

## YIELD AND YIELD ATTRIBUTES OF OKRA AS INFLUENCED BY PLANTING TIME AND PLANT SPACING IN HILL SLOPE CONDITION

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### ABSTRACT

An experiment was conducted at the Hill Agricultural Research Station, Khagrachari from May to November 2004 to find out the effect of planting time (1<sup>st</sup> week of June, July, August and September) and plant spacing (60 × 30 cm, 60 × 40 cm and 60 × 50 cm) on the yield and yield components of okra in hill slope condition during rainy season. The highest yield (12.53 t/ha) was obtained by the planting in July which was at par with June (11.69 t/ha). In case of plant spacing, the highest yield (9.02 t/ha) was recorded from close spacing at 60 × 30 cm that was statistically different from other two spacing and the widest spacing of 60 × 50 cm produced the lowest yield (8.06 t/ha). The treatment combination July sowing with 60 × 30 cm plant spacing produced significantly highest yield (12.86 t/ha).

**Key Words :** Hill slope, Okra yield, Planting time, Plant spacing

### 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). There is crucial need to increase vegetable production during rainy season through proper management techniques or introducing new rainy season vegetables. Okra as a summer/ rainy season vegetable can play a vital role in this regard. Chittagong Hill tracts region is about one tenth of the total area of Bangladesh (Anon, 1985). This area has great potentiality for growing okra during rainy season when the major part of the country goes under water by using high yielding varieties with improved production practices.

The sowing time plays an important role on yield of okra fruit and seed. Okra production in Bangladesh is mainly limited from February to July (Rashid, 1995). But its production from July onwards or even in winter is possible provided the vegetative growth of Plant is completed before the temperature falls and some diseases can be controlled (Islam, 1997). The production of okra in off-season may meet up the market demand during the lean period of vegetable supply and can improve the nutritional status. The effect of planting time on the growth and yield of okra was reported by many authors (Diz-Franco and Ortigon, 1997; Passam *et al.*, 1998; Amzad *et al.*, 2001).

Plant spacing is an important factor for okra production both in summer and rainy season crop (Palanisamy *et al.*, 1986; Shaha *et al.*, 1989; Saimbhi *et al.*, 1997; Hossain *et al.*, 1999). The improper plant spacing may cause either too dense or too sparse population resulting in the reduction of okra yield. But optimum plant density ensures the plants to grow uniformly and properly through efficient utilization of moisture, nutrients, light and thus causes to produce maximum yield of okra. Planting with proper spacing increases yield quality and size of fruit. In hilly region of Bangladesh systematic and comprehensive research effort on planting time and plant spacing in order to increase yield potential of okra is inadequate or sporadic. Considering this an experiment was carried out to determine the appropriate planting time and plant spacing for okra production in hill slope.

### MATERIALS AND METHODS

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari from May to November 2004. The experiment was laid out in a factorial combination in RCBD with three replications. The treatments of the experiment were four planting times viz. 1<sup>st</sup> week of June, July, August and September and three plant spacing viz. 60 × 30, 60 × 40 and 60 × 50 cm. Thus, altogether there were 12 treatments combinations. The okra variety was BARI Dherosh-1 The unit plot size was 6.0 × 1.8 m. The plot and blocks were separated by 0.5 and 1.0 m, respectively. Each unit plot had 3 rows. Fertilizers were used at the rate of 150, 100 and 150 t/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 up to 30 November 2004. Data on yield contributing characters were recorded from ten randomly selected plants. Collected data were subjected to statistical analysis by F-test and the difference among the treatment means were judged by Duncan's Multiple Range Test (DMRT).

### RESULTS AND DISCUSSION

#### *Number of fruits per plant*

Number of fruits per plant is no doubt an important component. Higher the number of fruits per plant, higher the yield. However, size and weight of individual fruit can modify the statement to a great extent. Whatever the fact, the general consent is in favour of grater number of fruits per plant. The number of fruits per plant was significant reduced with the delay in sowing dates (Table 1). The maximum number of fruits per plant was obtained from July sowing (18.1). This was statistically followed by June sowing (17.4). Beyond July there was reduction in number of fruits per plant. The number of fruits per plant in the crop of September was the lowest (6.1) and it significantly differed with August sowing (11.8). As the plant growth condition was not satisfactory in delay sowing crops, the number of fruits per plant was also reduced. This result is in agreement with the finding of Grewal *et al.* (1972) who mentioned that number of fruits declined at later sowing dates from July to on ward. Hossain *et al.* (1999) and Islam (1997) also found that the number of fruits per plant was higher in summer and rainy seasons than that of winter season. However, Yadav and Dhankhan (1999) stated that sowing on 13 June resulted lower number of fruits per plant.

Table 1. Yield and yield components of okra as influenced by planting time and plant spacing

Treatment	No. of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Wt. of fruits/plant (g)
<b>Planting time</b>					
1 <sup>st</sup> week of June	17.4 a	14.3 b	1.64 a	13.4 a	232.8 a
1 <sup>st</sup> week of July	18.1 a	15.1 a	1.65 a	13.5 a	246.4 a
1 <sup>st</sup> week of August	11.8 b	14.4 b	1.54 b	10.8 b	229.3 b
1 <sup>st</sup> week of September	6.1 c	9.9 c	1.44 c	8.8 c	61.2 c
<b>Plant spacing</b>					
60 x 30 cm	11.3 c	11.9	1.54 b	106 b	136.9 b
60 x 40 cm	13.1 b	12.2	1.57 b	11.0 a	162.7 b
60 x 50 cm	15.7 a	12.6	1.61 a	11.1 a	202.7 a

Means followed by a common letter or no letter are not significantly different at 5% level by DMRT

Significant difference was noticed on number of edible fruits per plant due to spacing (Table 1). The highest number of fruits per plant (15.7) was obtained with the spacing of 60 x 50 cm which showed significant variation with other two spacing while the lowest (6.1) number of fruits per plant was produced by 60 x 30 cm. Palanisamy *et al.* (1986) and Abdul and Araf (1986) also stated that wider spacing slightly increased number fruits/plant. Reduced number of plants per unit area under wider spacing got less inter and intra plant competition which caused an increased number of fruits per plant.

So far as the interaction (Table 2) between planting time and plant spacing is concerned, the plant in July sowing coupled with 60 x 50 cm spacing ( $T_2S_3$ ) gave the most satisfactory result (22.5 fruits/plant) and it was statistically identical to June sowing with 60 x 50 cm spacing ( $T_1S_3$ ). The second highest number of fruits per plant (17.4) was obtained when plants was treated with  $T_2S_2$ . This was statistically followed by those with  $T_2S_3$  (14.4),  $T_1S_1$  (14.5) and  $T_1S_2$  (14.5). September sowing with 60 x 30 cm ( $T_4S_1$ ) produced the least number (5.1) of fruits and this was at par with  $T_4S_2$  (6.2) and  $T_4S_3$  (6.8). But Sajjan *et al.* (2002) got the highest number of fruits per plant from sowing on 15 July with 60 x 30 cm spacing. This result partially supported the present result.

#### *Fruit size*

Fruits of July sowing were observed larger than those of other dates of sowing (Table 1). Significantly highest fruits length (15.2 cm) was noticed in July sowing as compared to those obtained from June, August and September sowing plants. There was no significant difference between August and September sowing. Fruit diameter was also highest (1.65 cm) in July sowing but it was at par with June sowing (1.64 cm).

The plants at the spacing 60 x 30 cm produced fruits having the largest length of 13.8 cm (Table 1) which was statistically different from fruit length of the plants at 60 x 40 and (13.0 cm) and 60 x 30 cm (13.1 cm) spacing. The larger fruits at widest spacing might be due to the accumulation of more dry matter by the plants. This result is accordance with

that of Palanisamy *et al.* (1986). They found that fruit length increased with decreasing of plant density. Fruit diameter also showed similar trend (Table 1). No significant difference was found due to the interaction effect of plant time and plant spacing in this regard (Table 2).

Table 2. Interaction effects of planting time and plant spacing on the yield and yield components of okra

Treatment	No. of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	Individual fruit wt. (g)	Wt. of fruits/plant (g)
T <sub>1</sub> S <sub>1</sub>	14.5 bc	13.6 b	1.62	13.3	192.5 bc
T <sub>1</sub> S <sub>2</sub>	16.8 b	14.3 ab	1.63	13.3	220.5 b
T <sub>1</sub> S <sub>3</sub>	21.0 a	14.9 a	1.68	13.6	285.4 a
T <sub>2</sub> S <sub>1</sub>	14.4 bc	14.7 ab	1.59	13.1	194.9 b
T <sub>2</sub> S <sub>2</sub>	17.4 b	15.2 a	1.65	13.5	234.9 b
T <sub>2</sub> S <sub>3</sub>	22.5 a	15.6 a	1.71	13.7	309.3 a
T <sub>3</sub> S <sub>1</sub>	10.8 d	10.8 c	1.52	10.4	111.7 d
T <sub>3</sub> S <sub>2</sub>	12.1 cd	11.6 bc	1.54	10.8	130.0 c
T <sub>3</sub> S <sub>3</sub>	12.6 cd	11.7 abc	1.57	11.1	146.3 c
T <sub>4</sub> S <sub>1</sub>	5.2 e	7.6 d	1.41	8.3	48.5 e
T <sub>4</sub> S <sub>2</sub>	6.2 e	8.0 d	1.43	9.1	63.5 e
T <sub>4</sub> S <sub>3</sub>	6.8 e	8.1 d	1.47	9.3	69.6 e
CV (%)	13.7	3.2	5.54	2.86	12.1

Means followed by a common letter or no letter are not significantly different at 5% level by DMRT.

T<sub>1</sub> = 1<sup>st</sup> week of June, T<sub>2</sub> = 1<sup>st</sup> week of July, T<sub>3</sub> = 1<sup>st</sup> week of August, T<sub>4</sub> = 1<sup>st</sup> week of September; S<sub>1</sub> = 60 x 30 cm, S<sub>2</sub> = 60 x 40 cm, S<sub>3</sub> = 60 x 50 cm

#### *Individual fruit weight*

It is not only the number of fruits per plant but individual fruit weight also plays a key role in determining yield per plant or per unit land. Planting time showed significant effect of individual fruit weight as presented in Table 1. The heaviest (13.5 g) fruit weight was attained from July sowing followed by June sowing (13.4 g) and it was gradually reduced in the crop of August (10.8 g) and September sowing (9.8 g).

Significant difference in fresh fruit weight at edible stage was observed due to differences in spacing (Table 1). The highest (13.1 g) was recorded from the widest spacing at 60 x 50 cm and minimum fruit weight was obtained from the plants in closer spacing at 60 x 30 cm (11.6 g). The planting times insignificantly interacted with the spacing (Table 2).

#### *Fruit yield per plant*

Yield capacity of okra is the function of number of okra per unit area, number of fruits per plant and fruit size. Table 1 revealed that the highest (246.4 g) fruit yield per plant was obtained from plants of July sowing which was statistically followed by June sowing (232.8 g/plant). The lowest (61.2 g) production was recorded in September sowing. The

poor vegetative growth i.e. plant height, branch per plant and decreased number of fruits per plant in delay sowing resulted in lower yield per plant reduction.

Fruits yield per plant varied widely among the three-plant spacing (Table 2). Plants of 60 x 50 cm spacing produced significantly higher amount of fruits (202.7 g) per plant as compared to those produced by other treatments. Similar result was also reported by Shaha *et al.* (1989); Rehman *et al.* (1994).

The responses of planting time and plant spacing interaction was significant in weight of fruits per plant (Table 2). Weight of fruits per plant showed a similar pattern with number of fruits per plant. The June and July sowing with 60 x 50 plant spacing (T<sub>2</sub>S<sub>3</sub> and T<sub>1</sub>S<sub>3</sub>, respectively) had considerably better performance (309.3 g and 285.9 g) compared to the other treatments.

#### *Yield (t/ha)*

Okra production due to planting time is found to differ significantly and is presented in Fig. 1. The most satisfactory yield (12.53 t/ha) was produced by the plants of July sowing was at par with June (11.69 t/ha). Fruit yield of okra was extremely poor in the crop of September sowing (3.09 t/ha) which indicated that okra cultivated in late rainy season in hill slope condition might be affected adversely by low rainfall and little bit cool weather at fruiting stage (Islam, 1997). The lowest number of fruits and weight of fruits per plant in delay sowing resulted in total yield reduction. Gadakh *et al.* (1990) reported that among the autumn, winter and summer, the crop gave the lowest yield in winter. Similarly, the yield of BARI Dherosh-1 was gradually decreased from summer to winter (Anon, 1997) and July on ward (Islam, 1997). Satpathy *et al.* (1985) reported that maximum yield was obtained from the crop sown in first week of June.

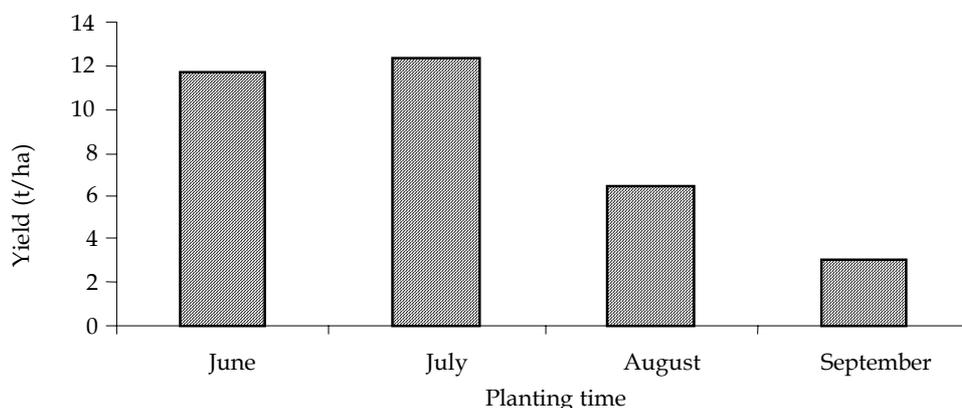


Fig. 1. Main effect of planting time on fruit yield of okra

The most satisfactory (9.02 t/ha) per hectare yield was recorded from close spacing at 60 x 30 cm which was statistically different from other two spacings and the widest spacing of 60 x 50 cm produced the lowest yield (8.06 t/ha) (Fig. 1). The result indicated that fruit

production (t/ha) increased with the decrease in plant spacing. Khan and Jaisal (1988), Mondal *et al.* (1989) and Singh *et al.* (1988) reported higher yield of okra per hectare at closer spacing (Fig. 2). Increase in fruit yield at closer spacing could be attributed to higher number of plant per unit area.

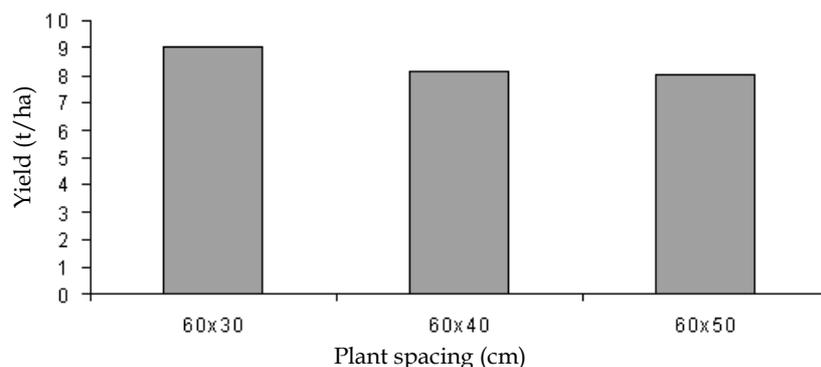


Fig. 2. Main effect of plant spacing on fruit yield of okra

The interaction effect of sowing time and plant spacing on edible fruit yield is presented in Fig. 3. The treatment combination July with 60 x 30 cm produced significantly highest (12.86 t/ha) yield followed by June with 60 x 30cm (12.63 t/ha), July with 60 x 50 cm (12.37 t/ha) and July with 60 x 40 cm (11.75 t/ha). Identically poor yield were produced by September with 60 x 30 cm (3.20 t/ha), September with 60 x 40 cm (3.27 t/ha) and September with 60 x 50 cm (2.8 t/ha).

The above result revealed that July sowing with 60 x 30 cm plant spacing is most suitable for better production of okra in hill slope condition.

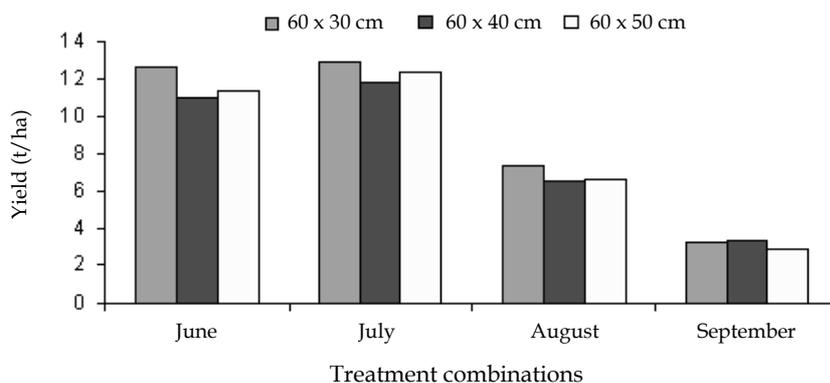


Fig. 3. Interaction effect of planting time and plant spacing on fruit yield (t/ha) of okra

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