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**EFFECTS OF DIFFERENT FERTILIZERS ON GROWTH AND YIELD OF
OKRA (*Abelmoschus esculentus*) cv. HARITHA IN AMPARA DISTRICT OF
SRI LANKA**

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ABSTRACT

Organic agriculture techniques are the potential approach to reduce the bad effects on environment which can be eco friendly tactic and improve soil and environmental health. Okra (*Abelmoschus esculentus* L.) belongs to family Malvaceae, considered as one of the most important vegetable crop in Sri Lanka which needs good fertilizer management practices for the optimum production with less environmental hazards. Hence considering this a pot experiment was conducted during the period of January to April 2021 at the School of Agriculture, Palamunai, Sri Lanka to evaluate the different types of fertilizer over the practices of recommended chemical fertilizers in the growth and yield performances Okra. There were eight treatments as T1 (sand only-control), T2 (sand : poultry manure=1:1), T3 (sand : cow dung =1:1), T4 (sand : goat manure =1:1), T5 (sand: cow dung: poultry manure= 1:0.5:0.5), T6 (sand: cow dung : goat manure=1:0.5:0.5), T7 (sand: poultry manure: goat manure=1:0.5:0.5), T8 (sand: Department of Agriculture (DOA) recommended chemical fertilizer). Each treatments

contained ten replicates and the experimental units were arranged in Randomized Complete Blocked Design (RCBD) manner. Growth and yield variables were measured and statistically analyzed using SAS 9.1.3 statistical software. It was revealed that, there were significant ($p>0.05$) differences between the treatments on all the tested variables. Based on the results obtained recommended chemical fertilizer application showed statistically similar performances with poultry manure, combination of cow dung: poultry manure and combination of goat manure: poultry manure in most tested parameters on growth and yield basis. Therefore, it can be concluded that there is a potential to replace the recommended chemical fertilizers with poultry manure based fertilizer source for a sustainable organic production of okra.

INTRODUCTION

Fertilizers performs a key role among the cultural crop production practices. Over application of inorganic chemical fertilizers without adequate knowledge leads to the degradation of soil structure especially increased soil acidity. Furthermore, availability of high concentrated rapidly available nutrient content in inorganic fertilizers and which released for the plant uptake instantly, comparatively cost is high and cause nutrient imbalance and soil acidity (Akande *et al.* 2010). Organic manures possess the major plant nutrients in small quantities compared to the fertilizers and sufficiently have the growth promoting substances like enzymes and hormones, which build up the essential structure for improvement of soil fertility and productivity. The need for renewable forms of energy is the topmost concern and reduced cost of fertilizing crops is the profitable

approaches, both have revived the use of organic manures worldwide (Ayoola and Adeniran, 2006).

Physical and biological properties of the soil can be improved by application of manure which have micro and macro nutrients in available form (Abou El-Magd *et al.* 2006). Poultry manure is one of the excellent organic source which can supply macro and micro nutrients during mineralization which lead to increased organic matter content, enhanced soil texture, structure, aeration, moisture holding capacity and infiltration capacity of the soil (Akinrinde *et al.* 2006; Dekissa *et al.* 2008). Furthermore, poultry manure has the capacity to supplies phosphorous more easily available to plants compared to other organic sources. In another experiment by Abd El-Kader *et al.* (2010) indicated that poultry manure

increased okra yield and water use efficiency than composted plant residue.

To sustain the growth and development mainly Okra, it requires faster releasing nutritive amendments in soil. While concerning the negative side, integrated use of fertilizer becomes so popular to replenish the demand of readily available nutrients and form well quality soil. Integrated use of fertilizers enhance the crop productivity and sustain soil health and its nature character (Satyanarayana *et al.*, 2002). Rautaray (2003) stated that integrated use of organic wastes and chemical fertilizers helps to improve crop yield, soil pH, organic carbon and available N, P and K in sandy loam soil. This study aims to evaluate the effects of different types of Organic manures, and its combination with Recommended synthetic fertilizers in the growth and yield parameters of Okra to find out the best possible option to sustain the yield performances to sustain the market demand with the concerning of the health conditions.

METHODOLOGY

Experimental Location

The experiment was conducted at the School of Agriculture Palamunai. The soil type of the experimental area is classified as sandy. The altitude of this area is 30 meters above mean sea level and this area comes under the

Agro Ecological Zone of Low Country Dry Zone of Sri Lanka.

Preparation of pots

The experiment was conducted using polythene pots sized 14" x 14" diameter and height. Holes were made at the bottom of each pot to facilitate the drainage of water. The pots were filled with sand and media based on the other treatments.

Planting of seeds

Okra variety Haritha was used for this study and a quantity of 70g of okra seeds were collected from school of agriculture, Palamunai, Sri Lanka. Seeds of Okra were sown at the rate of 3 seeds per hole and a depth of about 1- 2cm depth. Thinning out was done after two weeks and one plant was maintained per each pot thereafter. Each pot was arranged with the spacing of 90cm * 60cm as recommended by Department of Agriculture, Sri Lanka. Watering was done continuously in early days of emergence. Then watering was practiced once in two days during the growing season.

Treatment structure

The experiment consisted of eight treatments and ten replications. The treatments were as follows;

T1 (sand only-control)

T2 (sand: poultry manure=1:1)

T3 (sand: cow dung =1:1)

T4 (sand: goat manure =1:1)

T5 (sand: cow dung: poultry manure= 1:0.5:0.5)

T6 (sand: cow dung: goat manure=1:0.5:0.5)

T7 (sand: poultry manure: goat manure=1:0.5:0.5)

T8 (sand: DOA recommended chemical fertilizer)

The experimental units were arranged in Randomized Complete Block Design (RCBD) manner.

Data collection

Germination percentage was calculated at 2nd week. Plant height and number of leaves were measured at 4 weeks interval, days taken for 50% flowering was recorded at flowering stage, stem weight, root weight, pod length and yield were measured at harvesting stage.

Analysis of data

The collected data were statistically analyzed using ANOVA procedures and significant differences between the treatments were compared using DMRT at 5% significance level.

RESULTS AND DISCUSSION

Plant Height

Data regarding plant height are given in Table 1. Results revealed that there were significant ($p < 0.05$) differences among the treatments on plant height throughout the

experiment. Highest plant height was observed in recommended chemical fertilizer application and it was followed by T2, T5 and T7 respectively during initial days and later not significant higher values were observed in T8, T2 and T5. The lowest performances were shown by T1 where no any fertilizers were added. It confirms that addition of poultry manure and combination of cow dung and poultry caused comparable effects on plant height at later stages to the results obtained from conventional fertilizers (recommended chemical fertilizer application in Okra. Incorporation of goat manure with soil was not performed well in Okra plants. It might be the available forms of nutrients less in goat manure within a shorter period of time compare to other types of manure. Several researches also were in agreement with the present study (Agboola and Omueti, 1982; Agboola and Obigbesan, 1975; Okwuagwu *et al.*, 2003; Agboola and Fagbenro, 1985). The present advantageous effects of organic manure on plant height could be due to the influence of manure to enhance the fertility status of the soil. Decomposing of manure increased both macro and micro nutrients as well as improved the physico-chemical properties of the soil (Tiamiyu *et al.*, 2012). This could have led to its high vegetative growth).

Further the studies by Tihamiyu *et al.*, (2012) mentioned that, there was a non-significant difference observed with no manure application when supply sheep and cow manure for okra as treatments could be either there were presence of some nutrients in the soil or the plants need were fulfilled with the already available nutrients in the soil. The study was further suggested that, Okra grown on poultry manure showed better

performances in plant height than other tested manures. It suggested that, the available nutrients in the poultry manure is easily available for plant growth. Furthermore, the obtained results were in agree with the finding of Ajari *et al.*, (2003) in okra. They reported that, poultry manure could increase plant height of crops when compared with other sources of manures.

Table 1: Effects of different fertilizers on plant height, number of leaves and stem girth of Okra (*Abelmoschus esculentus*) cv. Haritha at 4th and 8th weeks after sowing

Treatment	Plant height (cm)		No. of leaves	
	4 th WAS	8 th WAS	4 th WAS	8 th WAS
T1	8.53±0.43 ^f	18.27±0.72 ^c	5.10±0.18 ^c	6.30±0.15 ^c
T2	18.53±1.12 ^b	62.09±5.49 ^a	6.60±0.17 ^a	9.40±0.34 ^{ab}
T3	9.41±0.44 ^{ef}	41.22±2.14 ^c	5.40±0.22 ^{bc}	7.90±0.26 ^d
T4	8.97±0.50 ^{ef}	29.55±1.58 ^d	5.10±0.18 ^c	6.70±0.26 ^c
T5	14.23±1.17 ^c	55.74±5.31 ^{ab}	5.70±0.21 ^b	8.80±0.13 ^{bc}
T6	11.06±0.84 ^{de}	37.81±2.20 ^{cd}	5.40±0.22 ^{bc}	7.80±0.33 ^d
T7	12.65±0.76 ^{cd}	46.94±2.76 ^{bc}	5.40±0.17 ^{bc}	8.10±0.26 ^{cd}
T8	21.09±0.60 ^a	66.83±5.97 ^a	6.80±0.13 ^a	10.0±0.26 ^a
Sig	*	*	*	*

Values represent mean± standard error of ten replicates. Means followed by the same superscripts in a same column are not significantly different at 0.05 probability level according to DMRT. ‘*’ and ‘ns’ represents significant at P<0.05 and not significant, respectively; WAS – Weeks After Sowing

Number of leaves

Average numbers of leaf per plant of the treatments at different periods are given in Table 1. Throughout the experiment, the results showed that there were significant differences ($p < 0.05$) among the treatments due to the application of different fertilizer sources. Higher number of leaves were observed in T8 and T2 during 4th and 8th weeks after planting. Lowest values were observed where no any fertilizer sources

added to the sand. As mentioned by Adhikari and Piya (2020), there was significant impact on number of leaves of okra due to different nutrient sources and maximum number of leaves per plant was observed in poultry manure application. The significant lowest number of leaves per plant was recorded in control treatment where no any manures applied. Further the chemical fertilizer application showed intermediate and not significant effect with Farm Yard Manure

and goat manure. Tindall (1992) reported that, increased number of leaves was observed with application of organic fertilizers and it confirmed the its importance on plant growth. Experiments of Akanbi *et al.*, (2000) revealed that, plant vegetative growth is determined by availability of nutrients especially nitrogen.

Stem weight

Data regarding the effect of treatments on average stem weight is given in Figure 1. The stem weight significantly differs ($p < 0.05$) among the treatments. Application of recommended chemical fertilizer (T8) showed significantly increased stem weight. It followed by T2 and T5, while the minimum stem weight was recorded in T1 where no fertilizers were added. Shahriazzaman *et al.*, (2014) observed the significantly varied fresh weight of okra plant with different organic manure application. However, highest fresh weight was observed in poultry manure application and lowest was found in no application of manures. Further experiment of Nwanne *et*

al., (2020) mentioned that, poultry application manure produced the tallest plants with highest number of leaves and branches which lead to the higher fresh weight of plants. Least values in all vegetative parameters were recorded in control plots where no manures applied which is because of low soil nutrient content. The results were in agreement with the experiment conducted by Senjobi *et al.* (2010) indicated that, use of organic manures such as poultry manure, cow dung, goat manure and pig manure improved all the tested growth parameters of leaf vegetables. They also help in better nutrient recycling in soil (Elshakweer *et al.*, 1998). Further the results were in consistent with Adewole and Ilesanmi (2012) that, application of inorganic fertilizers leads to soil degradation, increased soil, imbalance in nutrients and reduced crop growth and yield. At the same time, application of organic manures encourages microbial activity and the gradual release of nutrients over time.

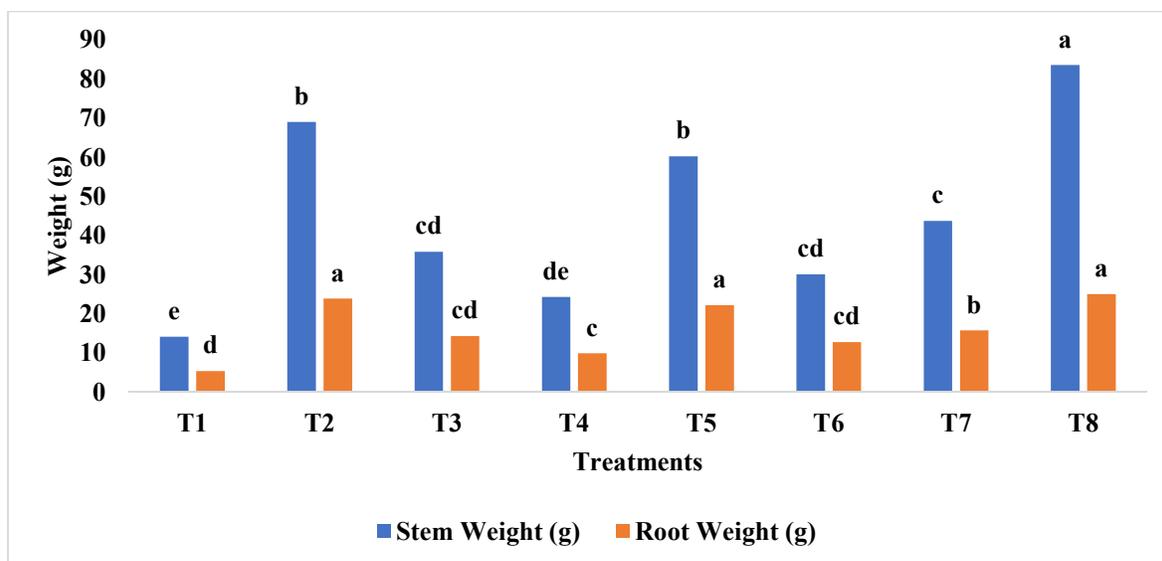


Figure 1: Effects of different fertilizers on stem and root weight of okra (*Abelmoschus esculentus*) cv. Haritha

Root weight

Results obtained on root weight showed significant ($p < 0.05$) differences among the applied fertilizer treatments. Data regarding average root weight are given in figure 1. The higher values in average root weight were recorded in T8, T2 and T5 not significantly while the minimum average of root weight was observed in okra plants not treated with any fertilizer (control). In this present investigation, plants received with poultry manure produced the highest root weight as conventional fertilizer application. Root is the most important part of the plant. when the nutrient availability increases, the root growth affinity will increase, thus organic manure application act as stimulant for supply for crop nutrients during the

period of microbial decomposition and make the crop to utilize nutrient and water more efficiently under light textured loamy sand soil (Singh and Ram, 1982). Moreover, increasing values of growth parameters under FYM treatment could be due to increase availability of Nitrogen, Phosphorus and Potassium to the plants initially through FYM. Kannan *et al.* (2006), Premsekhar and Rajashree (2009) and Sharma and Choudhary (2011) also reported that the organic manures increased the plant growth parameters of tomato and okra. John *et al.*, (2004) reported that, application of poultry manure related to the enhanced photosynthesis which promotes root and shoot growth. It is in agree with the studies of Dauda *et al.*, (2008).

Days taken for 50% of flowering

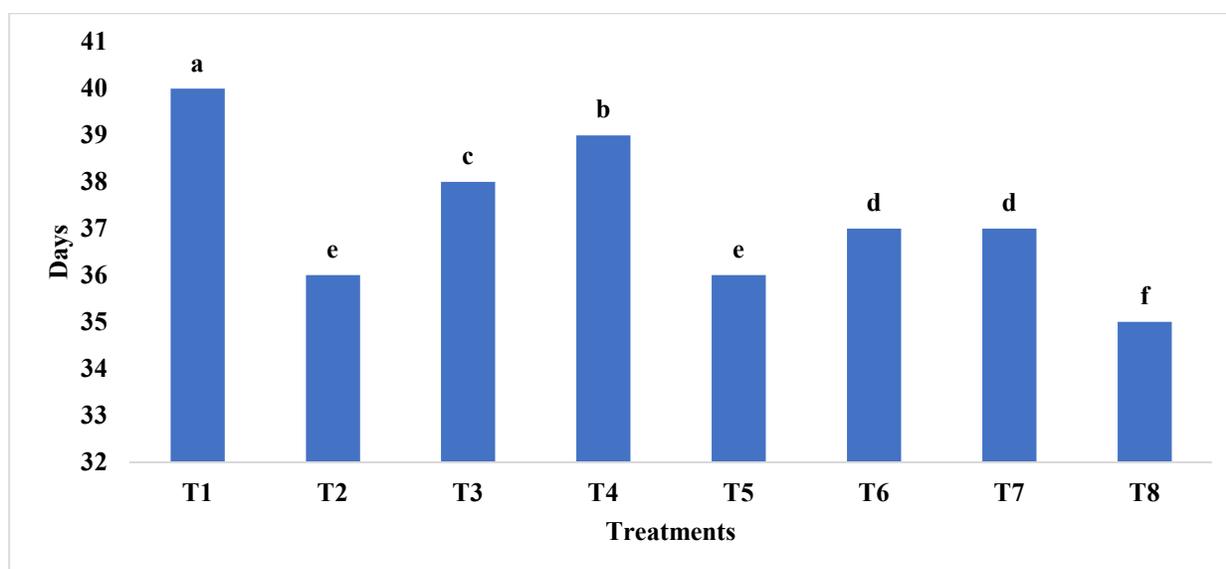


Figure 2: Effects of different fertilizers on days taken for 50% flowering of okra (*Abelmoschus esculentus*) cv. Haritha

Figure 2 showed the number of days to taken to produce 50% of flowering. The results showed that there were significant ($p < 0.05$) differences among the treatments in mean number of days taken. The lowest mean number of days taken to reach 50% of flowering recorded in T8 and it was followed by T2 and T5 while highest number of days in taken in okra which did not receive any fertilizers, control. The data revealed, poultry

manure application had a comparable effect on the mean number of days taken to reach 50% of flowering next to conventional fertilizer. As mentioned by Shahriazzaman *et al.*, (2014), early flowering was found from vermicompost which was statistically identical with poultry manure) while late from no manure application.

Pod length

Table 2: Effects of different fertilizers on pod length (cm) of Okra (*Abelmoschus esculentus*) cv. Haritha up to 5th harvest

Treatment	1 st harvest	2 nd harvest	3 rd harvest	4 th harvest	5 th harvest
T1	12.83±0.33 ^c	12.37±0.27 ^c	12.12±0.27 ^c	8.31±1.82 ^c	0.00±0.00 ^d
T2	15.41±0.89 ^{bcd}	15.58±0.90 ^{ab}	14.80±0.71 ^b	15.49±0.71 ^a	13.07±1.52 ^{abc}
T3	14.07±0.89 ^{cde}	15.11±0.78 ^b	14.38±0.57 ^b	14.48±0.71 ^{ab}	10.77±1.85 ^{bc}
T4	13.39±0.70 ^{de}	13.86±0.63 ^{bc}	13.38±0.59 ^{bc}	12.45±0.64 ^b	4.32±1.93 ^d
T5	16.36±0.85 ^{ab}	15.66±0.91 ^{ab}	15.17±1.15 ^{ab}	14.96±0.59 ^{ab}	14.30±0.92 ^{ab}
T6	15.59±0.90 ^{bc}	15.11±0.92 ^b	15.16±0.91 ^{ab}	14.80±0.96 ^{ab}	8.92±2.57 ^c
T7	16.18±0.62 ^{bc}	15.73±0.77 ^{ab}	14.80±1.01 ^b	14.74±0.85 ^{ab}	12.80±1.52 ^{abc}
T8	18.33±0.50 ^a	17.81±0.49 ^a	17.07±0.42 ^a	16.94±0.30 ^a	15.62±1.18 ^a
Sig	*	*	*	*	*

Values represent mean± standard error of ten replicates. Means followed by the same superscripts in a same column are not significantly different at 0.05 probability level according to DMRT. ‘*’ and ‘ns’ represents significant at $P < 0.05$ and not significant, respectively.

Data recorded on average pod length per plant is represented in table 2. The response of average pod length per plant to different treatments were significant ($p < 0.05$) up to 5th harvest. Higher values in pod length was recorded in T8, T5, T2 and T7. As revealed by Adhikari and Piya (2020), there was a significant influence of different nutrient sources on fruit length and the highest fruit length was observed in poultry which was having statistically not significant with application goat manure and also chemical fertilizer. Further, Shahriazzaman *et al.*, (2014) indicted that, application of poultry manure produced the longest pod length which was statistically not significant with vermicompost and the lowest pod length was recorded in control. Several researchers mentioned that, incorporation of poultry

manure enhance the soil chemical properties such as total Nitrogen, soil pH, organic matter, available Phosphorus, cation exchange capacity and exchangeable (Akande *et al.*, 2003; Cooper and Warman, 1999; Ano and Agwu, 2006).

Ofofu-Anim *et al.*, (2006) reported that, significant pod length was observed between the treatments manure application and control. Further, application of poultry manure showed longest length of pods may be due to variations in soil fertility and structure. The increase plant available nutrients in the soil and water holding capacity of the soil in manured plots might have supplied further support to the plants (Tisdale and Nelson, 1978; Agarwala *et al.*, 1981) for its yield attributes.

Yield

Table 4: Effects of different fertilizers on yield plant height, number of leaves and stem girth of Okra (*Abelmoschus esculentus*) cv. Haritha up to 5th harvest

Treatment	Yield / Pot (g)
T1	40.2±0.5 ^c
T2	99.5±1.24 ^{ab}
T3	72.9±1.18 ^{cd}
T4	57.2±1.26 ^{de}
T5	104.9±1.45 ^a
T6	83.2±1.38 ^{bc}
T7	111.7±1.57 ^a
T8	113.7±1.27 ^a
Sig	*

Values represent mean± standard error of ten replicates. Means followed by the same superscripts in a same column are not significantly different at 0.05 probability level according to DMRT. ‘*’ and ‘ns’ represents significant at $P < 0.05$ and not significant, respectively.

Yield is the main aim of okra production since pod influence is essential on the final yield. It was found that there were significant

differences ($p < 0.05$) among the treatments on okra yield. The yield recorded per pot is indicated in table 4. Okra plants received T8,

T7, T5 and T2 as treatments showed not significant higher values in yield. Lowest yield was recorded in treatment where no any fertilizer added.

The increase in fresh pod weight leads to the higher yield of okra due to the application of poultry manure caused easy solubilization plant nutrients leading to enhanced water holding capacity and nutrient status of the soil. Further the current results were in agreement with the findings of Premsekhar and Rajashree (2009) in okra, that the enhanced yield of crop due to application of organic manure could lead to improved soil physical and biological properties which resulted improved supply of soil nutrients to crops. Moreover, it confirmed the findings of Akande *et al.* (2003) that organic manure application could enhance the characters of soil which could lead to improved crop production. Organic fertilizer plays a major role as a plant nutrient. It also behaves as a buffering agent against the pH fluctuations. (Adepetu and Corey, 1975). Adhikari and Piya (2020) indicated that, the maximum yield in Okra was recorded in poultry manure which was statistically at par with chemical and goat manure whereas the significantly minimum yield was recorded in control.

CONCLUSIONS

Application of organic fertilizers showed higher competent with recommended chemical fertilizers in most of the growth and yield parameters since the organic manure application has a potential to apply instead of chemical fertilizers to get optimum production and yield of Okra cultivar Haritha. Application of poultry manure alone showed not significant highest values with DOA recommended chemical fertilizer application in most of the parameters. In case of yield, application poultry manure alone, cow dung in combination with poultry manure and goat manure has showed not significant optimum value with conventional fertilizer application. It can be concluded that, chemical fertilizers can be successfully replaced with the organic manures such as poultry manure alone or in combination with cow dung or cow dung mixed with the goat manure to get an optimum yield of cv Haritha which is an environmentally friendly strategy in crop production practices.

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