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Effect of Foliar Fertilizer over Different Levels of Top Dressing on Growth and Yield of Gherkin (*Cucumis sativus* L.)

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ABSTRACT

A study was conducted to find out the effect of foliar fertilizer over different levels of top dressing on gherkin. The experiment was arranged in a Randomized Complete Block Design with three replicates. Gherkin variety "Ajax" was grown with five different top dressing fertilizer levels. They were 100% Recommended fertilizer dose, as control (T1), 80% of inorganic fertilizer dose, as T2, 60% of inorganic fertilizer dose, as T3, 40% of inorganic fertilizer dose, as T4, and without inorganic fertilizer, as T5.All treatments received similar dosages of foliar fertilizers and basal dressing. In addition each planting hole was filled with 500g of compost before sowing seeds. The results indicated that different fertilizer levels with foliar sprays had no significant influence on vegetative, reproductive, and yield parameters recorded. The yield gap between the treatments with different levels of top dressings and the treatment with only foliar sprays had no significant difference and T5 proved to be the most cost effective treatment over others with a 7% increase in profit (foliar sprays only).

KEYWORDS: *Cucumis sativus*, Foliar Fertilizers, Gherkin, Inorganic Fertilizers, Yield

INTRODUCTION

Gherkin is a vegetable which has similar nutrient value as cucumber and belongs to family Cucurbitaceae. Commercial Gherkin (*Cucumis sativus* L.) cultivation was started in 1985 in Sri Lanka. As Gherkin is quick income generating crop, the industry soon became popular over the past three decades and it is being cultivated in many areas in Sri Lanka (Silva *et al.*, 2010). The areas where Gherkin cultivation is done in Sri Lanka are Ampara, Mahaweli System B, Monaragala, Polonnaruwa, Badulla, Puttlam, Matale, Anuradhapura, and Kurunegala (Madhuwanthi *et al.*, 2011).

The cultivation extent in 2012 was 2500 acres and approximately 10,000 farmers were involved. Since total production was 12,000 to 15,000 metric tons and it is exported annually to countries like Japan, South Korea, New Zealand, Australia, Holland and Russia.

Farmers have been able to achieve profits by cultivating Gherkin through proper application of inputs. Since gherkin is a sixty day plant, it needs to be managed properly during this short period by providing all necessary inputs such as fertilizers, water etc. at correct time and in correct quantities. Hence special attention should be given to application of fertilizers to get a good, healthy plant as well as a higher yield within this short period of time. Fertilizers are compounds given to plants to promote growth and usually applied either via soil to uptake by plant roots or by foliar feeding to uptake through leaves.

There has been a great proliferation of foliar fertilizers on the agricultural chemical market in recent years because it has been accepted as an essential part of crop production, especially in horticultural crops. The leaves of terrestrial plants are capable of absorbing nutrient supplied in an aqueous medium. This capacity has been exploited in many agronomic practices like application of herbicides, growth regulators etc. for the purpose of enhanced crop growth. Hence, foliar fertilization is by far the effective way to apply macro and micro elements (Witneg, 1996).

However, farmers use both, foliar and granular fertilizers during the cropping cycle. Approximately two to three foliar sprays are used with five top dressings. It was felt that with the use of regular foliar sprays, level of top dressing could be reduced. Hence this experiment was focused to asses effectiveness of foliar feeding fertilizer with different levels of root feeding inorganic fertilizers that would give better quality fruits and higher yield.

MATERIALS AND METHODS

Location

The experiment was conducted at Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura situated in low country intermediate zone

(IL_{1a}), at an elevation of 30m from mean sea level. Experiment was carried out from January to April 2013.

Field Layout

Fifteen raised beds (4.5×2.1m) consisting two rows with ten planting holes in each row were prepared. Spacing of 1.2m between rows and 0.45m within rows was maintained. 30cm wide drains were prepared between plots. Five treatments were arranged in a Randomized Complete Block Design and replicated thrice.

Treatments

Five inorganic fertilizer treatments as top dressings with ten foliar fertilizer applications were applied as given in Table 1 and 2. T1 was the control treatment which is the present recommended fertilizer level for Gherkin.

Crop Establishment and Maintenance

Compost and inorganic fertilizers were added as basal dressing to each planting hole according to the treatment schedule (Tables 1 and 2). Seeds from Variety "Ajax" were sown two days after applying basal dressing. Seedlings were thinned out to a plant per hill ten days after emergence. Inorganic fertilizers and liquid fertilizer were added through the cultivation period according to the schedule given in Table 2.

Cotyledonary leaves were removed at initial stage to reduce the damage and population of leaf miner. Two to three lower leaves of the plants were also removed at the age of 25 days to avoid possible downy mildew disease. Application of Naphthalene Acetic Acid was done at three day intervals after they reached reproductive stage, to reduce the abortion of fruits. The trellising was done to support plant growth at initial stage of the crop. Recommendations of Sunfrost Ltd were adopted to manage pests and diseases.

Table 1. Inorganic fertilizer levels with foliar sprays used in the experiment

Treatment	Fertilizer type
T1(Control)	100% Foliar spray, 100% Basal and 100% Top dressing
T2	100% Foliar spray, 100% Basal and 80% Top dressing
T3	100% Foliar spray, 100% Basal and 60% Top dressing
T4	100% Foliar spray, 100% Basal and 40% Top dressing
T5	100% Foliar spray and 100% Basal dressing only

Table 2. Fertilizer application schedule (kg/ha)

DAP	Fertilizer		T1	T2	T3	T4	T5
2 DBP	Basal	Compost	500g/Plant	500g/Plant	500g/Plant	500g/Plant	500g/Plant
		Urea	50	50	50	50	50
		MOP	70	70	70	70	70
		TSP	310	310	310	310	310
11	TD 1	Urea	100	76	57	38	0
		MOP	80	68	50	34	0
	Foliar spray	Green care	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
16	Foliar spray	K Plus	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
21	TD 2	Urea	150	118	90	60	0
		MOP	150	118	90	60	0
	Foliar spray	Green care	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
26	Foliar spray	K Plus	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
31	TD 3	Urea	150	118	90	60	0
		MOP	150	118	90	60	0
	Foliar spray	Green care	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
36	Foliar spray	K Plus	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
41	TD 4	Urea	150	118	90	60	0
		MOP	150	118	90	60	0
	Foliar spray	Green care	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
46	Foliar spray	K Plus	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
51	TD 5	Urea	150	118	90	60	0
		MOP	150	118	90	60	0
	Foliar spray	Green care	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L
56	Foliar spray	K Plus	50ml/16L	50ml/16L	50ml/16L	50ml/16L	50ml/16L

DAP- Days After Planting; DBP-Days Before Planting; MOP-Muriate Of Potash; TD-Top Dressing; Green care and K plus contain Nitrogen; Phosphorus, Potassium, Magnesium, Manganese and Boron

Data Recording

In this experiment the plants were harvested for small fruits. The harvesting was done for grade 1. Grade 1 fruits have a diameter of 11-15mm. Data collected for all characters were from five randomly selected vines from each treatment in each replicate.

Vegetative Parameters

Number of Branches

The number of branches was counted on main stem, seven weeks after sowing.

Plant Height

Plant height (cm) was measured, seven weeks after sowing.

Shoot Dry Weight

Shoot dry weight (g) was measured thrice, 21, 42 and 63 days after sowing.

Reproductive Parameters

Days to First Flowering and First Harvest

The number of days taken from the date of sowing to first flowering and first harvest were recorded.

Number of Picks

Total number of picks was recorded.

Yield Parameters

The total number of fruits harvested from 10 plants in each plot was counted and weighed to calculate the fruits per vine, weight per fruit (g), yield per vine(kg) and final yield (T/ha) for each treatment.

Economic Analysis

Economic analysis for treatments was calculated as described by Silva *et al.* (2010).

RESULTS AND DISCUSSION

Vegetative Parameters

Significant differences were not observed among treatments for plant height, number of branches, and shoot dry weight (Table 3).

The result indicated that regular application of foliar fertilizers was sufficient to achieve proper vegetative growth without top dressings. The most touted benefit of foliar fertilizers is their capacity to promote maximum nutrient absorption. This is based on the belief that foliar fertilizers cause an increase in sucrose level in plants which then simulate soil activity and plant nutrient uptake (Anon., 1998). Thus application of foliar fertilizer helps to utilize basal dressing in optimal level and helps to achieve best vegetative growth. Overall root system of gherkin is rather shallow and rootlets colonize only the top 30 cm of the soil (Anon., 2011). The shallow root system would result poor nutrient absorption. When foliar applications are done, more than 85% of the fertilizers is utilized by the plants, while when a similar amount of granular is applied to the soil, only 10 – 40% of it is utilized (Anon., 2013). All evidence showed that application of five top dressings is therefore had no significant effect on growth during short period of crop growth.

Table 3. Number of branches, plant height and shoot dry weight at three stages

Trt	No of Branches	Plant Ht. (cm)	Shoot dry Wt. (g)		
			St.1	St.2	St. 3
T1	8.40	157.9	2.35	18.6	156.6
T2	8.06	149.9	2.86	19.6	125.7
T3	7.80	148.6	2.71	17.5	178.0
T4	7.93	149.2	2.90	19.2	140.1
T5	7.46	154.5	2.94	18.9	150.7
CV	*12.36*	*4.64*	*19.7*	*20.99*	*26.17*
LSD	*NS*	*NS*	*NS*	*NS*	*NS*

St. - Stage; Trt. - treatments

Reproductive and Yield Parameters

Significant differences were not recorded among treatments for all parameters measured (Table 4), indicating that treatments have no effect on fruits per vine, fruit weight, yield, days to first flowering, days to first harvest and number of picks. T4 recorded highest (57.25) number of fruits per vine while T5 recorded lowest (53.70). For fruit weight T4 recorded the lowest (10.3 g) while T3 recorded the highest (10.75 g). Interestingly, with the decrease in levels of the top dressing yield began to decrease (from 10.73 to 10.37 t/ha), but the differences were not significant. This clearly indicated that under the present experimental conditions, the application of top dressing during the sixty day period (age of the crop) had no effect on yield or crop growth over foliar fertilizers applied ten times during the same period. It was clear that plants have not effectively utilized or absorbed the inorganic fertilizers that were applied to the soil as top dressings. Even with a treatment with no top dressing has given a comparatively higher yield (10.37 t/ha), when the control treatment recorded 10.73 t/ha with five top dressings.

These results further indicated that, granular fertilizer applied as top dressing have gone waste and not utilized by the plants effectively to improve their growth and yield. However, with only regular application of two foliar fertilizers throughout the crop (once in 5 days) has effectively looked after crop to give a yield similar to the yield obtained with the recommended top dressing.

Table 4. Fruits per vine, fruit weight, yield per vine, yield per ha, days to first flowering, days to first harvest and number of picks recorded for five treatments

Trt	Fruits /Vine	Fruit Wt. (g)	Yield (g) /vine	Yield (t)/ha	Days to first flowering	Days to first harvest	No of picks
T1	56.95	10.47	596.26	10.73	26.7	33	38.0
T2	55.70	10.66	593.76	10.69	27.0	33	36.7
T3	54.90	10.75	590.17	10.62	27.3	33	36.7
T4	57.25	10.30	589.67	10.61	27.0	33	36.3
T5	53.70	10.73	576.20	10.37	27.3	33	37.3
CV	*14.67*	*2.96*	*17.08*	*17.08*	*3.27*		*3.45*
LSD	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*

Application of five top dressings within a sixty day period may not be effective as foliar fertilizers as the latter gets absorbed faster through leaves. Since the gherkin plant has a shallow root system, absorption of fertilizers through roots may not take place effectively, causing part of fertilizers going waste. Further, for many other popular cucurbits cultivated in Sri Lanka, one or two top dressings are recommended by the DOA during a period of 90 – 110 days. This further indicates that application of five top dressings with ten day intervals during sixty day period was too much and unnecessary when ten sprays of foliar fertilizer also applied during this period

Cost Effectiveness

Though yield obtained under each treatment were not significant, a vast differences were obtained in cost effectiveness of each treatment (Table 5). When T1 recorded a profit of Rs 266,340 /ha, T5 recorded a profit of Rs 370,460 /ha which would be attractive from the farmers' point of view. It was clear that this increase in profit was not due to increased yield but due to decrease fertilizer cost, labour, and other input costs. Therefore, costing for treatments with top dressings have recorded more without gaining a significant increase in yield.

Pest and Diseases

During the experiment period Gummy blight, Downy mildew (*Pseudoperonospora cubensis),* Bacteriat wilt (*Erwinia tracheiphila),* Yellow Mosaic Virus (YMV) and Cucumber Mosaic Virus (CMV) were observed. Commonly observed pests were Red pumpkin beetle (*Aulacophora faveicollis),* Melon fly (*Bactrocera cucurbitae)* and Leaf miner (*Liriomyza sativa).*

Table 5. Cost Effectiveness of Five different fertilizer treatments (per ha)

Trt	Cost (Rs.,000)			Total Cost (Rs.000)	Income (Rs.000)	Profit (Rs.000)	Profit percentage	Profit Increasing percentage
	Fertilizer	Pest and Diseases control	Labour and others					
T1	156	40	160	356	622.34	266.34	17	0
T2	136	40	160	336	620.02	284.02	18	1
T3	116	40	160	316	615.96	299.96	19	2
T4	96	40	160	296	615.38	319.38	21	4
T5	56	40	135	231	601.46	370.46	24	7

Assumption: Price of Compost (1kg) - Rs.6.00; Price of Urea (1kg) - Rs.50.00; Price of MOP (1kg) - Rs.87.00; Price Of TSP (1kg) - Rs.55.00; Price of Gherkin (1kg) -Rs.58.00

CONCLUSIONS

The results indicated that there is a possibility in cutting down the top dressing totally or partially if foliar fertilizers are also to be used. The two foliar fertilizers used in this experiment, have provided the nutrients needed in the plants for better plant growth and yield. The foliar fertilizers have proved that they can be good replacements for granular fertilizers. Granular fertilizers are expensive and could cause soil and ground water pollution if they are not fully utilized by plants. Hence this study showed that excess application of granular fertilizers as top dressings have no effect on growth and yield of plant. Instead it has decreased profit margin. However, further studies are needed to evaluate how other foliar fertilizers available in the market react in this situation and even to identify the exact number of applications required during this sixty day period, for better performance of the crop and profit.

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