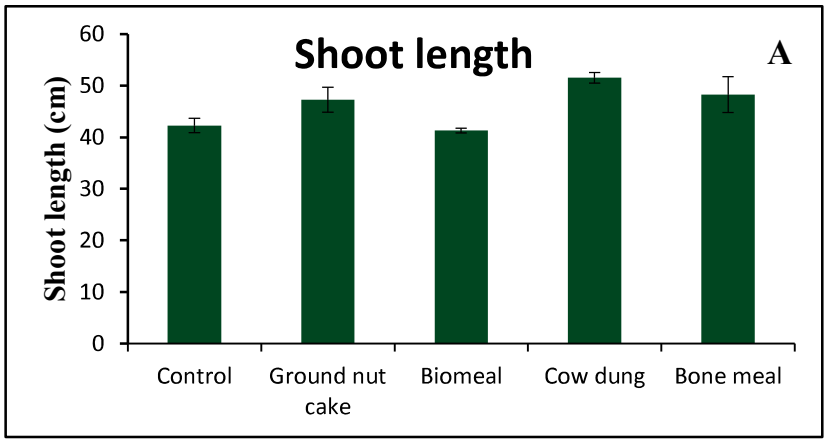
office excel sheet. Standard deviation and standard error were determined in the MS Excel programme.

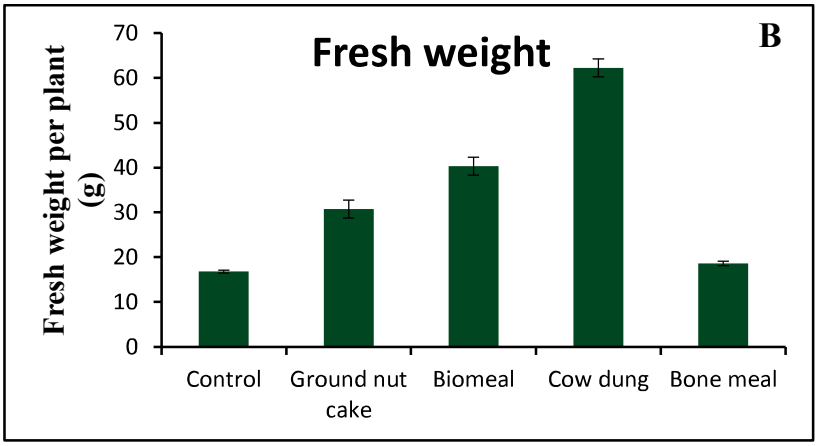
Results

Vegetative growth parameters

Shoot length, fresh weight and dry weight

The height of the plants showed considerable differences with different fertilizer application. The shoot length was found to be high in the plants which were grown in the biomeal when compared to the control (Fig. 1A). The fresh weight of the plants also showed significant variations among the treatments. Among the five treatments, the control plants and plants which were grown in bone meal showed almost same fresh weight and plants grown in cow dung showed high fresh weight compared to other three treatments (Fig. 1B). As in the case of fresh weight parameter, the dry weight of plants was found to be highest in the plants which were grown in cow dung (Fig. 1C).





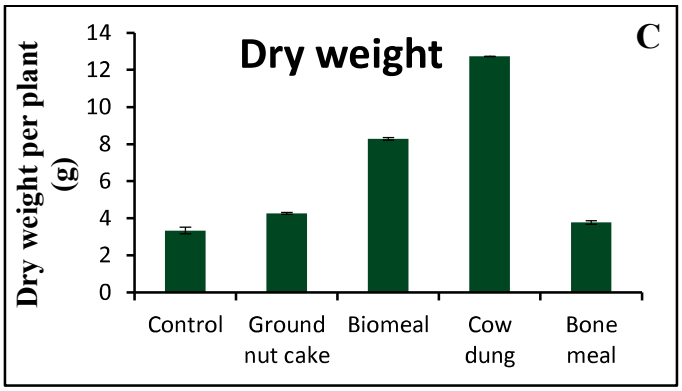


Fig.1: Shoot length (**A**), fresh weight (**B**) and dry weight (**C**) of tomato plants grown under different treatments (control, ground nut cake, biomeal, cow dung and bone meal). The vertical bars represent SE of the mean value of recordings from three independent experiments each with a minimum of three replicates.

Phenological characters

The number of flowers was counted at regular intervals and it was observed that the control plants produced least number of flowers when compared to other treatments. Among the treatments, plants grown in the ground nut meal showed highest number of flowers per plant (18 flowers/plant) followed by bone meal and cow dung grown plants (15 and 14 flowers/plant respectively) (Fig. 2A). It was also observed that the number of flowers was less in control ground nut cake and biomeal, whereas, the flowers in other two treatments resulted fruit setting (Plate 1).

Number of fruits

From the observations, it was noticed that most of the flowers were failed to set fruits. In the control plants, all the flowers failed to set fruits. In the plants subjected to treatment with fertilizers, it was observed that the cow dung treatment resulted in highest number of fruits. All other treatments showed same number of fruits per plant except control plants (Fig. 2B).

Weight of fruits

The weight of fruits were also analysed and it was observed that the fruit weight was highest in the case of tomato plants which were grown in cow dung, followed by the plants in bone meal, ground nut cake and biomeal. The maximum fruit weight measured was 28 g and it was in cow dung treatments (Fig. 2C).

Photosynthetic pigment content

As far as the photosynthetic pigment content was concerned, tomato plants which were grown in cow dung showed high total chlorophyll content (0.93mg/g fw) and the control plants showed least amount of total chlorophyll (0.41mg/g fw). The carotenoid content was found to be same in the control plants and the plants which were grown in cow dung (0.13mg/g fw) (Table 1).

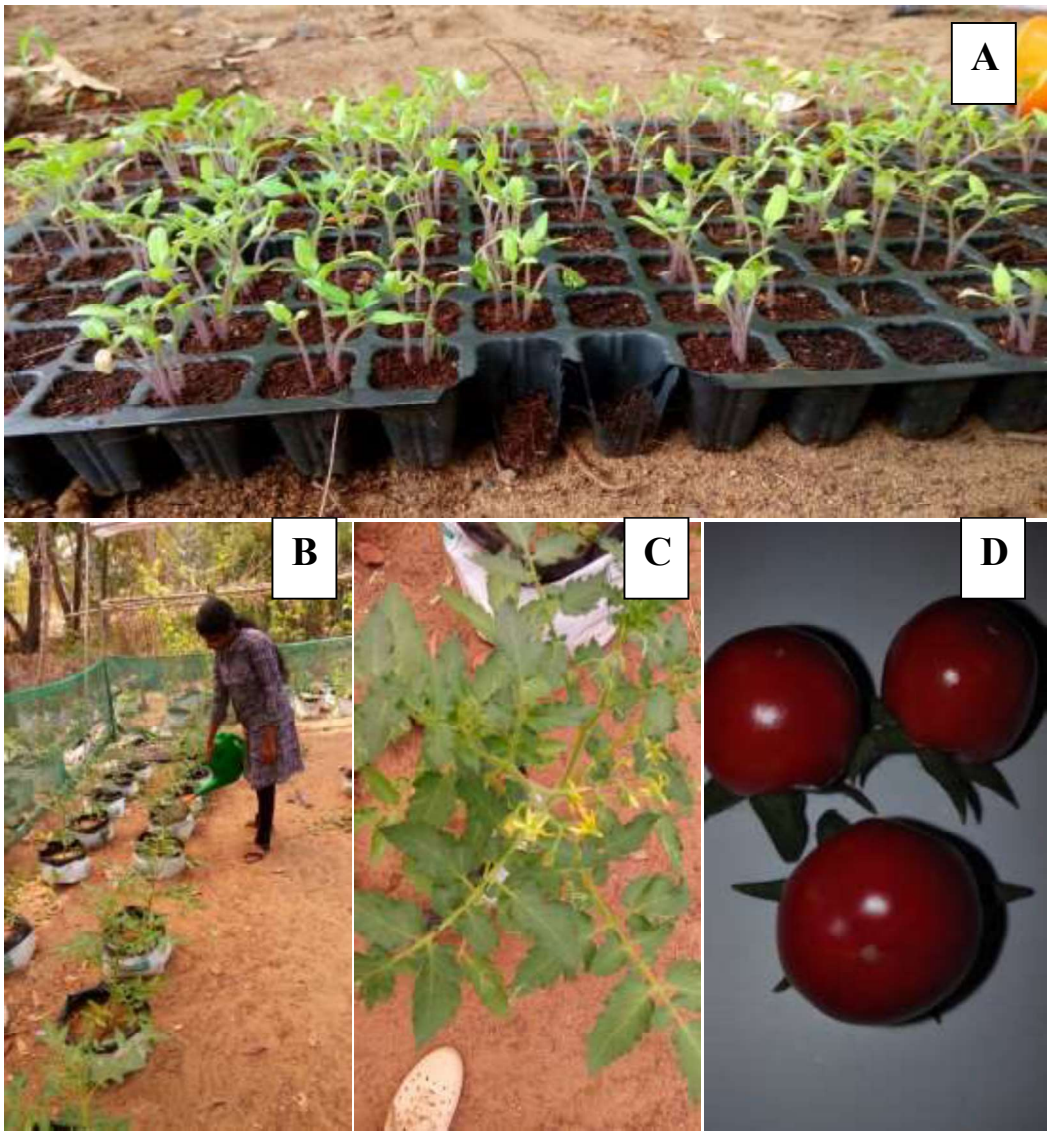
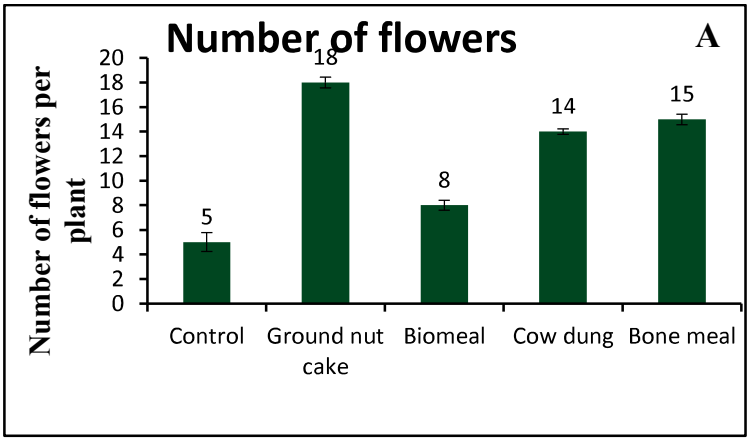


Plate 1: (**A**) Seedlings before transplantation, (**B**) Experimental set up, (**C**) Flowers, (**D**) Fruits



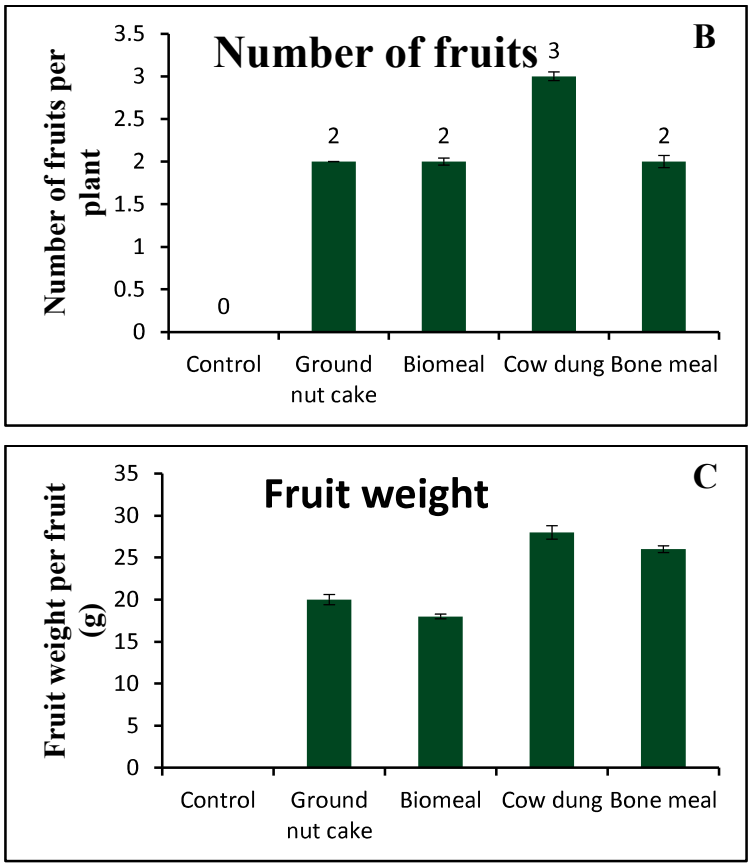


Fig.2: Number of flowers (**A**), number of fruits (**B**) andfruit weight (**C**) of tomato per plants grown under different treatments (control, ground nut cake, biomeal, cow dung and bone meal). The vertical bars represent SE of the mean value of recordings from three independent experiments each with a minimum of three replicates.

Chlorophyll a (mg/g dw)					***Chlorophyll b (mg/g dw)***				
Control	**T1**	**T2**	**T3**	**T4**	**Control**	**T1**	**T2**	**T3**	**T4**
0.25±0.06	0.43±0.01	0.43±0.06	0.50±0.17	0.40±0.07	0.16±0.02	0.44±0.12	0.42±0.08	0.46±0.05	0.34±0.05
Total chlorophyll (mg/g dw)					***Carotenoids (mg/g dw)***				
Control	**T1**	**T2**	**T3**	**T4**	**Control**	**T1**	**T2**	**T3**	**T4**
0.41±0.11	0.87±0.06	0.87±0.03	0.93±0.09	0.75±0.17	0.13±0.11	0.12±0.14	0.12±0.07	0.13±0.06	0.12±0.05

Table 1: Photosynthetic pigment content of tomato seedling leaves under control, and different treatments (T1-ground nut cake, T2-biomeal, T3-cow dung andT4- bone meal). The data is an average of recordings from three independent experiments each with three replicates (i.e. n=9). The data represent mean±standard error.

Total soluble sugar content

The total soluble sugar content showed significant variation among the different treatments. It was found that the tomato plants which were grown in cow dung showed highest total soluble sugar content (730µg/g fw) followed by plants in bone meal (522µg/g fw) and biomeal (475µg/g fw). Least amount of total soluble sugar content was obtained in control plants (Fig. 3A).

Total protein content

The total protein content also showed significant variation among the different treatments. It was found that the plants which were grown in cow dung showed highest total protein content (1576µg/g fw) followed by plants in bone meal (996µg/g fw) and ground nut cake (960µg/g fw). The control plants recorded least amount of total protein content (Fig. 3B).

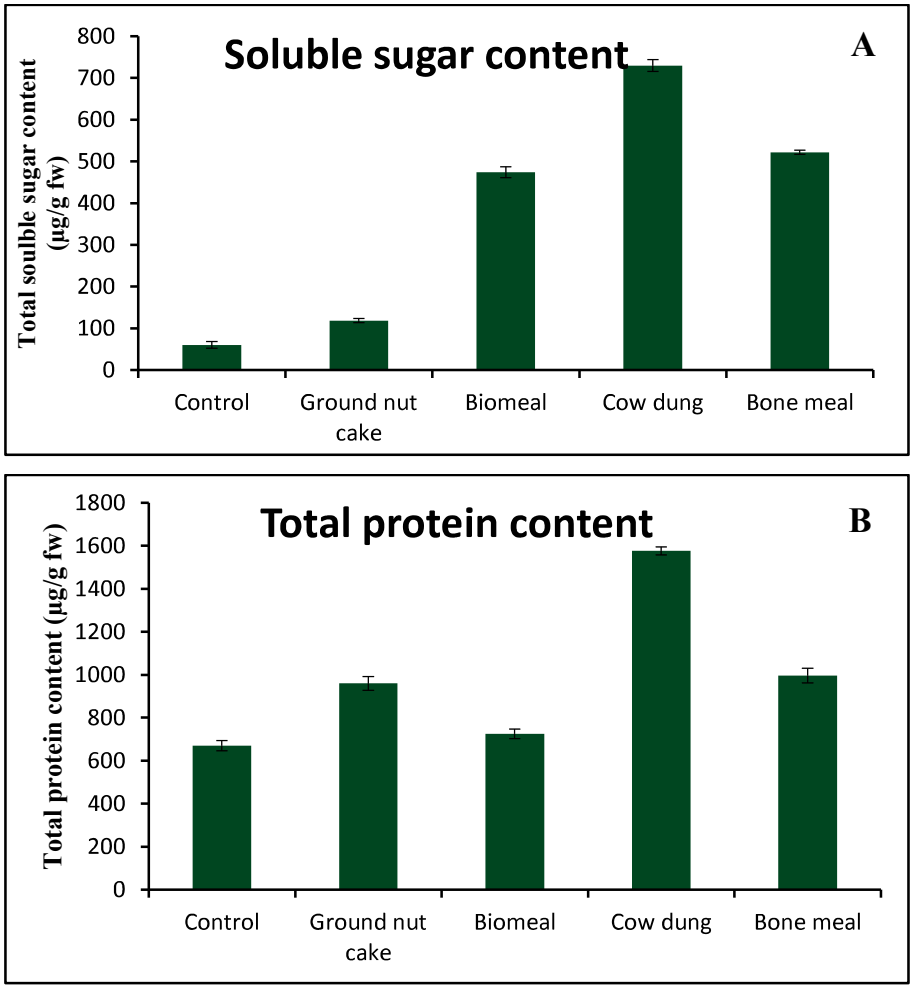


Fig.3: Total soluble sugar content (**A**) and total protein content (**B**) in tomato plants grown under different treatments (control, ground nut cake, biomeal, cow dung and bone meal). The vertical bars represent SE of the mean value of recordings from three independent experiments each with a minimum of three replicates.

Discussion

Nowadays, agricultural practices are shifting to organic farming. The most common easily available organic fertilizers in local areas are cow dung, bone meal, groundnut cake etc. These organic fertilizers are cheaper than the chemical one and is more eco-friendly. In an area like Kodugallur taluk, near to sea, fertility of the soil is minimum and the cultivation of crops is difficult. So, effective and good source of fertilizers is needed to have a high yield low production cost in agriculture.

The present study proves that the tomato grown in the cow dung fertilizer showed more vegetative and reproductive growth when compared to other fertilizers. The growth parameters indicate positive influence of cow dung on the growth of tomato plants and also showed that it was more efficient in providing nutrients for growth. Good yield was obtained from a single treatment alone and this result was previously published by Ehigiator (1998). In his work he concluded that organic manure alone or in combination with mineral fertilizer exerts more beneficial effect on fruit yield when compared to fertilizer applied alone.

Several workers (Heeb *et al.,*2005a; 2005b; Moccia *et al*., 2006 and Roberts *et al*., 2007) reported that the application of cattle manure alone or in combination with other organic fertilizers increases organic tomato yield comparable to that of inorganic fertilizers and the same result was obtained in the present study also. The yield of tomato obtained was minimum in the treatment and it can be improvised by using that application of composted cattle manure about 30 to 40 t/ha along with inorganic fertilizer which is proposed by, Hellemi and Azarovit (2002). Moreover, Adelana (1975) discovered that only 50% of the flowers produced developed into fruits in tomato. And this result gives an explanation to the present study result that all the flowers produced were not developed to fruits. Dauda *et al*. (2008) reported that the organic fertilizers improved the chemical and physical properties of soil which enhanced crop growth and development and in the present study also, the plant has shown comparatively high vegetative growth in organic manure and it agrees with the previous works. The higher growth recorded by plants grown in cow dung may be due to the elements present in the cow dung (Ram, 2017).

Summary and Conclusion

From the present study it was concluded that the different organic fertilizers showed different effects on the growth and yield of tomato plants. Moreover, among the different organic fertilizers used, cow dung was found to be the most suitable fertilizer for tomato. As evident from the results obtained. Cow dung is the cheapest and common organic fertilizer in agriculture. Thus our study again proves its agricultural importance. From the results it was also concluded that in an area like Kodungallur, which is a coastal area, cow dung is the most suitable organic manure for the cultivation of tomato and we recommend this manure for tomato cultivation.

References

Adelana, B.O. 1975. Effect of staking on growth and yield of tomatoes. *East African wildlife journal* 41: 243-249.

Arnon, D. I. 1949. Copper enzymes in isolated chloroplasts polyphenoloxidase in *Beta vulgaris*. *Plant Physiology* 24: 1-5.

Dauda, S. N., Ajayi, F. A. and Ndor, E. 2008. Growth and yield of water melon (*Citrullus lanatus*) asaffected by poultry manure application.*Journal of Agriculture and Social Science*4: 121–124.

Dubois, M., Gilles, K. A., Hamilton, J. K., Reber, P. A. and Smith, F. 1956. Calorimetricmethod for determination of sugars and related substances. *Analytical Chemistry*28: 350-356.

Ehigiator, J.O. 1998. Farmyard manure, needs for its adoption as an alternative to chemical fertilizers uses in Nigeria. *Nigerian Journal of Horticultural Science* 3:19-24.

Heeb, A., Lundegardh, B., Ericsson, T. and Savage, G. P. 2005. Effects of nitrate- ammonium- and organic-nitrogen-based fertilizers on growth and yield of tomatoes. *Journal of soil science and plant nutrition* 168: 123-129.

Heeb, A., Lundegardh, B., Savage, G. P. and Ericsson, T. 2006. Impact of organic and inorganic fertilizers on yield, taste, and nutritional quality of tomatoes. *Journal of soil science and plant nutrition* 169: 535-541.

Heeb, A., Lundegardh, B., Ericsson, T. and Savage, G. P. 2005. Nitrogen form affects yield and taste of tomatoes.*Journal of the food and agriculture* 85: 1405-1414.

Hellemi, D. O. C. and Azarovits, G. L. 2002. Effect of organic fertilizer applications on growth, yield and pests of vegetable crops.*Proceedings of the Florida state society* 115: 315-321.

Liu, C. W., Sung, Y., Chen, B. C. and Lai, H. Y. 2014. The effects of nitrogen fertilizers onthe growth and nitrate content of Lettuce. *International Journal of Environmental Research and Public Health* 11: 4427–4440.

Lowry, O. H., Rosebrough, N. J., Farr, A. L., and Randall, R. J. 1951. Protein measurementwith the Folin phenol reagent. *Journal of biological chemistry*193:265–275.

Moccia, S., Chiesa, A., Oberti, A. and Tittonell, P. 2006. Yield and quality of sequentially grown cherry tomato and lettuce under long-term conventional, low-input and organic soil management systems.*European Journal of Horticultural Science*71: 183-191.

Mohanty, S., Paikaray, N. K. and Rajan, A. R. 2006. Availability and uptake of phosphorus from organic manures in groundnut corn sequence using radio tracer technique.*Geoderma* 133: 225–230.

Ram, A.A. 2017. Effective use of cow dung manure for healthy plant growth International *Journal of Advanced Research and Development* 5:218-221.

Roberts, P., Jones, D. L and Edwards-Jones, G., 2007. Yield and vitamin C content of tomatoes grown in vermicomposted wastes. *Journal of the Scienceof the Food and Agriculture* 87: 1957-1963.

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