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Influence of different dose of fertilizers management on growth and yield of Gimakalmi (*Ipomoea reptans* Poir)

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Abstract
The study was conducted in the horticulture of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from March to June 20013 to find out the influence of different dose of fertilizer management on the growth and yield of Gimakalmi. The experiment consisted of four levels of fertilizer, such as F_0: No fertilizer, F_1: Cowdung: 15 t/ha, F_2: Poultry litter: 7 t/ha and F_3: Inorganic fertilizer (Urea: 200 kg/ha + TSP: 100 kg/ha + MP: 200 kg/ha). At 75 DAS the longest (25.55 cm) plant was obtained from F_3, while the shortest (18.14 cm) plant was recorded from control condition. The maximum (55.56) number of leaves per plant was recorded from F_3, while the minimum (36.66) number of leaves per plant was recorded from control condition. The highest (10.69%) dry matter content of foliage was obtained from F_3, while the lowest (7.91%) dry matter content of foliage was recorded from control condition. The highest (16.28 t/ha) yield was recorded from F_3, while the lowest (12.81 t/ha) yield was recorded from control condition.

Keywords: Gimakalmi, fertilizers management, growth and yield.

1. Introduction
Gimakalmi (*Ipomoea reptans* poir), a leafy vegetable grown in Bangladesh, belongs to the family Convolvulaceae. It is an important vegetable of the South East Asia, and is widely grown throughout the South East Asian countries, Australia and some parts of Africa [6]. The crop is also known as kangkong, swamp cabbage, water convolvulus, water spinach etc. [13]. Gimakalmi was developed from an introduced strain of Kangkong brought from Taiwan by the Citrus and Vegetable Seed Research Centre of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur [11].

In Bangladesh most of the vegetables are produced in summer and winter season, while in between these two seasons, there is a lag period when scarcity of vegetables occur. Introduction of Gimakalmi is a positive achievement since it can be grown in summer and rainy season [12]. Although similar, but aquatic type of local Kalmi is naturally grown in ponds or marshy land of Bangladesh, Gimakalmi has a special significance, because it grows in upland soil with an appreciable yield potential of foliage. Unlike the Bangladeshi local Kalmi, Gimakalmi grows erect producing heavy foliage.

Gimakalmi is a very important leafy vegetable from the nutritional point of view. Like other leafy vegetable, it is nutritionally rich in vitamins, minerals, calories etc. It is an excellent source of Vitamin A. Leafy vegetable of 100 g of its edible portion contains 87.6 g water, 1.1 g minerals, 0.1 g fat, 9.4 g carbohydrates, 107 mg calcium, 3.9 mg iron, 10740 microgram carotene, 0.14 mg vitamin B_1, 0.40 mg vitamin B_2, 42 mg vitamin C, 1.8 g protein and 46 kilocalories. Since it requires low input, easy to grow, and is suitable for growing in summer, its cultivation should be increased. There are, however, signs of its gaining popularity among the Bangladeshi vegetable growers and consumers.

Deficiency of soil nutrient is now considered as one of the major constraints to successful upland crop production in Bangladesh [8]. The nutrient requirement can be provided by applying inorganic fertilizer or organic manure or both. Only organic manure application can replace the requirement of inorganic fertilizer. Organic manure improves soil structure as well as increase its water holding capacity. Moreover, it facilitates

aeration in soil. Recently, organic farming is appreciated by vegetable consumers as it enhances quality of the produce. Gimakalmi responds greatly to major essential elements like N, P and K for its growth and yield [9, 14] and inorganic fertilizer plays a vital role for proper growth and development of the crop. Application of inorganic fertilizer in appropriate time, dose and proper method is prerequisite for any crop cultivation [7]. Nitrogen, phosphorus and potassium progressively increase the marketable yield but an adequate supply is essential for vegetative growth, and desirable yield [16]. Excessive application is not only uneconomical but also induces physiological disorder.

Like many other vegetables such as root and tuber crops as well as spices, the growth and yield of Gimakalmi is influenced by organic and inorganic fertilizer. A number of factors like temperature, soil moisture are involved with organic and inorganic fertilizer which ultimately influence the growth and yield of the crop. Still to day there is few research work focusing on the effects of fertilizers management on the growth and yield of Gimakalmi production in Bangladesh. Considering above facts, the present study was undertaken with the following objective to find out the suitable fertilizer management for better growth and maximum yield of Gimakalmi.

2. Materials and Methods

The study was carried out in the horticulture farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from March to June 2013. The location of the experimental site is $23^0 74'$N latitude and $90^0 35'$E longitude an elevation of 8.2 m from the sea level. The experimental site belongs to the Madhupur Tract (UNDP, 1988) [15] under AEZ No. 28 and had Shallow red brown terrace soil. The selected plot was medium high land and the soil series was Tejgaon [3, 15]. The experimental site was under the subtropical climate, characterized by three distinct seasons, the monsoon or the rainy season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October [2]. For the research work, Gima Kalmi BARI-1 seed was used as the planting material. The seed of Gima Kalmi were collected from Siddique Bazar, Dhaka. Seeds were used @ 1.3 kg/ha. The experiment consisted of four levels of fertilizer, such as F_0: No fertilizer, F_1: Cowdung: 15 t/ha, F_2: Poultry litter: 7 t/ha and F_3: Inorganic fertilizer (Urea: 200 kg/ha + TSP: 100 kg/ha + MP: 200 kg/ha). The experiment was laid out in Randomized Complete Block Design (RCBD) with five replications. There were 20 unit plots altogether in the experiment. The size of the each plot was 1.5 m × 1.0 m. The plot selected for conducting the experiment was opened in the first week of March 2013 with a power tiller, and was kept exposed to the sun for a week, after one week the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain a good tilth condition. Direct sowing method was followed in this experiment and seeds were sown on 31 March, 2013 and to seeds were sown in each row where plant to plant distance 30 cm and row to row distance 25 cm. The fertilizers of urea, TSP and MP were applied in the experimental plot. The first harvest was done from all plots at 30 days of sowing of Gimakalmi seeds.

Ten plants were randomly selected from each unit plot for the collection of data. Data were recorded on plant height (cm), number of leaves per plant, dry matter content of stem, dry matter content of leaves and yield per hectare parameters from the sample plants during the course of experiment. The mean values of all the recorded characters were evaluated and analysis of variance was performed by 'F' (variance ratio) test. The significance of the difference of means was estimated by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984) [4].

3. Results and Discussion

3.1 Plant height

Different fertilizer management showed significant differences on plant height at 30, 45, 60 and 75 DAS (Figure 1). During 1st harvest at 30 DAS the longest (19.12 cm) plant was obtained from F_3 (200 kg/ha urea + 100 kg/ha TSP and 100 kg/ha MP) which was closely (17.41 cm) followed by F_2 (Poultry manure: 7 t/ha), while the shortest (15.38 cm) plant was the control condition i.e. no fertilizer. The longest (24.36 cm) plant was recorded from F_3 which was statistically similar (23.45 cm) with F_2 and the shortest (19.35 cm) plant was found from control condition i.e. no fertilizer at 45 DAS during 2nd harvest. During 3rd harvest at 60 DAS the longest (30.29 cm) plant was found from F_3 which was statistically similar (28.47 cm) to F_2 and the shortest (22.96 cm) plant gave the control condition i.e. no fertilizer. The longest (25.55 cm) plant was recorded from F_3 which was closely followed (23.02 cm) by F_2, while the shortest (18.14 cm) plant was observed in control condition i.e. no fertilizer. Chemical fertilizer ensures plant nutrients which help proper growth of plant and the results are the longest plant. It was revealed that tallest plant was found from F_3 (inorganic fertilizer) at 30, 45, 60 and 75 DAS. Awal (1989) [1] reported that plant height per plant were significantly increased by increasing manure dose.

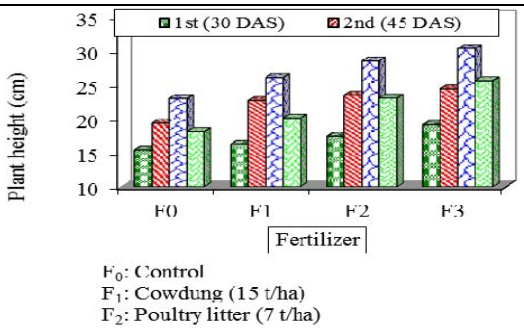

Figure 1. Effect of fertilizers on plant height of Gimakalmi at different days after sowing

3.2 Number of leaves per plant

Application of different fertilizers raveled significantly influence on number of leaves per plant at 30, 45, 60 and 75 DAS (Table 1). During 1st harvest at 30 DAS the highest (39.23) number of leaves per plant was recorded from F_3 (200 kg/ha Urea + 100 kg/ha TSP and 100 kg/ha MP) which was closely (35.38) followed by F_2 (Poultry manure: 7 t/ha), while the lowest (28.41) was obtained from control condition i.e. no fertilizer. The highest (45.97) number of leaves per plant was recorded from F_3 which was statistically similar (44.06) to F_2 and the lowest (33.84) number of leaves per plant was found from control condition i.e. no fertilizer at 45 DAS during 2nd harvest. During 3rd harvest at 60 DAS, the highest (57.76) number of leaves per plant was recorded from F_3 which was statistically similar (55.92) to F_2 and the lowest (38.57) number of leaves per plant was obtained from control condition i.e. no fertilizer.

The highest (55.56) number of leaves per plant was recorded from F_3 which was statistically similar (54.59) to F_2, while the lowest (36.66) number of leaves per plant was recorded from control condition i.e. no fertilizer during the harvest at 75 DAS. It was found that the maximum number of leaves obtained from inorganic fertilizer. The trend of the result that inorganic fertilizer increases number of leaves per plant. Hamid *et al.* (1986) [5] conducted significant variation among the different nitrogen treatment in number of leaves of Indian spinach.

Table 1: Effect of fertilizers management on number of leaves per plant at different days after sowing

Treatment	1st (30 DAS)	2nd (45 DAS)	3rd (60 DAS)	4th (75 DAS)
F_0	28.41	33.84	38.57	36.66
F_1	33.58	42.88	54.57	51.74
F_2	35.38	44.06	55.92	54.59
F_3	39.23	45.97	57.76	55.56
LSD (0.05)	0.201	0.546	0.222	7.745
CV (%)	9.24	6.55	4.06	3.55

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

3.3 Dry matter content of stem

Significant differences were obtained due to application of fertilizer management (Table 2). The highest (4.25%) dry matter was recorded from F_3 while the lowest (2.72%) was obtained from control condition at 30 DAS. At 45 DAS the highest (4.50%) dry matter was recorded from F_3 while the lowest (3.85%) was obtained from control condition. The highest (4.77%) dry matter was recorded from F_3 while the lowest (3.96%) was obtained from control condition at 60 DAS. At 75 DAS the highest (4.97%) dry matter was recorded from F_3 while the lowest (4.09%) was obtained from control condition. From the observation it was found that the highest result showed in F_3 (inorganic fertilizer). The possible reason regarding high dry matter of stem is that proper dose of inorganic fertilizer uptake other nutrient in balance condition which accumulated more plant nutrient that gave more dry matter in stem.

3.4 Dry matter content of leaves

Application of Different fertilizer showed significant differences with respect to dry matter content of leaves at 30, 45, 60 and 75 DAS (Table 2). During the 1st harvest at 30 DAS the highest (6.98%) dry matter content of leaves was recorded from F_3 (200 kg/ha Urea + 100 kg/ha TSP and 100 kg/ha MP) which statistically similar (6.58%) with F_2 (Poultry manure: 7 t/ha), while the lowest (5.27%) was obtained from control condition i.e. no fertilizer. The highest (8.50%) dry matter content of leaves was found from F_3 which was statistically similar (8.11%) to F_2 and the lowest (5.97%) dry matter content of leaves was recorded from control condition i.e. no fertilizer at 45 DAS during the 2nd harvest. During the 3rd harvest at 60 DAS the highest (10.17%) dry matter content of leaves was recorded from F_3 which was statistically similar (9.76%) to F_2 and the lowest (7.86%) dry matter content of leaves was obtained from control condition i.e. no fertilizer. The highest (10.69%) dry matter content of leaves was found from F_3 which was statistically similar (10.36%) to F_2, while the lowest (7.91%) dry matter content of leaves was recorded from control condition i.e. no fertilizer during 4th harvest at 75 DAS. From the observation it was found that highest dry matter content of leaves obtained from inorganic fertilizer it might be caused that in organic fertilizer increases dry matter content of leaves.

Table 2: Effect of fertilizers management on dry matter content of stem and leaves at different days after sowing

Treatment	Dry matter content (%) of stem at different days after sowing				Dry matter content of leaves (%)at different days after sowing			
	30 DAS	45 DAS	60 DAS	75 DAS	30 DAS	45 DAS	60 DAS	75 DAS
F_0	2.72 c	3.85	3.96 c	3.99 b	5.27 c	5.97 c	7.86 c	7.91 c
F_1	3.84 b	4.14	4.19 b	5.00 a	6.19 b	7.27 b	9.05 b	9.57 b
F_2	3.93 b	4.19	4.30 b	4.12 b	6.58 ab	8.11 a	9.76 a	10.36 a
F_3	4.25 a	4.50	4.77 a	0.457	6.98a	8.50 a	10.17 a	10.69 a
LSD (0.05)	0.241	0.516	0.222	7.51	0.454	0.682	0.618	0.701
CV (%)	7.12	8.15	6.96	5.51	7.43	9.35	6.86	7.44

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

3.5 Yield per hectare

Application of different fertilizer revealed significant differences for yield at 30, 45, 60 and 75 DAS (Table 3). During the 1st harvest at 30 DAS the highest (8.97 t/ha) yield was recorded from F_3 (Urea: 200 kg/ha + TSP: 100 kg/ha and MP: 100 kg/ha) which statistically similar (8.96 t/ha) to F_2 (Poultry manure: 7 t/ha), while the lowest (7.47 t/ha) was found from control condition i.e. no fertilizer. The highest (16.91 t/ha) yield was obtained from F_3 which was statistically similar (16.58 t/ha) to F_2 and the lowest (11.81 t/ha) yield was recorded from control condition at 45 DAS during the 2nd harvest. During the 3rd harvest at 60 DAS the highest (17.58 t/ha) yield was obtained from F_3 which was statistically similar (17.26 t/ha) to F_2 and the lowest (12.71 t/ha) yield was recorded from control condition i.e. no fertilizer. The highest (16.28 t/ha) yield was recorded from F_3 which was statistically similar (16.04 t/ha) to F_2, while the lowest (12.81 t/ha) yield was recorded from control condition i.e. no fertilizer at 75 DAS (4th harvest). It was revealed that the highest yield was found from inorganic fertilizer at 30, 45, 60 and 75 DAS. It might be caused that application of inorganic fertilizer increase the yield of Gima kalmi. Islam *et al.* (s) revealed that application of nitrogen increase yield and quality of kangkong.

Table 3: Effect of fertilizers management on yield at different days after sowing

Treatment	1st (30 DAS)	2nd (45 DAS)	3rd (60 DAS)	4th (75 DAS)
F_0	7.47	11.81	12.71	12.81
F_1	8.34	15.93	16.61	15.04
F_2	8.96	16.58	17.26	16.04
F_3	8.97	16.91	17.58	16.28
LSD $_{(0.05)}$	0.193	0.436	1.932	7.045
CV (%)	3.93	3.50	5.94	7.34

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability

4. Conclusion

At 75 DAS the longest (25.55 cm) plant was recorded from F_3, while the shortest (18.14 cm) plant was found from control condition. The maximum (55.56) number of leaves per plant was obtained from F_3, while the minimum (36.66) number of leaves per plant was recorded from control condition. The highest (10.69%) dry matter content of leaves was obtained from F_3, while the lowest (7.91%) dry matter content of leaves was recorded from control condition. The highest (2.44 kg/plot) yield was found from F_3, while the lowest (1.92 kg/plot) yield was recorded from control condition. The highest (16.28 t/ha) yield was obtained from F_3, while the lowest (12.81 t/ha) yield was recorded from control condition.

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