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Effect of different time of sowing on growth and yield of Gimakalmi

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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 effect of sowing time on the growth and yield of Gimakalmi. The experiment consisted of 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. The longest (24.67 cm) plant was recorded from S_2, while S_1 gave the shortest (18.57 cm) plant at 75 DAS during 4th harvest. The maximum (51.46) number of leaves per plant was recorded from S_2, while S_1 gave the minimum (49.35) number of leaves per plant at 75 DAS during 4th harvest. The highest (76.00 g) fresh weight of leaves per plant was recorded from S_3, while S_1 gave the lowest (71.86 g) fresh weight of leaves per plant at 75 DAS during 4th harvest. The highest (10.13%) dry matter content of leaves was recorded from S_3, while S_1 gave the lowest (9.36%) dry matter content of leaves at 75 DAS at 4th harvest. The highest (16.45 t/ha) yield was recorded from S_3, while S_1 gave the lowest (13.53 t/ha) yield at 75 DAS during 4th harvest.

Keywords: Gimakolmi, sowing time, 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 (Hossainand Siddique, 1982). The crop is also known as kangkong, swamp cabbage, water convolvulus, water spinach etc. (Tindal, 1983). 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 (Rashid et al., 1985).

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 (Shinohara, 1980). 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 B1, 0.40 mg vitamin B2, 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.

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. A number of factors like temperature, soil moisture are involved with 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 on the growth and yield of Gimakalmi production in Bangladesh. Considering above facts, the present study was undertaken with the following objective to determine the optimum sowing time for optimum growth and higher 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 Modhupur Tract (UNDP. 1988) under AEZ No. 28 and had Shallow red brown terrace soil. The selected plot was medium high land and the soil series was Tejgaon (FAO. 1988). 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 (Edris *et al.*, 1979). 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, Bangladesh. Seeds were used @ 1.3 kg/ha. The experiment consisted of 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. The experiment was laid out in Randomized Complete Block Design (RCBD) with five replications. There were 15 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 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 (Rashid, 1993). 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 (Gomez, and Gomez, 1984).

3. Results and Discussion

3.1 Plant height

A significant variation was found on plant height at different days after sowing due to sowing time (Figure 1). During 1st harvest at 30 DAS the longest (17.91 cm) plant was obtained form S_2 (sowing on 31 March) which was statistically similar (17.00 cm) to S_3 (sowing on 15 April) and the shortest (16.24 cm) plant was recorded form S_1 (sowing on 16 March). The longest (23.71 cm) plant was recorded from S_2 and the shortest (21.49 cm) was found from S_1which was statistically similar (22.15 cm) to S_3 at 45 DAS at 2nd harvest. At 60 DAS, in 3rd harvest the longest (29.01 cm) plant was recorded from S_2 and the shortest (25.38 cm) was recorded from S_1, which was statistically similar (26.40 cm) to S_3. The longest (24.67 cm) plant was recorded from S_2, while S_1 gave the shortest (18.57 cm) plant, which was followed (21.86 cm) by S_3 at 75 DAS at 4th harvest. Gimakalmi plant height increased upto a certain period of time under the present trial than decreased. But the sowing time of 31 March was the best for the growth of plant as compared to other sowing date.

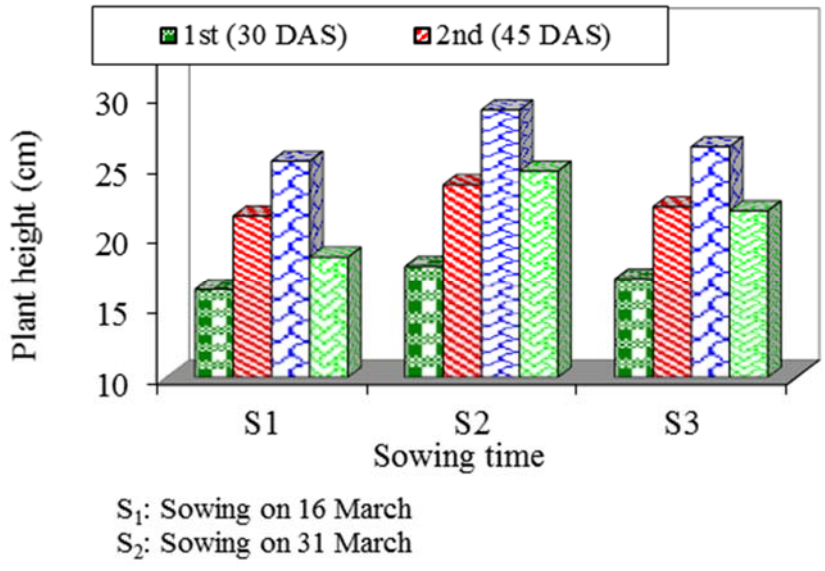

Fig 1: Effect of sowing time on plant height of Gimakalmi at different days after sowing

3.2 Number of leaves per plant

A Remarkable Variation was observed in respect of number of leaves per plant among different sowing time at 30, 45, 60 and 75 DAS (Table 1). During 1st harvest at 30 DAS the highest (35.74) number of leaves per plant was recorded form S_2 (sowing on 31 March) which was statistically similar (34.06) to S_3 (sowing on 15 April) and the lowest (32.64) number of leaves per plant was recorded form S_1 (sowing on 16 March). The highest (43.61) number of leaves per plant was found from S_2 and the lowest (40.45) was recorded from S_1 which was statistically similar (41.00) to S_3 at 45 DAS during 2nd harvest. During 3rd harvest at 60 DAS the highest (53.14) number of leaves per plant was recorded from S_2 which was statistically similar (52.62) to S_3 and the lowest (49.35) was obtained from S_1. The highest (51.46) number of leaves per plant was recorded from S_2 which was statistically similar (50.62) to S_3, while S_1 gave the lowest (49.35) number of leaves per plant at 75 DAS during 4th harvest. It was revealed that sowing time of 31 March was the best for number of leaves per plant compared to other sowing date. It might be caused that the plant which was planted in the March 31(S_2) Availed relatively favorable environment resulting higher number of leaves per plant.

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

Treatment	1st (30 DAS)	2nd (45 DAS)	3rd (60 DAS)	4th (75 DAS)
S_1	32.64	40.45	49.35	47.57
S_2	35.74	43.61	53.14	51.46
S_3	34.06	41	52.62	49.87
$LSD_{(0.05)}$	0.592	0.892	0.535	0.925
CV (%)	9.37	3.84	7.84	6.52

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

There was significant variation on dry matter content of stem at different days after sowing (Table 2). The maximum (3.14%) dry matter content of stem was found from S_2 which was statistically similar (3.11%) to S_3 and treatment S_1 had the lowest (2.32%) dry matter of stem at 30 DAS. At 45 DAS the maximum (4.87%) dry matter content of stem was found from S_3 and treatment S_1 had the lowest (3.81%) dry matter of stem. The maximum (5.14%) dry matter content of stem was found from S_2 which was statistically similar (5.04%) to S_3 and treatment S_1 gave the lowest (4.03%) dry matter of stem at 60 DAS. At 75 DAS the maximum (5.00%) dry matter content of stem was found from S_2 which was closely followed by S_3 (4.12%) and treatment S_1 gave the lowest (3.99%) dry matter of stem.

Table 2: Effect of sowing time 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
S_1	2.32 c	3.81	4.03 b	3.99 b	6.10 b	7.29 b	9.03 b	9.41 b
S_2	3.14 a	4.02	5.14 a	5.00 a	6.81 a	7.91 a	9.64 a	10.13 a
S_3	3.11 a	4.87	5.04 a	4.12 b	5.86 b	7.18 b	8.96 b	9.36 b
$LSD_{(0.05)}$	0.531	0.912	0.634	0.457	0.394	0.591	0.536	0.607
CV(%)	7.23	5.45	6.49	7.51	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

3.4 Dry matter content of leaves

There had a variation of dry matter content of leaves among three sowing time at different days after sowing (Table 2). During 1st harvest at 30 DAS the highest (6.81%) dry matter content of leaves was recorded form S_2 (sowing on 31 March) and treatment S_1 showed the lowest (5.86%) dry matter which was statistically similar (6.10%) to S_3 (sowing on 15 April). The highest (7.91%) dry matter content of leaves was recorded from S_2 and the lowest (7.18%) was obtained from S_3 which was statistically similar (7.29%) with S_1 at 45 DAS during the 2nd harvest. At 60 DAS during the 3rd harvest the highest (9.64%) dry matter content of leaves was recorded from S_2 and the lowest (8.96%) was recorded from S_3 which was closely followed (9.03%) by S_3. The highest (10.13%) dry matter content of leaves was recorded from S_3, while S_1 gave the lowest (9.36%) dry matter content of leaves which was statistically similar (9.41%) to S_2 at 75 DAS during 4th harvest. It was revealed that the highest dry matter content of leaves was found from S_3 as 75 DAS. It might be caused due to availed favorable environment.

3.5 Yield per hectare

There had variation of yield among three sowing time at 30, 45, 60 and 75 days after sowing (Table 3). During the 1st harvest, at 30 DAS the highest (8.93 t/ha) yield was recorded form S_2 (sowing on 31 March) and the lowest (8.16 t/ha) yield was found form S_1 (sowing on 16 March) which was statistically similar (8.21 t/ha) to S_3 (sowing on 15 April). The highest (16.91 t/ha) yield was obtained from S_2 and the lowest (14.43 t/ha) was recorded from S_3 which was statistically similar (14.59 t/ha) to S_1 at 45 DAS during the 2nd harvest. At 60 DAS during the 3rd harvest, the highest (17.37 t/ha) yield was recorded from S_2 and the lowest (15.29 t/ha) was recorded from S_1 which was closely followed (15.46 t/ha) by S_1. The highest (16.45 t/ha) yield was recorded from S_3, while S_1 gave the lowest (13.53 t/ha) yield which was closely followed (15.16 t/ha) by S_2 at 75 DAS during the 4th harvest. It was revealed that the highest yield per hectare was found in sowing on 31 March at 30, 45, 60 and 75 DAS. It might be caused due to availed environment condition was favorable for high yield of Gimakalmi.

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

Treatment	1st (30 DAS)	2nd (45 DAS)	3rd (60 DAS)	4th (75 DAS)
S_1	8.16	14.43	15.29	13.53
S_2	8.93	16.91	17.37	16.45
S_3	8.21	14.59	15.46	15.16
$LSD_{(0.05)}$	0.108	0.942	0.945	0.995
CV(%)	3.84	3.93	4.28	4.52

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

The longest (24.67 cm) plant was recorded from S_2, while S_1 gave the shortest (18.57 cm) plant at 75 DAS during the 4th harvest. The maximum (51.46) number of leaves per plant was found from S_2, while S_1 gave the minimum (49.35) number of leaves per plant at 75 DAS during the 4th harvest. The highest (10.13%) dry matter content of foliage was recorded from S_3, while S_1 gave the lowest (9.36%) dry matter content of foliage at 75 DAS at 4th harvest. The highest (2.47 kg/plot) yield was recorded from S_3, while S_1 gave the lowest (2.03 kg/plot) yield at 75 DAS during the 4th harvest. The highest (16.45 t/ha) yield was recorded from S_3, while S_1 gave the lowest (13.53 t/ha) yield at 75 DAS at 4th harvest.

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