Performance of Gima kalmi (*Ipomomea reptans*) under multilayer Agroforestry systems as influenced by fertilizer application

S. M. Shafi, G. M. M. Rahman, M. A. Rahim and M. S. Alam
Department of Agroforestry,BAU,Mymensingh

Abstract: The experiment was conducted at the Germplasm Centre, Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the period from April to May 2007 to study the effect of different levels of fertilizer and canopy on the growth and yield of Gima Kalmi (Kangkong).The experiment consisted of four fertilizer levels viz., no fertilizer, recommend fertilizer, 20% and 40% less fertilizer of recommended dose and three canopy structure viz. no canopy (open area), lemon canopy and guava canopy were included in this experiment. The result revealed that plant height, number of leaves per plant, number of branches per plant, fresh weight of foliage per plant, yield per plot and yield per hectare grown under lemon and guava canopy showed significantly reduction than those grown in no canopy. The ranked order of different canopy structure for better performance were no canopy>lemon canopy>guava canopy. The maximum plant height and number of leaves, number of branches, fresh weight of foliage per plant were observed in recommended dose of fertilizer. A total of 7.39 t/ha yield was obtained at recommended dose of fertilizer at 45 DAS, whereas the lowest yield (5.79 t/ha) was found from the control treatment (no fertilizer).

Introduction

Gima Kalmi (*Ipomoea reptans*) is a leafy vegetable which belongs to the family Convolvulaceae. The vegetable crop is also known as kangkong, swamp cabbage, water convolvulus, water spinach etc. (Tindal, 1983). Now a day, canopy orientation is an important practice for Bangladesh as well as in the world because of people can get more return round the year from the same orchard from the same time through multilayer cropping system. For proper crop production, application of fertilizer at optimum dose is one of the most important factors. Fertilizer increases the vegetative growth of plants and produces good quality foliage and promotes carbohydrate synthesis (Rai, 1981). For successful production, Gima Kalmi requires early and rapid vegetative growth, which could be influenced by application of fertilizers. The use of fertilizer for the production of Gima Kalmi is particularly important when several harvests are done from a single plant. In Bangladesh fertilizer is mostly used as the source of NPK and split application of this fertilizer is commonly practised for leafy vegetable production (Hossain, 1990). On the other hand, optimum plant spacing ensures judicious use of natural resources, makes the intercultural operations easier, which help increase the number of leaves and branches. In Bangladesh information about spacing to be used

in Gima Kalmi cultivation is scanty. The farmers cultivate this crop according to their own conception due to absence of standard production technique. As a result they do not get satisfactory yield and ultimately become financially loser. Therefore, program was undertaken to evaluate the comparative performance of gimakalmi grown under three years old guava and lemon tree species

Materials and Methods

The experiment was conducted in the field laboratory of Germplasm Centre of Fruit Tree Improvement Project, Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period from 3rd April to 17th May, 2007 to investigate the effect of different levels of fertilizer, plant density and canopy structure on the growth and yield of Gima Kalmi. In this research work, Gima Kalmi seed was used as the planting material. Seeds were used @ 10 kg/ha for 108 m^2 of land (rate 1 gm/1 m^2 land). The present experiment comprised of two factors, which are as follows. Factor A: Three canopy orientations: Open (without tree) canopy, (C_0) Lemon canopy (C_1) and Guava canopy (C_2); Factor B: Four doses of mixed fertilizer: No fertilizer (T_o), Recommended (Optimum) dose (T_1), 20% less than the recommended dose (T_2), 40% less than the recommended dose(T_3) was laid out following Randomized Complete Block Design (RCBD) with three replications. The following doses of manure and fertilizers were applied to grow the experimental crop as recommended by BARI (1983). Cowdung 1 kg/Plot, Triple Super Phosphate (TSP) 11 gm/plot, Muriate of potash (MP) 11 gm/plot, Urea (No top dressing) 37 gm/plot .The unit plot size was 1.0 m × 1.0 m. Two seeds were sown directly in each planting hole at one cm depth and covered with a thin layer of soil. Thinning was done seven days after emergence and only one seedling was allowed to grow in each hill. Intercultural operation was done as and when necessary. Data were recorded on plant height, number of leaves per plant, number of branches per plant, yield per plant, yield per plot, yield per hectare. The mean differences were evaluated by Least Significant Difference (LSD) test (Freed, 1992).

Results and Discussion

Effect of canopy orientation: Performance of Gima Kalmi (Kangkong) grown under 3 years old lemon (*Citrus aurantifolia*), guava (*Psidium guajava*) canopy and no canopy in different orientation were evaluated. Morphological characteristics as well as the yield of Kangkong were significantly influenced by different tree canopy in different orientation. The morphological characteristics on the studied parameters decreased remarkably by tree canopy. Higher plant height was observed in different orientation under tree canopy, where significantly the tallest plant (26.49 cm) was observed in no canopy orientation and the shortest (15.51 cm) plant was recorded in guava canopy and moderate (21.50 cm) was under lemon canopy. In case of number of leaves per plant (50.24), number of branches per plant (5.77), fresh weight of foliage per plant (50.54 g/plant) were always lower under guava canopy compared to no canopy (70.97, 9.36 & 80.20 g/plant). Plant growth was moderate under lemon canopy. The maximum yield per hectare (8.00 t/ha) was found under no canopy,

moderate (6.40 t/ha) under lemon canopy and lowest (4.80 t/ha) under guava canopy at 45 DAS (Table 1).

Table 1. Effect of canopy structure on the growth and yield of Gima Kalmi at 45 DAS

Treatment	Plant height (cm)	Number of leaf per plant	Number of branches per plant	Fresh weight of foliage per plant (g)	Yield per plot (Kg)	Yield per hectare (t/ha)
No (Control)	26.49a	70.97a	9.36a	80.20a	0.80a	8.00a
Lemon canopy	21.50b	64.21b	7.16b	64.20b	0.64b	6.40b
Guava canopy	15.51c	50.24c	5.77c	50.54c	0.48c	4.80c
$S\overline{X}$	0.06	0.10	0.04	0.09	0.01	0.10
Level of significance	**	**	**	**	**	**

Table 2. Effect of fertilizer on the growth and yield of Gima Kalmi at 45 DAS

Treatment	Plant height (cm)	Number of leaf per plant	Number of branches per plant	Fresh weight of foliage per plant (g)	Yield per plot (kg)	Yield per hectare (t/ha)
No fertilizer	19.40d	58.01d	6.84c	60.91c	0.58c	5.79c
Recommended fertilizer	23.87a	66.51a	9.08a	70.51a	0.74a	7.39a
20% less fertilizer	21.56b	62.77b	7.36b	67.37b	0.65b	6.52b
40% less fertilizer	19.83c	59.93c	6.43d	61.13c	0.59c	5.89c
$S\overline{X}$	0.07	0.11	0.05	0.11	0.01	0.11
Level of significance	**	**	**	**	**	**

Table 3. Combined effect of canopy and fertilizer on the growth and yield of Gima Kalmi at 45 DAS

Treatment Combination	Plant height (cm)	Number of leaf per plant	Number of branches per plant	Fresh weight of foliage per plant (g)	Yield per plot (kg)	Yield per hectare (t/ha)
C_0T_0	25.34c	66.23d	8.41d	74.44c	0.71	7.13
C_0T_1	28.89a	76.86a	11.59a	87.79a	0.92	9.22
C_0T_2	26.48b	71.04b	9.76b	84.19b	0.83	8.27
C_0T_3	25.23c	69.74c	7.68e	74.39c	0.74	7.38
C_1T_0	19.27g	61.00f	6.92f	60.40f	0.59	5.88
C_1T_1	23.49d	69.24c	8.73c	69.69d	0.74	7.41
C_1T_2	22.41e	65.43e	6.70f	65.79e	0.65	6.47
C_1T_3	20.82f	61.17f	6.28g	60.91f	0.58	5.83
C_2T_0	13.59i	46.79j	5.19i	47.88i	0.44	4.37
C_2T_1	19.23g	53.43g	6.91f	54.06g	0.55	5.55
C_2T_2	15.78h	51.83h	5.62h	52.13h	0.48	4.83
C_2T_3	13.42i	48.89i	5.34i	48.10i	0.45	4.47
$S\overline{X}$	0.12	0.20	0.08	0.19	0.02	0.20
Level of significance	**	**	**	**	NS	NS

C_0 = Open area (control) T_0 = No fertilizer, T_1 = Recommended fertilizer
C_1 = Lemon canopy T_2 = 20% less fertilizer recommended rate
C_2 = Guava canopy T_3 = 40% less fertilizer

The figures in a column having the same letter(s) do not differ significantly.

** = Significant at 0.01 level; NS = Not significant

Effect of fertilizer: Levels of fertilizer significantly influenced on all the parameters studied. The values of yield contributing characters increased with an increase of fertilizer

level. The maximum plant height (23.87 cm), number of leaves per plant (66.51), number of branches per plant (9.08), fresh weight of foliage per plant (70.51 g/plant), yield per plot (0.74 kg/plot) and yield per hectare (7.39 t/ha) were found with the application of recommended dose of fertilizer respectively at 45 DAS under no canopy and the minimum plant height (19.40 cm), number of leaves per plant (58.01), number of branches per plant (6.84), fresh weight of foliage per plant (60.91 g/plant), yield per plot (0.58 kg/plot) and yield per hectare (5.79 t/ha) were observed at 45 DAS under guava canopy at no fertilizer level. The yield increased with the increase significantly in fertilizer levels. The highest yield per hectare (7.39 t/ha) was found by applying recommended dose of fertilizer and the lowest (5.79 t/ha) result was found from the control treatment where no fertilizer applied. It might be due to the fact that fertilizer might be encouraged vegetative growth of Gima Kalmi plant and as a result photosynthesis occurred at higher rate in the leaves producing more yield. The yield per hectare increased with the increasing levels of fertilizer as stated by different scientific (Bruemmer and Roe, 1979; Rashid *et al.*, 1981; Islam, *et al.* 1984; Rahman, *et al.* and Aditya *et al.*, 1995). It was also found that yield per hectare gradually decreased at 20% and 40% less fertilizer treatment (Table 2).

Combined effect of canopy and fertilizer on the growth and yield of GimaKalmi at 45 DAS

The combined effect of different canopy and levels of fertilizer on the growth and yield of Gima Kalmi at 45 DAS was presented in Table 2. The highest plant height, number leaves per plant, number of branches per plant, fresh weight foliage per plant, yield per plot and yield per hectare were (28.89 cm, 76.86, 11.59, 87.79 g, 0.92 kg and 9.22 t/ha), respectively. The lowest plant height, number of leaves per plant, number of branches per plant, fresh weight foliage per plant, yield per plot and yield per hectare were (13.42 cm, 46.79, 5.19, 47.88 g, 0.44 kg and 4.37 t/ha), respectively (Table 3).

Conclusion

Among different canopy orientation Kangkong grown in open area showed the best performance and under guava canopy orientation showed the lowest performance, where lemon canopy orientation showed comparatively moderate performance. According to the experimental results it may be concluded that two tree species can be used in agroforestry systems by different management practices. But degree of their suitability for agroforestry systems were open>lemon>guava.The values of yield contributing characters increased with an increase in fertilizer level.

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