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EFFECT OF ALLEY SIZE AND HEDGEROW PRUNING INTERVAL ON PHENOLOGY AND YIELD OF OKRA *[Abelmoschus esculentus* (L.) Moench] IN HILL SLOPE

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Abstract

An experiment was conducted at the Hill Agricultural Research Station, Khagrachari from May 2002 to November 2004 to find out the effect of alley size (3.0 , 4.0, and 5.0 m) and hedgerow pruning interval (1, 2, and 3 months) on phenology and fruit yield of okra in hill slope condition during the rainy season. The highest fruit yield (16.14 t/ha) was produced by the plants grown in 3.0 m size alley. In case of hedgerow pruning interval, the highest yield (16.07 t/ha was recorded from 2 months pruning interval and it was significantly different with other two pruning intervals. The treatment combination of 3.0 m size alley with I month pruning interval produced significantly highest yield (17.67 t/ha). The highest gross return (Tk.176700/ha), net return (Tk.120380/ha) and BCR (3.14) were also found from the same treatment though highest cost of production was involved in this treatment.

Key words: Alley size, pruning interval, phenology, okra yield, cost benefit.

Introduction

Okra *[Abelmoschus esculentus* (L.) Moench] is an annual vegetable crop in tropical and sub-tropical parts of the world (Thakur and Arora, 1986). It is one of the important nutritious vegetable crops grown round the year in Bangladesh. Vegetable availability in Bangladesh is primarily concentrated in the winter season. The shortage of vegetables prevails from June to September (rainy season) due to lower production. Of the total vegetable production, around 70% is produced during *rabi* season and the rest 30% in *kharif* season (Hossain, 1992). This scenario of vegetable production emphasizes to increase vegetable production during summer season. There are two ways to increase vegetable production in Bangladesh during summer season-one is management practice and another is introduction of new vegetables. Introduction of new summer vegetable is time consuming while adoption of appropriate agronomic techniques is quick and easy approach to increase vegetable production. Okra is usually grown in summer season, and adoption of proper agronomic techniques is the best option to increase its yield and meet the demand during the lean period of vegetable production.

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Among the agronomic techniques, alley size (Distance between two hedgerow lines) and hedgerow pruning interval are important to maximize crop yield. Hedgerow intercropping/alley cropping could be a sound technology for sustainable crop production in hilly area. Kang and his colleagues at the International Institute of Tropical Agriculture (IITA) first introduced the concept of hedgerow intercropping system in 1970. It is an agroforestry system similar in approach to the contour hedgerow system or alley cropping system. In this system, food corps are grown in alley formed hedgerows of trees and/or shrubs preferably legumes. The hedgerows are periodically pruned during cropping to prevent shading and to reduce competition. Moreover, the pruning provides green manure or mulch materials for the benefit of the associated food crops (Kang *et al.*, 1981; Rain Tree and Warner, 1986; Kang *et al*., 1990). When there are no crops, the hedgerows are allowed to grow freely to cover the land (Kang *et al.,* 1984). During the cropping season, pruned materials obtained from different hedgerow species are incorporated to the soil in order to improve the soil condition and ultimately improve the growth and development of associate crops (Miah, 1993). *Gliricidia sepium, Leucaena leuocosepala, Indigofera tysmanii* are the most suitable tree species that are used widely in the alley cropping system throughout the world. Alley size and hedgerow pruning interval play vital role for crop production in hedgerow intercropping system. Therefore, the experiment was undertaken to find out the effect of alley size and hedgerow pruning interval on phenology and the yield of okra in hill slope condition.

Materials and Method

The experiment was conducted at 5-20 % hill slope at the Hill Agricultural Research Station, Khagrachari from May 2002 to November 2004. The soil in the area belongs to brown hill soil type series under Northern and Eastern Hills (AEZ-29). It is generally well drained and clay loam in texture. Soil parameters are given in Table 4.The experiment was laid out in a split plot design with three replications. The main plot treatments were assigned in 3 alley sizes viz. 3.0, 4.0, and 5.0 m. The treatments in the sub-plot consisted of different pruning intervals as 1, 2, and 3 month. The okra variety was BARI Dherosh- 1. Seeds of okra were sown in 1 June 2004. The unit plot size was 3.0 x 2.4 m, 4.0 x2.4 m, and 5.0 x2.4 m depending on alley size. Fertilizers were applied at the rate of 150, 100, and 150 kg/ha of Urea, TSP, and MP, respectively. Cowdung was used 10 t/ha during land preparation. Intercultural operations were done as and when necessary. Harvesting was started from 15 July and continued upto 30 November 2004. Data on phenology were recorded from ten randomly selected plants.

Hedgerow establishment and management

Hedgerow seeds (Indigofera) was collected from "Slopping Agricultural Land Technology (SALT) model farm at Allotila, Khagrachari (Established by Upland Settlement Project, Hill Tracts Development Board). Seedlings of Indigofera were raised in polybag nursed for about 3 months. The seedlings were transplanted during August 2002 and adequate management practices were done to establish the seedlings. Plant to plant distance was 50 cm for Indigofera. Indigofera was pruned 12 months after transplanting above 1 m from ground and all pruned materials were used in the soil as mulch and green manure. Collected data were subjected to statistical analysis by F-test and the differences among the treatment means were judged by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Days to first flower bud initiation

Number of days required for first flower bud initiation showed a significant variation due to variable of alley width (Table 1). It was observed that first flower bud appeared in 3 days in 3 and 4 m wide alley that showed significant variation from 5 m wide alley. In this regard, in narrow size alley took comparatively more time. In initial stage, plant growth condition was comparatively poor in narrow alley. This might be due to less availability of light which delayed flower bud initiation.

Table 1. Effect of alley size and hedgerow pruning interval on phenology of okra.

Treatment	Days to 1st flower bud initiation	Days to 1st flowering	Days to 1st fruit harvesting	Days to last fruit harvest
Alley size				
3 m width (A_1)	30 a	40 a	47 a	118a
4 m width (A_2)	30a	40 a	46 b	115 ab
5 m width (A3)	29 b	38 b	45 b	109 c
Pruning interval				
1 month (P_1)	30 a	39b	46 b	
2 month (P_2)	30a	39b	45 b	
3 month (P_3)	30a	40 a	47 a	

Means followed by different letter(s) differ significantly at 5% level by DMRT.

Hedgerow pruning interval did not show significant difference among treatments to reach the stage of first flower bud initiation (Table 1). There was no significant interaction between alley size and hedgerow pruning interval regarding time required for first flower bud initiation (Table 2).

Days to first flowering

Table 1 shows that alley with width and pruning interval had profound influence on the length of time required from sowing to first flower opened. Result showed quite similar trend as days to first flower bud initiation. Less time was required for wide alley size.

Table 2. Combined effect of alley size and hedgerow pruning interval on phenology of okra.

Treatment	Days to 1st flower bud initiation	Days to 1st flowering	Days to 1st fruit harvesting	Days to last fruit harvest
A_1P_1	30	40b	46b	122a
A_1P_2	30	40b	46 b	121 ab
A_1P_3	31	41a	48a	110c
A_2P_1	30	40b	45c	118b
A_2P_2	30	40b	45c	118b
A_2P_3	30	41 a	46 b	110 c
A_3P_1	29	38d	45 c	110c
A_3P_2	29	38d	45c	111 c
A_3P_3	30	39c	46.0b	106d
CV (%)	0.69	0.53	0.91	1.52

Means followed by different letter(s) differ significantly at 5% level by DMRT.

Alley size and hedgerow pruning interval interacted significantly on days required for first flowering (Table 2). The shortest time (38 days) was required in A_3P_2 that showed significant variation with all other treatment combinations and the maximum time (41 days) was required in A_1P_3 followed by A_2P_2.

Days to first fruit harvest

The difference among the alley size in respect of days to first harvest was significant (Table 1). It was observed that days required sowing to first fruit harvest was increased with the increase of alley width. The crop grown in 5 m wide alley took 45 days which gradually increased upto 47 days in 3 m wide alley. In case of hedgerow pruning interval, 3 months interval required the highest time (47 days) for first fruit harvest, which was statistically different from other two treatments (Table 1).

Significant difference was observed in respect of days to first harvest when interaction effect was considered (Table 2). Identically the shortest time for okra harvest was recorded in the treatment combination of A_3P_1 (45 days), A_3P_2 (45 days), and A_2P_2 (45 days), respectively. More time was required in closed alley size with longer pruning interval.

Table 3: Benefit cost analysis of okra as influenced by alley size and hedgerow pruning interval.

Treatment combinations	Gross return (Tk./ha)	Cost of production (Tk./ha)	Net return (Tk./ha)	Benefit cost Ratio (BCR)
A_1P_1	176700	56320	120380	3.14
A_1P_2	174800	55900	118900	3.13
A_1P_3	132700	54010	78690	2.46
A_2P_1	141800	54450	87350	2.60
A_2P_2	162800	55550	67250	2.93
A_2P_3	111500	52860	58640	2.11
A_3P_1	128100	53020	75080	2.42
A_3P_2	144600	52860	91740	2.73
A_3P_3	101800	51700	50100	1.97

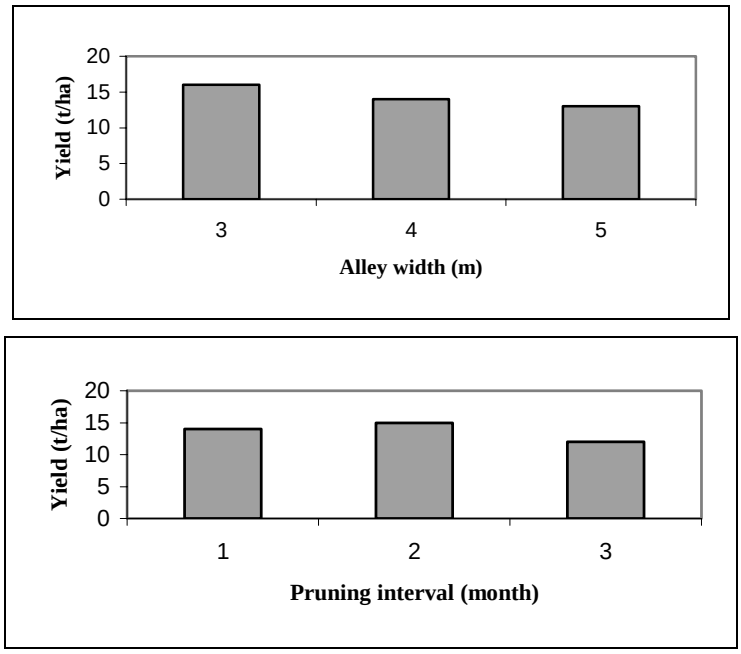
Alley size (Width): A_1-3 m, A_2-4 m, A_3-5 m
Pruning interval: P_1-1 month, P_2-2 month, P_3- 3 month
Price of okra: Tk.. 10.00/kg BCR: Gross return ÷ Cost of production

Days to last fruit harvest

Alley size widely differed in days required for last fruit harvest (Table 1). Plants grown in 3 m wide alley has got longest time (118 days) to produce fruit followed by 4 m wide alley (115 days). Marked variation was noticed among the hedgerow pruning interval in case of time for last fruit harvest (Table 1). One and two months pruning interval treatment was superior than 3 months interval. The alley size significantly interacted with pruning interval (Table 2). The maximum time (122 days) regarding this parameter was observed in A_1P_1 followed by A_1P_2 (121 days) and minimum time from A_3P_3 (100 days).

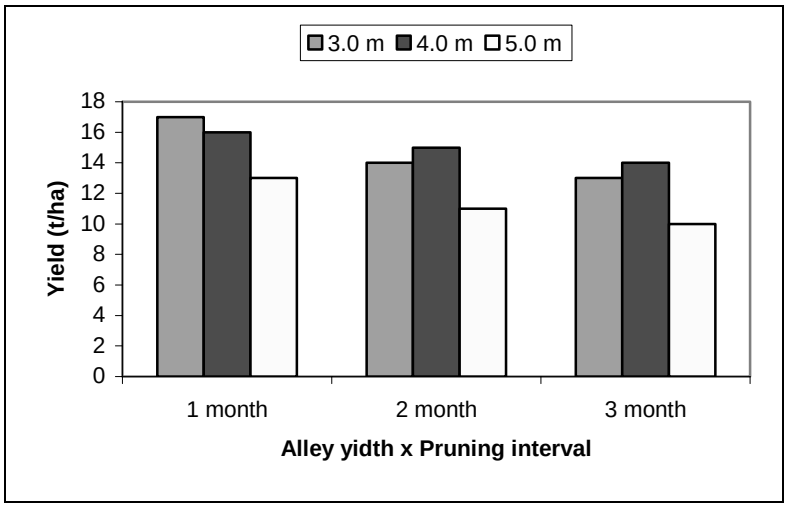
Fruit yield (t/ha)

The highest fruit yield (16.14 t/ha) in 3 m wide alley and the lowest (12.48 t/ha) was in 5 m wide alley (Fig. 1). Among the pruning interval, 2 month performed best in terms of yield (16.07 t/ha) and the lowest (11.53 t/ha) from in 3 month's pruning interval (Fig.1). The result indicates that close pruning interval had positive effect on okra yield. Okra yield was lower in delay pruning interval due to shady effect of hedgerow tree. Singh *et al.* (1989) opined that major reduction in crop yield was restricted by the shade of hedgerow tree. In case of treatment combination, maximum yield (17.67 t/ha) was found from A_1P_1 (Fig.2) followed by A_1P_2 (17.48 t/ha). There was trend to decrease yield with wider alley (5 m) in all interval schedules.



LSD (0.05) P=0.16

Fig. 1. Effect of alley size and pruning interval on okra yield (t/ha).



LSD (0.05) P=0.49

Fig. 2. Combined effect of alley size and pruning interval on okra fruit yield.

Table 4. Physio-chemical properties of 0-20 cm topsoil at the experimental plot.

Soil characteristics	Analytical value	Critical level
Texture class	Clay loam	-
Soil pH	4.70	-
Organic matter (%)	1.35	-
Total N(%)	0.07	-
Exchangeable calcium (meq/100 g soil)	1.09	2.0
Exchangeable magnesium (meq/100 soil)	0.50	0.8
Exchangeable potassium (meq/100 g soil)	0.19	0.2
Available P (ppm)	4.20	12.0
Available S (ppm)	10.00	12.0
Available Cu (ppm)	2.20	1.0
Available Iron (ppm)	170.00	10.0
Available Zinc (ppm)	1.20	2.0
Available boron (ppm)	0.15	0.2
Available manganese (ppm)	13.00	-

Cost benefit analysis

The highest gross return (Tk.176700) and net return (Tk.120380) were found from close alley size (3 m) and one month pruning interval. The production cost was lowest (Tk.5 1700) in case of 5 m wide alley with 3 month pruning interval (Table 3) and the highest cost of production (Tk. 56320) was in 3 m wide alley with one month pruning interval (A_1P_1). Though higher cost was involved in treatment A_1P_1, but BCR (3.14) was close to A_1P_2 (3.13). Overall delayed pruning with wider alley size showed lower fruit yield as well as benefit. Considering fruit yield and economic return, 3 m wide alley size with one month pruning interval was the best for okra production in hill slope condition.

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