



Growth and yield performance of red *Okra* (*Hibiscus esculentus* L.) applied with different organic commercial foliar fertilizer

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Abstract

The study was conducted to determine the effect of different foliar fertilizers on the growth and yield performance of red okra and specifically, the study aimed to determine the response of red okra in terms of: plant height (cm), number of fruits, length (cm) of fruits, weight (g) of fruits per plant; the yield in (kg) per hectare and return on investment. The Randomized Complete Block Design (RCBD) was used in the study with four treatments and replicated four (4) times. The experimental treatments were as follows: T₁ (control); T₂ (Golden crop multi-NPK 12-2-44); T₃ (Malago solid foliar fertilizer); and T₄ (Yield master-crop growth enhancer 15-15-30+ME master). The result of the study did not show significant differences in plant height, but significantly different in terms of number of fruit, length of fruit, yield per hectare weight of fruits and yield per hectare sprayed with different foliar fertilizers was observed. Results of the study on plants sprayed with Foliar 3 (15-15-30+ME) T₄ produces the longest average length (cm), heaviest weight (g) of fruits, and highest in yield per hectare and with the highest return on investment of 168.73%. The result of the study, on the application of foliar fertilizer Yield master-crop growth enhancer 15-15-30+ME to red okra is recommended to farmers within the locality. However, similar study using other vegetable crops should be conducted for more reliable and conclusive results.

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Introduction

Okra scientifically known as *Hibiscus esculentus* Li is a tall growing, warm season and annual vegetable crop. Green okra is mostly popular and profitable vegetable in the country. The young and tender fruits can be prepared as salad, boiled, or fried and can be mixed in many meat and fish dishes. It is also an important vegetable mix of the famous Ilocano dish, *pinakbet*. Okra is rich in vitamin A, C and B complex, protein, calcium, fats potassium, phosphorus, iron and carbohydrates. Today, red *okra* is also available in the market.

Red *okra* is torpedo shaped and two to five inches long. Offering a unique flavor and texture, the fresh taste is somewhere between eggplant and asparagus, when cooked. However, the red color disappears and the pods turn green. But raw red okra adds a colorful touch. It provides a good source of vitamin C, vitamin A, folacin and other B vitamins plus magnesium, potassium and calcium. It is fat-free, saturated-fat-free, cholesterol-free and low in calories (<https://www.specialtyproduce.com>). Today, our country is experiencing economic crisis specifically in agriculture sector. The price of organic fertilizer as well as other agricultural supplies had increased tremendously. Thus, most of the time our farmers cannot afford to provide the needed of farm inputs.

One way to increase yield is the application of fertilizer. However, with the increasing price of inorganic fertilizers in the market nowadays, there is a need to find ways and means to lessen cost of fertilizer inputs, thus the practice of organic farming. According to Corpuz (1996) the use of organic liquid fertilizer on vegetable has no effect on the height of plant. But foliar fertilizer is believed to be readily absorbed right at the site where they are used as quick fast acting, whereas much of the soil applied with fertilizer may never be used by plants. The 80% of the phosphorous may get fixed up in the soil. Added phosphorous are directly absorbed by the plants. (<http://www.cababastractplus.org/abstract.aspx>)

Organic fertilizer has been proven to be more advantageous than the inorganic fertilizer, in some

aspects. Organic fertilizer improves physical condition of the soil because of its excellent nutrients. Organic foliar fertilizer is tested and proven to enhance the growth and development of the plant. This is one way to increase quality yield for our farmers. Proper application of foliar fertilizer tends to give high yield of crops base from the recommendation. It is highly acceptable for farmers because the nutrients carried by foliar fertilizer that the result to higher rates of production in terms of quality as well as the quantity of the harvested crops. Foliar fertilizers are highly recommended for the growing crops to enhance its growth and development. Under Lal-lo condition, no attempt has been made to plant red okra applied with organic fertilizer, thus this study.

Generally, the study aimed to determine the effect of different foliar fertilizers on the growth and yield performance of red okra. Specifically, it aimed to find out the effect of different foliar fertilizer in production of red okra in terms of the following parameters: (a) plant height (cm); (b) number of fruits per sample plants; (c) average length (cm) of fruits; (d) average weight (g) of fruits per sample plants; (e) computed yield (in tons per hectare and (f) Gross margin analysis.

Materials and methods

Experimental Design and Treatments

The Randomized Complete Block Design (RCBD) was used in the study. A field with a total area of 414 sq m (18m x 23m) including spaces between blocks and plots was divided into four (4) equal blocks to represent the four (4) replications. Each block was divided into four (4) equal plots to represent the four (4) treatments and each plot has a dimension of (3.75m x 5m). The experimental treatments were labeled as follows: T₁- unsprayed (control); T₂-Foliar 1; T₃-Foliar 2; and T₄-Foliar 3.

Cultural Management

All package of technology for okra production were followed, *i.e.*, from seeds to planting, fertilizer application, thinning, irrigation and inter cultivation and harvesting.

Securing the seeds

The red okra seed was secured at Cagayan State University Lal-lo campus, college of agriculture.

Preparing the Land

A land with a total area of 414 sq. m was thoroughly plowed and harrowed three (3) weeks before planting. Then final lay out was done and furrows was dug at a distance of 30cm between hills and 75cm between furrows.

Applying Fertilizer

A basal application of recommended decomposed commercial bio-organic fertilizer was uniformly applied before planting. The application of foliar fertilizer was based on the recommended amount on the product used and was applied from vegetative stage up to flowering. Spraying of foliar fertilizer was done at 7 days interval at the rate of 2tbs per 16 liters.

Planting the seeds and thinning

Two to three seeds per hill were planted and covered with pulverized soil at about two (2) to three (3)cm. The distance of planting was 75cm x 30cm. A week after seedling emergence, thinning was done by leaving two healthy plants per hill.

Watering the plants

Watering the plants was done twice a week or as the need arises.

Cultivating and weeding

Hilling up was done 14 days after seed emergence by honing in between furrows to suppress the emergence of the weeds. Finally, hilling up was done 42 days after emergence or one month after. Weeding was done as the need arose throughout the duration of the study to minimize competition of light soil moisture and nutrients.

Harvesting

Harvesting of the immature fruit was done 10 days after flowering and every other day thereafter to obtained higher yield. Harvesting was done in the morning. Sample fruits were harvested first and separated for data gathering.

Marketing

The harvested red okra fruits were sold at the public market, students, faculty and staff of the Campus at the prevailing price in the locality.

Data gathered

The following parameters were observed and gathered; (a.) Plant height(cm), of which the height of the plants was determined by measuring the base to the tip most part of the ten (10) sample plants at 15 days interval from the. This was started one (1) month after planting; (b) Number of fruits, this was taken by counting all the fruits per sample plants from first harvesting to third harvesting; (c) Length (cm) of fruits, of which the length of fruit was determined by measuring the length of an harvested fruit from the base to the tip using a foot rule then it was divided by number of fruit measured; (d) Weight of fruit, this was obtained by weighing all the fruits harvested per sample plants divided by 10; (e) Computed Yield per hectare, the yield were taken per plot basis in an area of 18.75 sq. (3.75mx5m) which were weighed and adjusted in a hectare basis using the formula : Yield in Kg per hectare =(Yield per plot (kg) x Area/hectare)/Area per Plot; and (f) Return on Investment (ROI) was computed by determining the Cost of farm inputs (Variable Cost) based on the current prices. The total expenses was subtracted from the gross income to get the net income. The cost and return on investment was computed per treatment, as follows: $ROI = \frac{\text{Net Income}}{\text{Total Cost of Production}} \times 100$.

Analyzing the data

The data gathered were analyzed using the Analysis of variance (ANOVA) in the Randomized Complete Block Design (RCBD)

Result and discussion*General Observation*

The red okra seeds started to emerge three days after transplanting. Forty six (46) days after planting 50% of the Red okra plants flowered and were sprayed with foliar fertilizers per treatment. During the vegetative stage, minor damage of the leaf was

observed caused by cut worm. Aside from this, some plants were also infected by aphids especially in T₁ (control) however this was controlled through physical method of controlling pest. Fifty (50) days after planting, red okra fruits were harvested and gathering of data was immediately done.

Plant height, number of fruits per sample plant, average length of fruits per sample plants (cm), weight of fruits (g) per sample and computed yield per hectare (kg) of red okra sprayed with different organic commercial foliar fertilizers are presented in Table 1.

Table 1. Mean Plant height (cm), Mean Number of fruits , Mean length of fruits (cm), Mean weight of fruits (g) and Computed yield per hectare by red okra plant sprayed with different foliar organic commercial fertilizers. Cagayan State University, Lal-lo, Cagayan.

Parameter	Treatment				0.05% Level of significance
	T ₁ (Control)	T ₂ -Foliar 1	T ₃ -Foliar 2	T ₄ -Foliar 3	
Mean Plant height(cm)	40.10	40.91	40.70	44.00	ns
1st harvesting	20.73	20.65	22.13	21.45	
2 nd harvesting	48.3	47.84	47.39	54.91	
3 rd harvesting	51.25	54.23	52.56	55.66	
Mean Number of fruits	5.81	6.71	6.49	6.67	ns
1st harvesting	5.31	6.21	6.00	6.17	
2 nd harvesting	5.51	6.41	6.40	6.47	
3 rd harvesting	5.71	6.61	6.60	6.67	
Mean length of fruits (cm)	6.46	6.96	6.84	7.00	ns
Mean weight of fruits (g)	250.58 b	310.83 a	319.16 a	332.50 a	*
Computed yield ^{-ha}	336.00 c	445.17 ab	377.25 bc	461.00 a	*

*Means with the same letter in a row are not significantly different

Plant height

The plant height of red okra sprayed with different organic commercial foliar fertilizers shows that the plants sprayed with Foliar 3 (T₄) produced the tallest plant height with the mean of 44cm followed by plants sprayed with Foliar 1 (T₂) with the mean of 40.91cm followed by plants sprayed with Foliar 2 (T₃) with the mean of 40.70cm while plants did not received foliar fertilizer (T₁) produced the least height with mean of 40.10cm only. Analysis of variance (ANOVA) reveals that the average. Plant height was not significantly affected by the different foliar fertilizer. This result is the same with the study of Corpuz 1991 that the used of liquid fertilizer on bush sitao revealed no significant differences observed among the treatments on plant height.

Number of fruits per sample plant

The average number of fruits sprayed with different foliar fertilizers shows that the red okra plants sprayed with Foliar 1 (T₂) produced the most number of fruits with a mean of 6.71. It was followed by plants sprayed with Foliar 3(T₄), Foliar 2 (T₃) and control (T₁) with a mean of 6.67, 6.49and 5.82 respectively.

This finding means that spraying of foliar fertilizers influenced the number of fruits production in Red okra. Hence, the analysis of variance showed significant variations among the treatments evaluated. This corroborated with the study of Galura *et al.*, in 1991, that the Green bee (8-18-16) foliar fertilizer, increases fruits, because of containing all the essential primary, secondary and trace elements. Moreover, number of days to flowering were reduced when okra was fertilized with chemical fertilizers along with foliar fertilizers, thus the number of developed fruits was lesser in non-treated okra plant (Abbasi *et al.*, 2010).

Average length of fruits per sample plants (cm)

The average length of fruits per sample plants shows that the plant sprayed with Foliar 3 (T₄) produced the longest fruits with a mean of 7.00cm and followed by plants sprayed with Foliar 1 (T₂). Foliar 2 (T₃) and control (T₁) with a mean of 6.96cm, 6.94cm, and 6.46cm respectively. The analysis of variance (ANOVA) reveals that the lengths of fruits were not significantly different.

Weight of fruits (g) per sample

The weight of fruits per treatment shows that plants that produced the longest fruits (Foliar 3), produced the heaviest fruits with a weight of 332.50g followed by Foliar 2 (T₃), Foliar 1 (T₂) and control (T₁) with a mean of 319.16g, 310g,250.58g respectively. It further shows that the plants sprayed with different organic commercial fertilizer are better than the unsprayed plants in terms of the weight of fruits. It might due to the advantages of foliar fertilizers quickly deliver the nutrients to the tissues and organs of plants. It contains various macro and micro nutrients, which are essential for the proper growth and yield of the plant. (<http://www.honnfl.edu.vegetarian>).

The results corroborates with the study of Capinia (2010), where the growth and yield performance of bush sitao as influenced by different levels of foliar fertilizer (Florida Green), Capinia (2010) showed that the different levels of foliar fertilizer significantly influence the growth and yield performance of bush sitao. It was observed that the highest level of foliar fertilizer sprayed on the crops significantly distributed to the higher pod yield. This was due to the production of more and longer pods per hill. An increase in the level of application of foliar fertilizer resulted also to an increase in the production of green pods. This observation proves that the different levels of foliar fertilizer exhibited some degree of effects on the growth and yield performance of bush sitao.

Computed yield per hectare (kg)

Results of the yield of red okra in kilograms per hectare reveals that crops sprayed with Foliar 3 (T₄) produced the highest yield with a mean of 461.00 g followed with crops sprayed with Foliar 1 (T₂) with a mean yield 445.17, followed with Foliar 2 (T₃) with a

mean yield of 377.25, The lowest yield was obtained in (T₁) control with the mean of 336.00 The analysis of variance (ANOVA) shows Foliar 3 (T₄) is significantly different with Foliar 1 (T₂), and it is better than Foliar 2 (T₃), and control (T₁) is not significantly different with Foliar 1 (T₂). Shows that using foliar fertilizer produced higher yield, because of the various macro and micro nutrients it contain. (<http://www.honnfl.edu.vegetarian>). This is in consonance with the claim that foliar fertilization not only improves plant growth traits, crop yields and nutrient uptake by crops but also enhances nutrient use efficiency of crops. Hence, foliar fertilization is considered as an environmentally friendly fertilization technique. (Fageria *et al*, 2009)

Return on Investment (ROI)

The Return on Investment of Red okra is presented in Table 2. Result shows that the highest income and highest R.O.I of 206.47% was obtained by plants in T₄ (sprayed with Foliar 3) with a net income of PhP.556.75 followed by T₂ (sprayed with a Foliar 1) with a net income of PhP.546.35 and with a R.O.I of 202.61%, followed by T₃(sprayed with Foliar 2) with a net income of PhP.423.55 and with a R.O.I of 157.07%. The lowest R.O.I of 144.48% was obtained by T₁ (control) with a net income of PhP.359.78 The total cost of three (3) treatments sprayed with foliar fertilizer were the same PhP.269.65 and the least was T₁ which were not sprayed with foliar fertilizer. When it comes to gross income, the highest was obtained by T₄-crops that sprayed with (Foliar 3) with an income of PhP.826.4 followed by T₂ (Foliar 1) with an income PhP.816, then followed by T₃ (Foliar 2) with an income PhP.693.2, and the smallest income was obtained by unsprayed crops (T₁) PhP.608.8, respectively.

Table 2. Return on Investment of Red okra sprayed with different organic commercial Foliar Fertilizer in 414 square meters. Cagayan State University Lal-lo, Cagayan.

Treatment	Gross income (Php).	Total Cost of Production (Php).	Net Income per treatment (Php).	Return of Investment (%)
T ₁ -control	608.8	249.02	359.78	144.48
T ₂ -foliar	1 816	269.65	546.35	202.61
T ₃ -foliar	2 693.2	269.65	423.55	157.07
T ₄ -foliar	3 826.4	269.65	556.75	206.47

Although the experimental crops were primed for a short period of time, still there was response when it comes to yield and gross margin analysis.

Summary

The study was conducted at the Cagayan State University Research and Extension Area Lal-lo, Cagayan from December 2018 to March 2019. To find out this of the organic foliar fertilizers is the most effective for growth and yield of red okra production. It specifically aimed to find out the influence of different organic foliar fertilizers in terms of the following parameters; plant height, number of fruits per sample, average length of fruits per sample, average weight of fruits per sample, computed yield per hectare and gross margin analysis.

The Randomize Complete Block Design (RCBD) was used with four treatment blocked four times, the treatments were as follows; T₁ (control) no foliar spray; T₂ (Golden crop multi-NPK 12-2-44) foliar spray; T₃ (Malago solid foliar fertilizer) and T₄ (Yield master-crop growth enhancer 15-15-30+ME master) foliar spray.

Result of the study showed that plants not sprayed with organic foliar fertilizers, not totally affect the height of the plant, while on the other hand, the number of fruits per sample, average length of fruits per sample, average weight of fruits per sample and yield per hectare sprayed with different organic foliar fertilizers were founded the affect in red okra plants.

Conclusion

Base on the result of the study, it is concluded that Yield master foliar fertilizer sprayed in red okra plants significantly increases the length of fruits, weight of fruits, and lead to higher yield per unit area.

Recommendations

Based on the result of the study, the application of organic foliar fertilizers Foliar 3 (T₄) to red okra is recommended to farmers within the locality. However, a similar study using other vegetable crops should be conducted for more reliable and conclusive results.

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