International Journal of Research and Review
www.gkpublication.in ISSN: 2349-9788

*Original Research Article*

# Influence Of Combined Effect Of Sowing Time And Fertilizers Management On Growth And Yield Of Gimakalmi *(Ipomoea Reptans Poir)*

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*Received: 02/05/2015* *Revised: 18/05/2015* *Accepted: 23/05/2015*

## ABSTRACT

The study was conducted in the horticulture of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from March to June 2013 to find out the effect of sowing time and fertilizer management on the growth and yield of Gimakalmi. The experiment consisted of two factors. Factor A: Three levels of sowing time, such as $S_1$: Sowing on 16 March, $S_2$: Sowing on 30 March and $S_3$: Sowing on 15 April; Factor B: 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 longest (30.77 cm) plant was recorded from $S_2F_3$, while the shortest (17.30 cm) plant was recorded from $S_2F_0$ at 75 DAS during 4$^{th}$ harvest. The highest (84.89 g) fresh weight of leaves per plant was recorded from $S_2F_3$, while the lowest (59.83 g) fresh weight of leaves per plant was found from $S_2F_0$ at 75 DAS during the 4$^{th}$ harvest. The highest (11.88%) dry matter content of leaves was recorded from $S_2F_3$, while the lowest (6.65%) dry matter content of leaves was recorded from $S_2F_0$ at 75 DAS during the 4$^{th}$ harvest. The highest (18.28 t/ha) yield was recorded from $S_2F_3$, while the lowest (12.67 t/ha) yield was obtained from $S_1F_0$ at 75 DAS during the 4$^{th}$ harvest.

***Key Words:*** Gimakolmi, sowing time, fertilizer management, growth and yield.

## 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. [1] The crop is also known as kangkong, swamp cabbage, water convolvulus, water spinach etc. [2] 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, Joydevpur, Gazipur. [3]

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 occurs. Introduction of Gimakalmi is a positive achievement since it can be grown in summer and rainy season. [4] 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.

At present Gimakalmi is produced in very small area of land following less or minimum management practices. To attain the maximum production and quality yield it is necessary to adopt proper management practices ensuring proper space and availability of essential nutrients. Gimakalmi thrives well in a fertile, clay loam soil because it requires considerable amounts of nutrients for rapid growth within short period of time. In our country most of the growers cultivate this crop in fallow land without proper care, sowing time, spacing and management practices.

A number of agronomic practices have been found to affect the yield of vegetable crops. Sowing time had a marked effect on growth and development of crops. Optimum sowing time provides more time for the growth and development of plant which is favorable for higher yield whereas both early and late sowing hinder the growth and development with lowest yield potential. Deficiency of soil nutrient is now considered as one of the major constraints to successful upland crop production in Bangladesh. [5] The nutrient requirement can be provided by applying inorganic fertilizer or organic manure or both. Only organic manure applicatoin 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 [6,7] 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. [8] Nitrogen, phosphorus and potassium progressively increase the marketable yield [9] but an adequate supply is essential for vegetative growth, and desirable yield. [10] 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 growing time and organic and inorganic fertilizer. A number of factors like temperature, soil moisture are involved with organic and inorganic fertilizer as well as sowing time which ultimately influence the growth and yield of the crop. Still to day there is few research work focusing on the effects of sowing time and 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 best combination of sowing time and fertilizer management of Gimakalmi to achieve maximum growth and ensuring higher yield.

## 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 Modhupur Tract [11] under AEZ No. 28 and had Shallow red brown terrace soil. The selected plot was medium high land and the soil series was Tejgaon. [12] 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. [13] 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 two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. An area 25.0 m × 7.5 m was divided into three equal blocks. There were 36 unit plots altogether in the experiment. The size of the each plot was 1.5 m × 1.0 m. The experiment consisted of two factors. Factor A: Three levels of sowing time, such as $S_1$: Sowing on 16 March, $S_2$: Sowing on 30 March and $S_3$: Sowing on 15 April; Factor B: 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 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 16 March, 31 March and 15 April and to seeds were sown in each row where plant to plant distance 30 cm and row to row distance 25 cm. The cow dung @ 15 ton/ha, poultry manure @ 7 ton/ha, Urea-TSP-MoP @ 200-100-200 kg/ha was applied this experiment. [14] The entire amounts of MP and TSP were applied during the final preparation of land. Urea was applied in three equal installments at 20, 40 and 60 days after seed sowing of Gimakalmi. The first harvest was done from all plots at 30 days of sowing of Gimakalmi seeds. The border plants were not included at harvest.

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. [15]

## RESULTS AND DISCUSSION

### Plant height

The variation was found due to the combined effect of sowing time and fertilizer management in terms of plant height at different days after sowing (Table 1). At 30 DAS during 1st harvest the longest (21.13 cm) plant was recorded from $S_2F_3$ (Sowing on 31 March and 200 kg/ha Urea + 100 kg/ha TSP and 100 kg/ha MP) which was similar to $S_2F_2$ (19.87 cm) and the shortest (13.18 cm) plant was recorded from $S_2F_0$ (Sowing on 31 March and no fertilizer). The longest (26.61 cm) plant was found from $S_2F_3$ which was followed by $S_2F_1$ (24.30 cm) and $S_2F_2$ (4.30 cm) while the shortest (18.04 cm) plant3 was recorded

from $S_2F_0$ at 45 DAS during 2nd harvest. At 60 DAS during 3rd harvest the longest (34.44 cm) plant was recorded from $S_2F_3$ (sowing on 31 March) which was similar to $S_2F_2$ (33.23 cm) and the shortest (19.63 cm) plant was recorded from $S_2F_0$ (Sowing on 31 March) and no fertilizer.

**Table 1. Combined effect of sowing time and fertilizer management on plant height and number of leaves per plant of Gimakalmi at different days after sowing**

| Treatment | Plant height (cm) at different days after sowing | | | | Number of leaves at different days after sowing | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 45 DAS | 60 DAS | 75 DAS | 30 DAS | 45 DAS | 60 DAS | 75 DAS |
| $S_1F_0$ | 15.69 e | 18.31 d | 23.86 c-e | 17.44 e | 28.01 fg | 32.51 f | 36.35 e | 36.84 f |
| $S_1F_1$ | 15.38 e | 21.82 c | 23.47 de | 16.40 e | 31.87 ef | 41.82 c-e | 52.31 c | 50.85 de |
| $S_1F_2$ | 15.84 de | 22.25 c | 25.40 cd | 18.27 de | 33.39 c-e | 42.86 b-d | 53.46 bc | 50.27 e |
| $S_1F_3$ | 18.05 b-d | 23.58 bc | 28.81 bc | 22.17 bc | 37.30 a-d | 44.60 a-d | 55.30 a-c | 52.33 c-e |
| $S_2F_0$ | 13.18 f | 18.04 d | 19.63 e | 17.30 e | 25.26 g | 31.05 f | 35.26 e | 35.38 f |
| $S_2F_1$ | 17.45 c-e | 24.30 a-c | 28.73 bc | 22.50 bc | 36.13 b-e | 46.26 a-b | 56.92 a-c | 53.27 c-e |
| $S_2F_2$ | 19.87 ab | 25.86 ab | 33.23 ab | 28.12 a | 39.14 ab | 47.48 ab | 59.26 ab | 57.80 ab |
| $S_2F_3$ | 21.13 a | 26.61 a | 34.44 a | 30.77 a | 42.44 a | 49.64 a | 61.12 a | 59.39 a |
| $S_3F_0$ | 17.26 c-e | 21.68 c | 25.39 cd | 19.67 c-e | 31.95 d-f | 37.97 e | 44.08 d | 37.78 f |
| $S_3F_1$ | 16.03 c-e | 21.80 c | 25.79 cd | 21.35 b-d | 32.74 c-f | 40.56 de | 54.49 bc | 51.09 de |
| $S_3F_2$ | 16.51 c-e | 22.23 c | 26.78 cd | 22.68 bc | 33.60 c-e | 41.83 c-e | 55.03 bc | 55.69 a-c |
| $S_3F_3$ | 18.17 bc | 22.90 c | 27.62 cd | 23.73 b | 37.96 a-c | 43.67 b-d | 56.87a-c | 54.95 b-d |
| $LSD_{(0.05)}$ | 2.048 | 2.574 | 4.573 | 3.559 | 4.771 | 4.661 | 5.417 | 3.746 |
| CV(%) | 7.10 | 6.77 | 9.90 | 9.69 | 8.25 | 6.60 | 6.19 | 9.46 |

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

## Number of leaves plant$^{-1}$

Combined effect of sowing time and fertilizer management in terms of number of leaves per plant at different days after sowing showed significant differences (Table 1). At 30 DAS during 1$^{st}$ harvest the highest (42.44) number of leaves per plant was recorded from the treatment combination of $S_2F_3$ (Sowing on 31 March and 200 kg/ha Urea + 100 kg/ha TSP and 100 kg/ha MP) and the lowest (25.26) number of leaves per plant was obtained from $S_2F_0$ (Sowing on 31 March and no fertilizer). The highest (49.64) number of leaves per plant was recorded from $S_2F_3$, while the lowest (31.05) number of leaves per plant was found from $S_2F_0$ at 45 DAS during 2nd harvest. At 60 DAS during 3rd harvest the highest (61.12) number of leaves per plant was obtained from $S_2F_3$, and the lowest (31.05) number of leaves per plant was recorded from $S_2F_0$. The highest (59.39) number of leaves per plant was recorded from $S_2F_3$, while the treatment combination of $S_2F_0$ showed the lowest (35.38) number of leaves per plant during 75 DAS in 4th harvest. This result showed that the highest number of leaves was found in $S_2F_3$ at 60 DAS.

## Dry matter content of stem

Combined effect of sowing time and fertilizer manage showed significant differences at 30, 45, 60 and 75 DAS (Table 2). At 30 DAS, the maximum (3.69%) dry matter was obtained from the treatment combination of $S_2F_3$ and the minimum (2.52%) was found from $S_1F_0$. The maximum (4.68%) dry matter was obtained from the treatment combination of $S_3F_3$ and the minimum (3.83%) was found from $S_1F_0$ at 45 DAS. At 60 DAS, the maximum (4.95%) dry matter was obtained from the treatment combination of $S_2F_3$ and the minimum (3.99%) was found from $S_1F_0$. The maximum (4.98%) dry matter was obtained from the treatment combination of $S_2F_3$ and the minimum (4.04%) was found from $S_1F_0$ at 75 DAS.

**Table 2. Combined effect of sowing time and fertilizer management on dry matter content of stem and leaves at different days after sowing of Gimakalmi**

| 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 |
| $S_1F_0$ | 2.52 | 3.83 bc | 3.99 c | 4.04 | 5.37 d | 6.02 ef | 7.94 e | 8.30 d |
| $S_1F_1$ | 3.08 | 3.97 b | 4.11 bc | 4.14 | 5.93 b-d | 6.49 c-e | 8.91 c-e | 9.56 b-d |
| $S_1F_2$ | 3.12 | 4.00 ab | 4.16 bc | 4.22 | 6.40 bc | 7.97 b-d | 9.57 b-d | 9.82 bc |
| $S_1F_3$ | 3.28 | 4.15 ab | 4.40 ab | 4.48 | 6.71 b | 8.23 bc | 9.70 bc | 9.89 bc |
| $S_2F_0$ | 2.93 | 3.93 b | 4.55 ab | 4.54 | 5.13 d | 5.11 f | 6.75 f | 6.65 e |
| $S_2F_1$ | 3.49 | 4.08 ab | 4.66 a | 4.64 | 6.73 b | 7.81 b-d | 9.78 bc | 10.25 b |
| $S_2F_2$ | 3.53 | 4.10 ab | 4.72 a | 4.73 | 7.60 a | 9.01 ab | 10.70 ab | 11.75 a |
| $S_2F_3$ | 3.69 | 4.26 ab | 4.95 a | 4.98 | 7.77 a | 9.72 a | 11.32 a | 11.88 a |
| $S_3F_0$ | 2.91 | 4.36 ab | 4.50 a | 4.10 | 5.32 d | 6.86 de | 9.05 c-e | 8.78 cd |
| $S_3F_1$ | 3.47 | 4.50 ab | 4.61 a | 4.20 | 5.91 b-d | 6.99 c-e | 8.45 de | 8.91 b-d |
| $S_3F_2$ | 3.52 | 4.53 ab | 4.67 a | 4.29 | 5.76 cd | 7.49 cd | 9.10 c-e | 9.49 b-d |
| $S_3F_3$ | 3.68 | 4.68 a | 4.90 a | 4.54 | 6.44bc | 7.61 cd | 9.50 cd | 10.24 b |
| $LSD_{(0.05)}$ | 1.425 | 0.729 | 0.527 | 1.82 | 0.787 | 1.182 | 1.071 | 1.214 |
| CV(%) | 6.03 | 7.19 | 8.06 | 9.26 | 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

**Dry matter content of leaves**

The variation was found due to the combined effect of sowing time and fertilizer management in terms of dry matter content of leaves at different days after sowing (Table 2). At 30 DAS during the 1st harvest, the highest (7.77%) dry matter content of leaves was recorded from $S_2F_3$ (Sowing on 31 March and 200 kg/ha Urea + 100 kg/ha TSP and 100 kg/ha MP) which was similar (7.60%) to $S_2F_2$ and the lowest (5.13%) dry matter content of leaves was recorded from $S_2F_0$ (Sowing on 31 March and no fertilizer). The highest (9.72%) dry matter content of leaves was recorded from $S_2F_3$ which was similar (9.10%) to $S_2F_2$ and the lowest (5.11%) dry matter content of leaves was found from $S_2F_0$ at 45 DAS during the 2nd harvest. At 60 DAS during the 3rd harvest the highest (11.32%) dry matter content of leaves was obtained from $S_2F_3$ which was statistically similar (10.70%) to $S_2F_2$ while the lowest (6.75%) dry matter content of leaves was recorded from $S_2F_0$. The highest (11.88%) dry matter content of leaves was recorded from $S_2F_3$ which was similar (11.75%) to $S_2F_2$ while the lowest (6.65%) dry matter content of leaves was found from $S_2F_0$ at 75 DAS during the 4th harvest. From the result it was revealed that both sowing time inorganic fertilizer favored growth of Gimakalmi.

**Table 3. Combined effect of sowing time and fertilizer management on yield per hectare of Gimakalmi at different days after sowing**

| Treatment | Yield (t/ha) at harvest | | | |
|---|---|---|---|---|
| | 1st (30 DAS) | 2nd (45 DAS) | 3rd (60 DAS) | 4th (75 DAS) |
| $S_1F_0$ | 7.91 c-e | 11.93 c | 12.79 c | 12.67 d |
| $S_1F_1$ | 7.83 c-e | 14.76 b | 15.62 b | 13.53 d |
| $S_1F_2$ | 8.46 bc | 15.41 b | 16.27 b | 13.57 d |
| $S_1F_3$ | 8.44 bc | 15.61 b | 16.48 b | 14.36 cd |
| $S_2F_0$ | 7.16 e | 11.60 c | 12.55 c | 13.05 d |
| $S_2F_1$ | 8.97 ab | 18.02 a | 18.32 a | 16.40 b |
| $S_2F_2$ | 9.82 a | 18.90 a | 19.20 a | 18.05 a |
| $S_2F_3$ | 9.78 a | 19.12 a | 19.42 a | 18.28 a |
| $S_3F_0$ | 7.35 de | 11.91 c | 12.78 c | 12.71 d |
| $S_3F_1$ | 8.21 b-d | 15.03 b | 15.89 b | 15.21 bc |
| $S_3F_2$ | 8.58 bc | 15.43 b | 16.30 b | 16.50 b |
| $S_3F_3$ | 8.70 bc | 15.99 b | 16.85 b | 16.21 b |
| LSD (0.05) | 0.838 | 1.729 | 1.237 | 1.534 |
| CV (%) | 5.87 | 6.67 | 8.56 | 6.02 |

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

**Yield per hectare**

Statistically significant variation was recorded due to the combined effect of sowing time and fertilizer management in terms of yield at different days after sowing (Table 2). At 30 DAS during the 1st harvest the highest (9.78 t/ha) yield was recorded from $S_2F_3$ (Sowing on 31 March and Urea: 200 kg/ha + TSP: 100 kg/ha and MP: 100 kg/ha) which was statistical similar to $S_2F_1$ (8.97 t/ha) and $S_2F_2$ (9.82 t/ha) the lowest (7.16 t/ha) yield was found from $S_2F_0$ (Sowing on 31 March and no fertilizer). The highest (19.12 t/ha) yield was obtained from $S_2F_3$ which was similar to $S_2F_1$ (18.02 t/ha) and $S_2F_2$ (18.90 t/ha) while the lowest (11.60 t/ha) yield was recorded from $S_2F_0$ at 45 DAS during the 2nd harvest. At 60 DAS during the 3rd harvest the highest (19.42 t/ha) yield was recorded from $S_2F_3$ which was statistical similar to $S_2F_1$ (18.32 t/ha) and $S_2F_2$ (19.20 t/ha) and the lowest (12.55 t/ha) yield was recorded from $S_2F_0$. The highest (18.28 t/ha) yield was recorded from $S_2F_3$ which was similar to $S_2F_2$ (18.05 t/ha) while the lowest (12.67 t/ha) yield was recorded from $S_1F_0$ at 75 DAS during the 4th harvest. From the result it was revealed that both sowing time and inorganic fertilizer favored higher yield of Gimakalmi.

## CONCLUSION

The longest (30.77 cm) plant was recorded from $S_2F_3$, while the shortest (17.30 cm) plant was recorded from $S_2F_0$ at 75 DAS during the 4th harvest. The highest (11.88%) dry matter content of leaves was recorded from $S_2F_3$, while the lowest (6.65%) dry matter content of leaves was recorded from $S_2F_0$ at 75 DAS during 4th harvest. The highest (2.74 kg/plot) yield was obtained from $S_2F_3$, while the lowest (1.90 kg/plot) yield was recorded from $S_1F_0$ at 75 DAS during the 4th harvest. The highest (18.28 t/ha) yield was obtained from $S_2F_3$, while the lowest (12.67 t/ha) yield was found from $S_1F_0$ at 75 DAS during the 4th harvest.

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How to cite this article: Akand Md. H, Khairul Mazed HEM, Pulok Md. AI et. al. Influence of combined effect of sowing time and fertilizers management on growth and yield of gimakalmi *(ipomoea reptans poir)*. Int J Res Rev. 2015; 2(5):198-204.

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