Sri Lankan Journal of Technology
Research

SLJoT
2023 Issue 1 6 - 10
ISSN 2773-6970

Effect of Yaramila complex fertilizer on growth and yield of Cucumber (*Cucumis sativus* L.)

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Received: 28-09-2022 ∗ Accepted: 07-03-2023 ∗ Published Online: 30-06-2023

***Abstract*—This study was conducted to evaluate the effect of Yaramila complex fertilizer on the growth and yield of cucumber (*Cucumis sativus* L.). The experiment was laid out in Randomized Complete Block Design (RCBD) with six treatments (T1-T6) in nine replications. The Yaramila complex fertilizer (12:11:18 NPK + 3MgO + 8S) was applied at different rates as basal (0-4 g per plant) and top dressing (4-8 g per plant), whereas treatments were T1 (0,4), T2 (0,8), T3 (2,4), T4 (2,8), T5 (4,4) and T6 (4,8). The results revealed that the application of Yaramila fertilizer had a significant influence on the vine length, number of leaves, the total number of fruits, and fresh weight of fruits per plant, as well as the dry weight of crop residue among the treatments. At 5% significant level, the vine length in T4 (2 g basal and 8 g top dressing) (37.12 cm) was significantly longer than that (27.75 cm) in T5 (4 g basal and 4 g top dressing), which had a shorter vine length compared to other treatments at 4th WAP. The number of leaves was high (7.3) in T6 (4 g basal and 8 g top dressing), whereas the number of leaves was low (4.9) in T2 (0 g basal and 8 g top dressing) at 2nd WAP. Yaramila fertilizer application significantly (P=0.0001) influenced the total number of harvested fruits per plant. There were no remarkable differences in fruit diameter and fruit length between the treatments at P=0.05. Fruit length ranged from 14.06 cm (T1 as a control: 0 g basal and 4 g top dressing) to 17.33 cm (T4: 2 g basal and 8 g top dressing). There was a significant difference (P=0.0012) in harvested fruit weight per plant among the treatments. The highest mean value of cumulative fruit yield was obtained in T5 (14,968.89 kg/ha), and the least value was observed in T3 (7,857.78 kg/ha). Yaramila fertilizer 4 g per plant as basal application and 4 g per plant as a top dressing (2 g at 2 weeks and 2 g at 4 weeks) [T5 treatment] could be used in cucumber cultivation to obtain high fruit yield.**

***Keywords*—**Basal fertilizer, cucumber, fruit yield, top dressing, Yaramila fertilizer.

I. INTRODUCTION

Agriculture is the primary source of income for many of the rural population in Sri Lanka, whereas vegetables are the second most important sector after rice. Cucumber (*Cucumis sativus* L.) is a popular vegetable that belongs to the Cucurbitaceae family. It is widely grown in Asia and has been consumed for 3000 years. It is a warm-season crop that requires temperatures of 26 to 30 degrees Celsius and enough sunlight. Cucumber vines with sharply five-cornered leaves and unbranched tendrils are prostrate, branching, stiffly hairy vines (Schaffer *et al*., 2003). Cucumber contains about 90% water in the fruit and provides a cooling effect for the human body. According to Shrivastava and Ray (2013), frequent consumption of cucumber fruit promotes healthy hair growth. According to Jilani *et al*. (2009), Cucumber's high potassium concentration (50-80 mg/100 g) can be beneficial for both high and low blood pressure. It is also popular for fresh market salad and processed pickles. Its juice is also efficient in softening the skin texture. Agriculture production must be increased to meet the food requirements of growing population. Fertilizer application is one of the important practices in achieving high crop production. Vegetable farmers grow both hybrid varieties and open-pollinated local varieties in Sri Lanka for cucumber cultivation. Farmers prefer to cultivate hybrid varieties because of their higher yields and incomes. Conversely, hybrids require higher fertilizer inputs and appropriate fertilizer for higher crop yield. However, inorganic or organic fertilizers could be used for crop production to enhance crop yield for cucumber. The response of fertilizers depends on the crop varieties and the soil types. The timing of the release of macro and micro nutrients in relation to plant growth is one of the major problems (Evans *et al*., 2010; Burnett *et al*., 2016). However, excess use of fertilizer moves into ground and surface waters. It is an important to conduct fertilizer response studies for cucumber. Yaramila complex fertilizer contains nitrogen, potassium, and other nutrients. It is easy to use and provides uniform distribution of essential nutrients to the plants. Therefore, this experiment aimed to determine the effect of Yaramila complex fertilizer application on the yield and growth of cucumber.

II. Materials and Methods

The study was conducted from June to September 2021 at Mahagirila, Nikaweratiya (53 m above mean sea level at 7° 48' north 81° 34' east belonging to low country dry zone), which is located in Kurunegala district of Northwestern province in Sri Lanka. The average annual temperature in Nikaweratiya is 26 ± 2 °C, and the rainfall is around 1,640 mm per year. The average relative humidity is 63−73%. The soil commonly available on the highland of the farm is Reddish Brown Earth. The experiment was carried out in a Randomized Complete Block Design (RCBD) with six treatments (Table I) in nine replications. The experimental area was cleaned and ploughed into a depth of 20 cm, harrowed, and leveled by using mamoty and rake. 30 cm × 30 cm × 30 cm sized holes were made at the spacing of 1.0 m x 1.0 m, followed by adding 500 g of cow dung in each hole in all experiment plots two weeks before seeding. Yaramila complex fertilizer (12:11:18 NPK + 3MgO + 8S) as indicated in Table I was also added two days before seeding as basal application and rest of the space in each hole was filled with normal top soil. Seeds of cucumber variety, Chandini were used in this experiment. The percentage of seed germination was taken under laboratory conditions to ensure their viability before establishing experiment. The result showed that the germination percentage was 100%. In each hole, two seeds were placed at a depth of roughly 2 cm and covered with soil. Thinning out was done after one week of seeding to keep one plant per hill. Irrigation was done from sowing to germination two times per day in the early morning and late evening, and then it was reduced to one time per day until pod formation. After the pod formation, it was done once in two days in the evening by using a watering can. Hand weeding was done at two weeks intervals in the experimental plots and surround.

Vine length, number of leaves per plant and number of branches per plant were taken as growth parameter and number of fruits per plant, fruit weight per plant and fruit yield were taken as yield parameter were collected from 2nd week after seeding to harvesting. At 2, 4, 6, and 8 weeks after planting, the length of the vine, number of leaves, and branches were recorded. Three times, at one-week intervals, fruit harvesting was practiced. The number of fruits per plant, as well as their length, diameter, and fresh weight, were all recorded separately. Crop yield was calculated based on the fresh weight of fruits per plant. The data collected were analyzed using the SAS 9.1 version of statistical software application. Treatment means were compared with Duncan's Multiple Range Test at a 5% significant level.

III. Results and Discussion

A. Vine length

There was a significant difference in the vine length of *Cucumis sativus* plant at 2 − 8 weeks after seeding (WAS) (Table II). The maximum length of the vine was recorded in T2 (10.28 cm), followed by T1 (9.8 cm) while the lowest vine length was recorded in T6 (6.82 cm) at 2 WAS. But at 4 WAS, the longer vine length was observed in T4 (37.12 cm), and the short vine length was observed in T5 (27.75 cm). The vine length ranged from 86.34 cm (T3) to 98.30 cm (T6) at 8 WAS, and a significantly higher vine length was attained in T6 compared to T1, T2 and T3 at P=0.05. These findings are in line with Ahmed *et al*. (2007) and Abdel−Mawgoud *et al*. (2005), who discovered the increasing nitrogen application lengthens cucumber vines. When NPK application is increased, vegetative growth also increases (Arshad *et al*., 2014).

B. Number of leaves per plant

Yaramila fertilizer significantly influenced the number of leaves per plant at 2 WAS (Table III). More number of leaves were observed in T6 (7.3) and the lowest number of leaves were observed in T2 (4.9) at 2 WAS. It may be due to the additional nutrients from Yaramila fertilizer which produced a greater number of leaves and influenced vegetative plant growth. At 4 WAS, there was no significant difference between the T3, T4, T5, and T6 treatments at P=0.05. According to Omotoso *et al*. (2007), the fertilizer NPK considerably increases plant height, leaf area, root length, and leaf number. At 2 WAS, the vine length was lower (7.11) and number of leaves were higher (6.9) while, number of branches were highest (1.8) in T5. The Low vine length, high number of leaves and high number of branches implies that length of internodes may be short at early stage of vegetative growth. This may be due to required nutrient availability in soil for plant growth. The obtained results are in agreement with those mentioned by Abayomi *et al*., 2008) who found increment in vegetative growth with increasing of NPK fertilizer application.

C. Number of branches per plant

There were no significant differences in the numbers of branches at 2, 4, and 6 WAS, as shown in Table IV. More number of branches per plant was recorded in T5 (1.8) followed by T6 (1.7) while the lowest branch number was recorded in T1 (1.1) at 2nd WAS. At 4th week, the highest number of branches was observed in T3 (3.2) and the lowest number of branches was observed in T1 (2.2) and T2 (2.2). At 8 weeks, the highest number of branches was observed in T5 (6.9) and a lower number of branches was observed in T1 (5.5). According to Oad *et al*. (2001), the application of NPK fertilizer dosages was equally effective in producing branches.

D. Number of fruits per plant

Yaramila fertilizer application significantly influenced the number of fruits per plant at 1st picking which was confirmed with a p−value of 0.0001 according to the F test (Table V). More number (<2) of fruits was observed in T4 and T6 while a lower number of fruits was recorded in T2 at 1st picking. It may be due to the application of 4 g Yaramila fertilizer as top dressing with basal application to produce a greater

Table I: Yaramila complex fertilizer (g per plant) application as basal and top dressing in this study

Treatment codes	Yaramila complex fertilizer (g per plant)			
	Basal application before seeding	Top dressing application at 2 weeks after seeding	Top dressing application at 4 weeks after seeding	Total application (basal and top dressing)
T1 (control)	0	2	2	4
T2	0	4	4	8
T3	2	2	2	6
T4	2	4	4	10
T5	4	2	2	8
T6	4	4	4	12

Table II: Effect of Yaramila complex fertilizer on vine length at 2, 4, 6, and 8 WAS.

Treatments	Vine length (cm)			
	2 WAS	4 WAS	6 WAS	8 WAS
T1	9.80 ± 0.63^{a}	35.90 ± 1.17^{a}	63.68 ± 1.58^{bc}	87.68 ± 2.00^{cd}
T2	10.28 ± 0.66^{a}	36.11 ± 1.75^{a}	63.39 ± 2.18^{bc}	89.30 ± 2.15^{c}riptb^{cd}
T3	8.64 ± 0.55^{ab}	30.54 ± 1.51^{b}	61.43 ± 1.97^{c}	86.34 ± 1.99^{d}
T4	8.99 ± 0.54^{a}	37.12 ± 2.05^{a}	68.24 ± 2.29^{ab}	94.83 ± 3.13^{abc}
T5	7.11 ± 0.36^{bc}	27.75 ± 0.77^{b}	70.98 ± 1.78^{a}	95.91 ± 1.99^{ab}
T6	6.82 ± 0.54^{c}	28.21 ± 0.88^{b}	69.94 ± 1.87^{a}	98.30 ± 2.83^{a}
P value	0.0001	0.0001	0.0042	0.003

Means followed by the same letter in each column are not significantly different from each other at P=0.05 according to the Duncan's Multiple Range Test.

Table III: Effect of Yaramila complex fertilizer on the number of leaves per plant at different weeks after seeding.

Treatments	Number of leaves per plant	
	2 WAS	4 WAS
T1	5.2 ± 0.3^{b}	14.6 ± 0.5^{b}
T2	4.9 ± 0.2^{b}	14.6 ± 0.7^{b}
T3	7.2 ± 0.3^{a}	17.2 ± 0.7^{a}
T4	6.7 ± 0.3^{a}	17.8 ± 1.3^{a}
T5	6.9 ± 0.4^{a}	18.6 ± 0.3^{a}
T6	7.3 ± 0.3^{a}	18.6 ± 0.4^{a}
P value	0.0001	0.0001

Means followed by the same letter in each column are not significantly different from each other at P=0.05 according to the Duncan's Multiple Range Test.

number of fruits. At 2nd, 3rd and 4th pickings, higher numbers of fruits were observed in T6 which ranged 2.5−3.9 whereas the lowest numbers of fruits (range 1.0-1.8) were observed in T2. The overall (cumulative) number of fruits per plant varied significantly (P=0.0001) among the treatments. T6 (12.0) had a significantly higher number of fruits than the other treatments. Further, it was noted that T4 and T5 also produced high numbers (10.3 and 9.2) respectively compared to T1, T2 and T3. It may be due to the availability of required nutrients to produce a greater number of fruits in plants. Jilani *et al*. (2008) stated that proper nutrients enhance cucumber plant growth, which leads to an increase in the quantity of fruits per cucumber plant.

E. Fruit weight per plant

There was a significant difference (P=0.0033) in harvested fruit weight at 1st picking (55 days after seeding). Maximum fruit weight was noted in T6 (353.90 g), followed by T5 (332.89 g), while the lowest fruit weight was recorded in T3 (51.50 g) at 1st picking (Table VI). A significant difference was not observed in the harvested fruit weight per plant at each picking after 1st picking. Further, it was noted that among the treatments, significant variation was observed in the cumulative (total) fruit weight per plant (Figure 1). It ranged 785.8 g (T1) to 1,496.9 g (T5) from 1st - 4th pickings. Ahmed *et al*. (2007) found that cucumber fruit weight increased linearly as the nitrogen fertilizer rate increased. According to Choudhari and More (2002), cucumber plants that received NPK fertilizer generated the maximum fruit weight (g). To achieve optimal fruit output, tomato plants require sufficient nitrogen at various phases of growth (Seran and Imthiyas., 2016).

F. Fruit yield

There was a statistically significant difference (P=0.0012) among treatments (Figure 1). Treatment T5 had the highest average cumulative yield (14,968.9 kg/ha), while T3 had the lowest average cumulative yield (7,857.8 kg/ha). Yaramila fertilizer showed a remarkable effect on cumulative yield. These nutrients help to determine the yield attributing characters. This is in agreement with Osman *et al*. (2004), who found that all nitrogen treatments increased the quantity of fruits and marketable output of cucumbers when compared to the control. In Treatment 1, cumulative fruit weight is somewhat higher than T2 (Table V). This may be due to nutrient availability of soil. The observed results proved that by increasing NPK level the fruit weight also started

Table IV: Effect of Yaramila complex fertilizer on the number of branches per plant at 2, 4, 6, and 8 WAS.

Treatments	Number of branches per plant at different weeks after seeding			
	2 WAS	4 WAS	6 WAS	8 WAS
T1	1.1 ± 0.1	2.2 ± 0.1	4.0 ± 0.2	5.5 ± 0.7^{c}
T2	1.3 ± 0.2	2.2 ± 0.2	4.3 ± 0.2	5.9 ± 0.3^{bc}
T3	1.4 ± 0.2	3.2 ± 0.2	5.0 ± 0.2	6.4 ± 0.2^{ab}
T4	1.4 ± 0.2	2.7 ± 0.3	4.9 ± 0.3	6.3 ± 0.3^{abc}
T5	1.8 ± 0.1	2.8 ± 0.3	4.9 ± 0.3	6.9 ± 0.3^{a}
T6	1.7 ± 0.2	2.7 ± 0.3	4.9 ± 0.4	6.5 ± 0.3^{ab}
P value	0.0657	0.0921	0.0748	0.0126

Means followed by the same letter in each column are not significantly different from each other at P=0.05 according to the Duncan's Multiple Range Test.

Table V: Effect of Yaramila complex fertilizer on the number of harvested fruits per plant at one−week interval.

Treatments	Number of fruits harvested per plant				
	1^{st} picking	2^{nd} picking	3^{rd} picking	4^{th} picking	Total fruits
T1	0.5 ± 0.2^{d}	2.3 ± 0.6	1.3 ± 0.4^{c}	0.78 ± 0.4^{cb}	5.0^{d}
T2	0.3 ± 0.2^{d}	1.0 ± 0.2	1.8 ± 0.4^{c}	1.11 ± 0.4^{cb}	4.2^{d}
T3	1.2 ± 0.5^{cd}	2.2 ± 0.6	2.3 ± 0.5^{bc}	1.12 ± 0.3^{b}	7.0^{c}
T4	3.0 ± 0.3^{a}	1.5 ± 0.3	3.2 ± 0.5^{ab}	2.55 ± 0.6^{a}	10.3^{b}
T5	1.9 ± 0.4^{bc}	2.1 ± 0.4	2.5 ± 0.2^{bc}	2.67 ± 0.4^{a}	9.2^{b}
T6	2.4 ± 0.4^{ab}	2.5 ± 0.5	3.9 ± 0.3^{a}	3.22 ± 0.3^{a}	12.0^{a}
P value	0.0001	0.0887	0.0011	0.0003	0.0001

Means followed by the same letter in each column are not significantly different from each other at P=0.05according to the Duncan's Multiple Range Test.

Table VI: Effect of Yaramila complex fertilizer on the weight of harvested fruits per plant.

Treatments	Weights (g) of harvested fruits per plant at each picking			
	1^{st} picking	2^{nd} picking	3^{rd} picking	4^{th} picking
T1	194.8±69.0^{bc}	297.7±67.0	284.2±61.6	170.1±42.6
T2	110.9±44.9^{c}d	330.2±79.7	242.2±52.6	183.4±43.6
T3	051.5±23.3d	215.3±48.5	267.5±73.6	243.0±95.2
T4	253.1±48.7^{abc}	266.2±42.0	328.7±26.6	323.0±41.1
T5	332.9±49.4^{ab}	329.4±72.2	430.7±40.4	403.9±49.5
T6	353.9±28.9^{a}	251.2±47.8	400.3±65.9	350.2±84.2
P value	0.0033	0.0748	0.0951	0.0853

Means followed by the same letter in each column are not significantly different from each other at P=0.05 according to the Duncan's Multiple Range Test.

increasing gradually which shows the strong relation among NPK level and fruit weight accordingly.

IV. Conclusion

The results revealed that significant variations were noted on the measured parameters due to the application of cowdung with Yaramila complex fertilizer. There was a significant difference in number of fruits and fruit weight per cucumber plant. According to statistically analyzed results, Cowdung with Yaramila fertilizer had a significant influence on crop yield. The highest mean value of fruit yield was recorded in T5 (14968.89 kg/ha) and the low value was observed in T3 (7857.78 kg/ha). Therefore, 4 g Yaramila fertilizer as basal application and 4 g Yaramila fertilizer as top dressing (2 g at 2^{nd} week and also 2 g at 4^{th} week) could be applied to each plant for obtaining high yield of cucumber.

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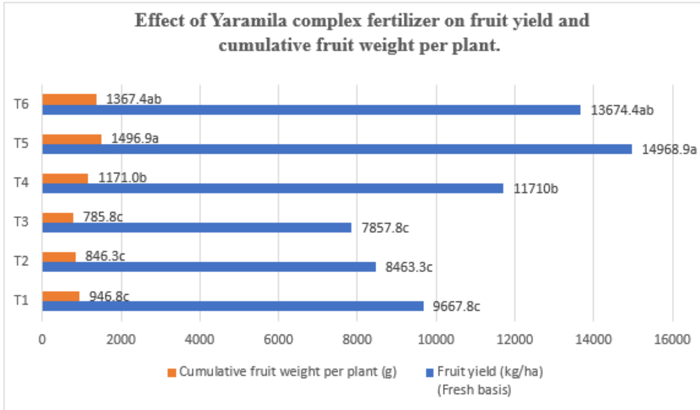

Figure 1: Effect of Yaramila complex fertilizer on fruit yield and Cumulative fruit weight per plant (g) — Means followed by the same letter in a bar are not significantly different from each other at P=0.05 according to the Duncan's Multiple Range Test.

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