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Influence of Soil-Applied and Foliar Fertilizer Combinations on the Performance of Fruit Vegetables

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Abstract

This research was conducted to find out the influence of soil-applied and foliar fertilizer combinations on the growth and yield of fruit vegetables using Randomized Complete Block Design (RCBD) with five treatments and four replications. The treatments were: T1 – 1/2 Recommended Rate (RR) of 46 – 0 – 0 (Urea) and 0 – 22 – 0 (Doufos Phosphate); T2 – RR of 46 – 0 – 0 and 0 – 22 – 0 (control); T3 – 1/2 RR + Hatake BF; T4 – 1/2 RR + Crop Giant FF; and T5 – ″ RR + GrowMax FF. All sets of data were analyzed using the Analysis of Variance (ANOVA) and F-test. Differences among treatment means were determined using Duncan's Multiple Range Test (DMRT), interpreted at both 5% and 1% levels of significance. Results revealed that fertilization with half of recommended rate of urea (46-0-0) and duofos phosphate (0-22-0) fertilizer supplemented with Crop Giant or GrowMax foliar produced the heaviest biomass in cucumber. The recommended rate of 46-0-0 and 0-22-0 and 1/2 RR of soil-applied supplemented with any of Hatake, Crop Giant or GrowMax foliar fertilizer gave the best growth to eggplant and okra. Fruit vegetables fertilized with the recommended rate of soil-applied fertilizer for better yield performance. Application of 1/2 fertilizer recommendations supplemented with foliar fertilizer was not proven to improve the growth and yield of fruit vegetables better than the recommended rate.

Keywords: Cucumber, Eggplant, Okra, Foliar Fertilizer, Performance

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Introduction

Vegetables are healthful food because they contain vitamins and minerals needed by our body. The recommended vegetable consumption is 200 g/capita/day (AVRDC, 2005, as cited by Aquino, 2016). Globally, vegetables have taken significant importance in research and development through the strong leadership of the Asian Vegetable Research and Development Center (AVRDC – WVC). Based on 2005 data, vegetables contribute an increase of 4% from 8% of the total agriculture output of the country (Aquino, 2016).

Modern crop fertility programs are complex in nature, resulting from the interactions of many factors. One important factor is fertilizer cost, which is a large portion of the crop production expenses. Application of unneeded nutrients contributes to farming inefficiency and ground water pollution (Hochmuth et al., 2005).

The balanced nutrients have been paid little attention in agriculture areas of the developing world. The deficiencies of micronutrients have emerged in the farmer's field and are recognized as symptoms on foliage and reduction in the quality and yield of the crop. The benefit of micronutrients is not limited solely to the replenishment of the micronutrients itself but in addition, they act as a catalyst in the uptake and use of certain macronutrients (Phillips, 2004).

Recently, foliar fertilizers are widely used in vegetable and fruit crops, that contain various macro and micronutrients, which are essential for the proper growth and yield. Foliar fertilizer technology came into use early in this century but did not become a common practice. After the 1980s, the application of foliar fertilizers is the quickest way to deliver nutrients to the tissues and organs of the crop and is proved that application of these micronutrients is beneficial to correct certain nutrient deficiencies (Anonymous, 2001). The use of both foliar and soil application of NPK have been found to increase grain yield in corn (Ghaffari et al., 2011). The findings of this study add to the pool of knowledge in the use of soil-applied and foliar fertilizer on vegetables and more likely, it will be a basis for related researches to be conducted in the future. Hence, this study is imperative and timely.

This study generally aims to find out the influence of soil-applied and foliar fertilizer combinations on the performance of fruit vegetables. This study specifically aims the following: 1.) To determine the effect of soil-applied and foliar fertilizer combinations on the growth and yield of fruit vegetables; and 2.) To find out which among the combinations of soil-applied and foliar fertilizer produced the best growth and highest yield.

Materials and Methods

Materials

The materials used were fruit vegetable seeds (cucumber, eggplant and okra), soil-applied fertilizers (46 – 0 – 0 and 0 – 22 – 0) , foliar fertilizers (Hatake biofertilizer, Crop Giant and GrowMax foliar fertilizers), knapsack sprayer, hand trowel, spade, bolo, labeling materials, weighing and measuring devices, record notebook and office supplies.

Methods

The experimental design used in the study was Randomized Complete Block Design with treatments replicated four times. The treatments used in the study were the following: T1 – 1/2 RR (46 – 0 – 0 and 0 – 22 – 0); T2 – RR (46 – 0 – 0 and 0 – 22 – 0); T3 – 1/2 RR (46 – 0 – 0 and 0 – 22 – 0) + Hatake BF; T4 – 1/2 RR (46 – 0 – 0 and 0 – 22 – 0) + Crop Giant FF; and T5 – 1/2 RR (46 – 0 – 0 and 0 – 22 – 0) + GrowMax FF.

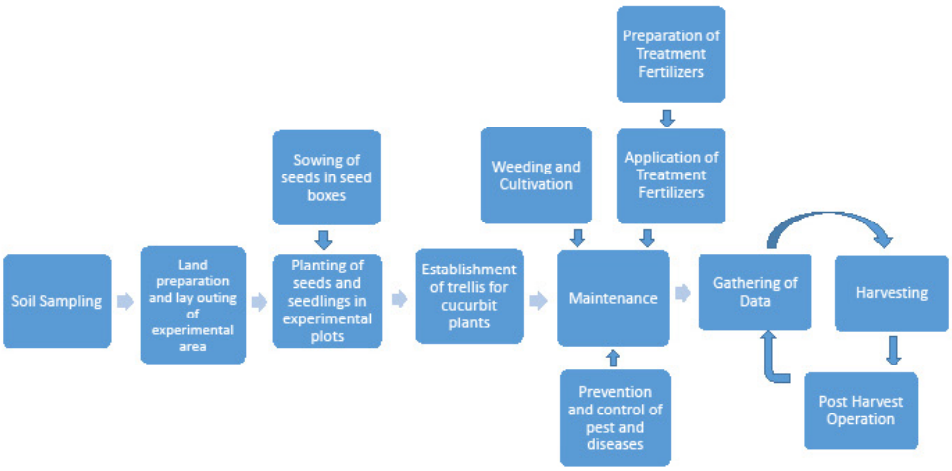

Figure 1.0. Research flow

The experimental area was thoroughly prepared by alternate plowing and harrowing three times with a week interval between operations to allow decomposition of weeds. Stones, rootstocks, and stubbles were removed from the area. Soil samples were taken from the experimental area before land preparation. These were air-dried and were brought to the Regional Soils Laboratory for analysis. The result of the soil analysis served as the basis on the kind and rate of fertilizers applied. Fruit vegetable seeds were bought from the vegetable seed sellers/suppliers at Tapaz, Capiz.

Small seeds as in eggplant were sown first in the seed boxes, then, these were planted in the field as soon as they attain an appropriate height. For vegetables

having bigger seeds as in cucumber and okra were directly planted on the field.

Planting was done when there was enough moisture in the soil or after rain to enhance germination. These were planted along the furrows spaced at 75 cm apart and 50 cm between hills. The cucumber plants were provided with a climbing structure/trellis using the stems of the talahib as soon as they start to crawl on the ground. Weeding was done three weeks after planting or as soon as a considerable number of weeds appeared in the experimental area. Weeding was done within three weeks to free the crops from competition. Soil near the base of the plants was pulverized to aerate the soil especially during the early stage of growth, however, extra care was observed not to damage the roots of the crops. Clean culture was practiced to prevent pest infestation and disease infection on the experimental plants. Regular inspection and monitoring for the presence of pests and diseases were also done. Harvesting of fruit vegetables were done as soon as they reach marketable size. Harvested fruits were separated by treatment and replication.

The amount of fertilizers applied varied with fruit vegetables and were based on the recommendation of the Regional Soils Laboratory. The fertilizer recommendation for eggplant and okra was 80-60-0 kg NPK/ha and 80-80-0 NPK/ha for cucumber. The soil-applied fertilizers used for all fruit vegetable were 46-0-0 (Urea) and 0-22-0 (Doufos Phosphate). One – half of the total amount of nitrogen (46 – 0 – 0) and a total amount of phosphorus (0 – 22 – 0) were applied 10 days after planting (DAP) and another half of nitrogen (46 – 0 – 0) was applied at 60 DAP. On the other hand, foliar fertilizers were applied based on the manufacturer's recommendations.

The data gathered from the study included growth and yield components of fruit vegetables such as biomass (t/ha), number of fruits, length of fruits (cm) and fruit yield (ton/ha) for cucumber. Plant height (cm), number of fruits, length of fruits (cm) and fruit yield (ton/ha) were measured for eggplant and okra.

All sets of data were analyzed using the Analysis of Variance and F-test for Randomized Complete Block Design. Differences among treatment means were determined using Duncan's Multiple Range Test (DMRT), interpreted at both 5% and 1% levels of significance.

Results and Discussion

Effect of Soil-Applied and Foliar Fertilizer Combinations on the Performance of Cucumber

Table 1. Growth and yield performance of cucumber as influenced by soil-applied and foliar fertilizer combinations.

Treatments	Growth and Yield Parameters			
	Biomass (ton/ha)*	Number of fruits**	Length of fruits (cm)ns	Fruit Yield (ton/ha)**
T1 –1/2 RR 46-0-0 & 0-22-0	32.13 c	164 b	22.70	36.73 b
T2 – RR 46-0-0 & 0-22-0 (Control)	39.47 b	212 ab	23.25	47.68 a
T3 –1/2 RR + Hatake	38.60 b	169 b	23.13	37.71 b
T4 –1/2 RR + Crop Giant	44.92 a	174 b	22.74	43.25 a
T5 – 1/2 RR + GrowMax	44.99 a	223 a	22.87	45.91 a
CV	16.65%	15.97%	7.98%	13.83%

*ns-not significant; * - Significant at 5% level; **- Significant at1% level; Means having the same letter are not significantly different from each other.*

The growth and yield characteristics of the cucumber were significantly influenced by the application of soil-applied and foliar fertilizer combinations except for the length of fruits (Table 1). Treatment 5 and Treatment 4 gave the heaviest biomass (44.99 ton/ha and 44.92 ton/ha, respectively), followed by Treatment 2 and Treatment 3 (39.47 ton/ha and 38.60 ton/ha, respectively) while Treatment 1 produced the lightest biomass with 32.13 ton/ha.

The highest number of fruits was obtained from the application of Treatment 5 with 223. This was statistically the same to the application of Treatment 2 (control) with 212 fruits which was found comparable to other treatments (T4:174, T3:169 and T1:164). Control treatment gained the same number of fruits as other treatments, which rejects the findings of Naruka et al. (2000) that foliar application had increased number of fruits. Length of cucumber fruits ranged from 22.70cm (Treatment 1) to 23.25 cm (Treatment 2).

The fruit yield was higher in Treatment 2, Treatment 5 and Treatment 4 (47.68 ton/ha, 45.91 ton/ha and 43.25 ton/ha, respectively) than in Treatment 3 and

Treatment 1 (37.71 ton/ha and 36.73 ton/ha, respectively). Moreover, application of combined Crop Giant and GrowMax foliar fertilizers to one-half of the recommended rate of soil-applied fertilizer (Treatment 4 and Treatment 5) produced the same yield as application of recommended rate of soil-applied fertilizer only (Treatment 2). This result does not conform to the findings of Pascua, et al. (1996) that plants fertilized with 1/2 fertilizer recommendations and supplemented with foliar fertilizer gave the highest yield.

Results further show that among the treatments, half of the recommended rate of soil-applied fertilizer combined with GrowMax foliar fertilizer (Treatment 5) consistently gave the best growth and yield performance when applied to cucumber.

Effect of Soil-Applied and Foliar Fertilizer Combinations on the Performance of Eggplant

Table 2.0. Growth and yield performance of eggplant as influenced by soil-applied and foliar fertilizer combinations.

Treatments	Growth and Yield Parameters			
	Plant height (ton/ha)*	Number of fruits**	Length of fruits (cm)ns	Fruit Yield (ton/ha)ns
T1 – 1/2 RR 46-0-0 & 0-22-0	101.43 b	143 b	18.18	8.68
T2 – RR 46-0-0 & 0-22-0 (Control)	111.53 a	169 a	20.96	10.25
T3 –1/2 RR + Hatake	110.12 a	166 a	19.50	9.80
T4 –1/2 RR + Crop Giant	113.20 a	157 a	19.60	9.37
T5 –1/2 RR + GrowMax	109.20 a	159 a	19.45	9.07
CV	13.02%	11.07%	5.22%	10.08%

*ns-not significant; * - Significant at 5% level; **- Significant at1% level; Means having the same letter are not significantly different from each other.*

The soil-applied and foliar fertilizer combinations affected the plant height and number of fruits but not the length of fruits and fruit yield of eggplant (Table 2). All treatments noted a taller plant height (T4:113.20 cm, T2:111.53 cm, T3:110.12 cm and T5:109.20 cm) than treatment of one-half of the recommended rate of soil-applied fertilizer (T1:101.43 cm). However, the control treatment composed of RR of soil-applied fertilizer (Treatment 2) obtained the same plant height as other treatments that combined half of RR and foliar fertilizer. This rejects the findings of Pascua et al. (1996) that plants fertilized with 1/2 fertilizer recommendations and supplemented with foliar fertilizer were tallest and most vigorous. The same result was observed in

the number of fruits where Treatment 2, Treatment 3, Treatment 5, and Treatment 4 produced 169, 166, 159 and 157 fruits, respectively, while Treatment 1 produced 143. Eggplant exhibited a length of fruits that ranged from 18.18 cm (Treatment 1) to 20.96 cm (Treatment 2).

The fruit yield of the different treatments was not significantly different from each other. Nonetheless, utilization of recommended soil-applied fertilizer (Treatment 2) numerically obtained the highest yield of 10.25 ton/ha, followed by T3 (1/2 RR + Hatake), T4 (1/2 RR + Crop Giant) and T5 (1/2 RR + GrowMax) with 9.80 ton/ha, 9.37 ton/ha and 9.07 ton/ha, respectively. Treatment 1 (1/2 RR 46-0-0 & 0-22-0) gave the lowest yield of 8.68 ton/ha in eggplant.

Effect of Soil-Applied and Foliar Fertilizer Combinations on the Performance of Okra

Table 3.0. Growth and yield performance of okra as influenced by soil-applied and foliar fertilizer combinations.

Treatments	Growth and Yield Parameters			
	Plant height (cm)**	Number of fruits**	Length of fruits (cm)ns	Fruit Yield (ton/ha)**
T1 – 1/2 RR 46-0-0 & 0-22-0	87.98 b	285 d	12.15	9.99 b
T2 – RR 46-0-0 & 0-22-0	110.5 a	434 a	12.52	18.78 a
T3 –1/2 RR + Hatake	114.58 a	315 c	12.34	11.41 b
T4 –1/2 RR + Crop Giant	108.78 a	322 c	12.21	11.61 b
T5 – 1/2 RR + GrowMax	108.35 a	364 b	12.28	13.37 b
CV	6.45%	8.32%	1.82%	14.76%

ns-not significant; - Significant at 5% level; **- Significant at 1% level; Means having the same letter are not significantly different from each other.*

The application of soil-applied and foliar fertilizer combinations significantly influenced the growth and yield characteristics of okra except for the length of fruits (Table 3). The plant height of okra applied with recommended rate of soil-applied fertilizer (Treatment 2:110.50 cm) was found similar to plants treated with combination of foliar fertilizers (Treatment 3:114.58 cm, Treatment 4:108.78 cm and Treatment 5:108.35 cm) but taller than those applied with half of the RR (Treatment 1:87.98 cm).

In terms of the number of fruits, Treatment 2 obtained the highest with 434,

followed by Treatment 5 with 364, and Treatment 4 with 322, which is comparable to Treatment 3 with 315. The lowest number of fruits was produced from Treatment 1 with 285.

The length of okra fruits was not significantly different among the treatments with means that ranged from 12.15 cm (Treatment 1) to 12.52 cm (Treatment 2). Applying the recommended rate of soil-applied fertilizer (Treatment 2) to okra produced the highest fruit yield (18.78 ton/ha). All other treatments that composed of one-half RR soil-applied and the combination of soil-applied and foliar fertilizers obtained lower fruit yield (Treatment 1:9.99 ton/ha, Treatment 3:11.41 ton/ha, Treatment 4:11.61 ton/ha and Treatment 5:13.37 ton/ha). This is in contrast to the findings of Pascua et al. (1996) that plants fertilized with 1/2 fertilizer recommendations and supplemented with foliar fertilizer gave the highest yield.

It can be noted that okra plants fertilized with control treatment (RR 46-0-0 & 0-22-0) exhibited the best performance in yield among treatments combined with foliar fertilizer. This result does not conform to the findings of Pascua et al. (1996) that plants fertilized with 1/2 fertilizer recommendations and supplemented with foliar fertilizer were tallest and most vigorous.

Conclusions

On growth performance, treatments 1/2 RR + Crop Giant (Treatment 4) and 1/2 RR + GrowMax (Treatment 5) gave the heaviest the biomass of the cucumber. The response of eggplant and okra plants to the soil-applied and combined soil-applied and foliar fertilization is the same in growth parameters. Plants applied with recommended Rate of 46-0-0 and 0-22-0 (Control) and 1/2 RR with combinations of Hatake (Treatment 3), Crop Giant (Treatment 4) and GrowMax (Treatment 5) were taller than plants applied with only 1/2 RR 46-0-0 & 0-22-0 (Treatment 1).

Generally, the application of soil-applied and combined soil-applied and foliar fertilizers did not influence the length of fruits of cucumber, eggplant, and okra. The length of fruits is the same regardless of kind of fertilizer applied in the study. This may be attributed to the inherent characteristics of the variety of the crops studied. The vegetables showed varied performance in the number of fruits and fruit yield under the application of different treatments. Nonetheless, fertilization of the recommended rate of soil-applied fertilizer alone consistently demonstrated the highest performance in all yield parameters.

Recommendations

Apply half of the recommended rate of urea (46-0-0) and duofos phosphate (0-22-0) fertilizer supplemented with Crop Giant or GrowMax foliar to obtain heavier biomass of cucumber. Use the recommended rate of 46-0-0 and 0-22-0 or 1/2 RR supplemented with any of Hatake, Crop Giant or GrowMax foliar fertilizer for higher growth of eggplant and okra. Fertilize any of the fruit vegetables with the

recommended rate of soil-applied fertilizer for better yield performance. Conduct other relevant studies using other biofertilizers and foliar fertilizers in other seasons, and locations to gather more comprehensive information.

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