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Influence of Sowing Time, Plant Spacing and Picking Interval on the Growth and Yield of Okra

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Abstract: A study was undertaken to find out the effect of sowing time; spacing and picking interval on yield and yield components of okra (BARI Dherosh-1). Green pod yield was significantly higher when crop was sown on April (18.92 t ha⁻¹) than March sown crop (16.24 t ha⁻¹). Significantly highest yield (20.99 t ha⁻¹) was recorded at closer spacing (60 × 30 cm²) than wider spacings. Yield was gradually decreased with increasing picking interval. Higher yield was obtained at 2 days picking interval (21.74 t ha⁻¹), which was statistically similar to 3 days picking interval (19.53 t ha⁻¹). Interaction among the effects of sowing times, spacing and picking interval on yield and yield components were found significant except interaction of sowing time with picking interval. The results showed that 2 or 3 days picking interval with closer spacing (60 × 30 cm²) sown in April were found higher yield (24.94 and 23.79 t ha⁻¹, respectively) in okra (var. BARI Dherosh-1).

Key words: Sowing time, plant spacing, picking interval, Okra

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop grown in tropical and subtropical parts in the world. Its tender fruits are very popular as vegetable among all classes of people in Bangladesh and elsewhere. It can be grown successfully in a serious shortage of vegetable in the market of Bangladesh. Although it is important in Bangladesh but the average yield (3.10 t ha⁻¹) is very poor (BBS, 1999). The main causes of poor production are yellow vein clearing mosaic virus (YVCMV) disease, okra shoot and fruit borer and lack of knowledge about cultural practices (Islam, 1997). Recently Bangladesh Agricultural Research Institute (BARI) developed one okra variety (BARI Dherosh-1) which is YVCMV tolerance and high yielded. However yield of okra is greatly influenced by sowing time and plant density (Kamaluddin, 1996; Gorachand *et al.*, 1990). Spacing has a great impact on the yield of okra (Absar and Siddique, 1982). High yield of okra has been reported to achieve by sowing in closer spacing (Saha *et al.*, 1989; Gupta, 1990). Again being a quick growing crop, the picking interval can also influence the yield of okra. But the information regarding the effects of spacing, picking interval etc. on the yield of BARI Dheros-1 at summer season is very scanty. Therefore the present investigation was undertaken to find out the optimum sowing time, plant spacing and picking interval on the yield and yield attributes of BARI Dherosh-1.

MATERIALS AND METHODS

The experiment was conducted at the Agricultural Research Station, Pahartali, Chittagong during 1999-00. Three levels of spacing viz. 60 × 50, 60 × 40 and 60 × 30 cm², five levels of picking intervals viz. 2, 3, 4, 5 and 6 days and two sowing time viz. 15 March and 15 April 1999 were the treatment of the experiment. Unit plot size was 2.4 × 3 m². The variety BARI Dherosh-1 was used in this trial. The experiment was laid out in randomized complete block design (factorial). There were thirty treatment combinations. The crop was fertilized with cowdung, urea, TSP, MP and gypsum @ 14 t, 150, 100, 150 and 120 kg ha⁻¹ respectively. The entire quantity of cowdung, TSP and half of urea and MP were applied during final land preparation. The rest of urea and MP were applied in three equal splits at 30, 45 and 60 days after sowing. Crop was irrigated timely. Spraying of insecticides and other intercultural operations were done as and when necessary. Data on different parameter were recorded from 10 randomly selected plants in each plot and analyzed statistically.

RESULTS AND DISCUSSION

Effect of sowing time: Plant height, days to 50% flowering, number of fruit per plant, fruit length and fruit yield per plant as well as per hectare were significantly influenced by sowing times (Table 1). Plants of April

Table 1: Effect of sowing time, spacing and picking interval on yield and yield components of okra

| Treatments | Plant population/plot at last harvest (No.) | Plant height (cm) | Days to 50% flowering | Fruit/plant (No.) | Fruit/length (cm) | Fruit breadth (cm) | Fruit yield/plant (g) | Fruit yield hectare (t) |
|-------------------------|---|-------------------|-----------------------|-------------------|-------------------|--------------------|-----------------------|-------------------------|
| Sowing time | | | | | | | | |
| T ₁ | 30.0 | 151.0b | 50.0a | 16.7b | 15.0b | 1.75 | 351.0b | 16.24b |
| T ₂ | 30.0 | 184.0a | 48.0b | 20.2a | 17.3a | 1.67 | 416.0a | 18.92a |
| CV (%) | 2.5 | 8.0 | 3.6 | 7.1 | 6.9 | 5.40 | 6.5 | 8.3 |
| Spacing | | | | | | | | |
| S ₁ | 23.0c | 159.0b | 50.0 | 19.6a | 16.2 | 1.71 | 403.0a | 14.86c |
| S ₂ | 27.0b | 165.0b | 49.0 | 18.2a | 16.3 | 1.71 | 380.0b | 16.88b |
| S ₃ | 39.0a | 178.0a | 49.0 | 17.6b | 15.9 | 1.72 | 367.0c | 20.99a |
| CV (%) | 2.5 | 8.0 | 3.6 | 7.1 | 6.9 | 5.40 | 6.5 | 8.3 |
| Picking interval | | | | | | | | |
| P ₁ | 30.0 | 168.0 | 49.0 | 25.1a | 14.9d | 1.70 | 521.0a | 21.74a |
| P ₂ | 30.0 | 167.0 | 50.0 | 22.1ab | 15.4cd | 1.71 | 452.0b | 19.53ab |
| P ₃ | 30.0 | 169.0 | 50.0 | 17.6bc | 15.7c | 1.72 | 370.0c | 17.56bc |
| P ₄ | 30.0 | 169.0 | 49.0 | 15.8c | 17.0b | 1.73 | 311.0d | 15.64cd |
| P ₅ | 30.0 | 164.0 | 49.0 | 11.7c | 17.8a | 1.70 | 262.0e | 13.41d |
| CV (%) | 2.5 | 8.0 | 3.6 | 7.1 | 6.9 | 5.40 | 6.5 | 8.3 |

In a column, means followed by same letter are not significantly different at 5% level of significant by DMRT.

Note: T₁ = Sowing at March 15, 1999, T₂ = Sowing at April 15, 1999, S₁ = 60 × 50 cm², S₂ = 60 × 40 cm², S₃ = 60 × 30 cm², P₁ = Picking at 2 days interval, P₂ = Picking at 3 days interval, P₃ = Picking at 4 days interval, P₄ = Picking at 5 days interval, P₅ = Picking at 6 days interval

sowing were found vigorous than that of March sowing. The plants of April sowing were significantly taller (184 cm) than that of March sowing (151 cm). This result supports the finding of Gorachand *et al.* (1990) who mentioned the greatest plant height (85.50 cm) of cv. Pusa Swani on 20 April sowing and minimum in November sowing (43.25 cm). Plants of April sowing flowered (50%) earlier (48 days) than March sowing crop (50 days). It might be due to the higher vegetative growth of April sowing plants, which resulted earlier transition from vegetative to reproductive phase. April sowing crop produced higher number of fruits (20.2) per plant than March sowing crop (16.7). Significantly large fruit (17.3 cm) was obtained in April sowing than that of March sowing (15.0 cm). Significantly the highest fruit yield (416 g) per plant was recorded in April sowing than that of March sowing (351 g). The crop of April sowing produced significantly higher edible fruit yield (18.92 t ha⁻¹) than the crop of March sowing (16.24 t ha⁻¹). This may be due to higher number of fruits per plant as well as higher fruit yield per plant. Similar findings were also reported by Gadzhonov (1977) and Ghanti *et al.* (1991). Gorachand *et al.* (1990) and Hossain *et al.* (2001) also reported that yield of okra was increased from March to June and it was decreased towards the cooler month in a year.

Effect of spacing: Spacing significantly influenced the plant population at last harvest, plant height, number of fruits per plant, fruit yield per plant as well as edible fruit yield per hectare of BARI Dherosh-1 (Table 1). Spacing did not significantly influence the other parameters. More plant accommodates (39) in closer spacing than that of wider spacing (23). The plant height was found higher

(178 cm) in the plants when grown in closer spacing (60 × 30 cm²) than those of wider spacing (60 × 50 cm²) (159 cm). Hossain *et al.* (2001) also found the similar result. The maximum number of fruit (19.6) was found in wider spacing (60 × 50 cm²) than that of closer spacing (60 × 30 cm²) (17.6). Significantly higher fruit yield (403 g) per plant was recorded in wider spacing than the closer spacing (367 g). This may be due to plants grown at wider spacing comparatively received more nutrition and light for their growth and development and thereby, produced more yield per plant. Hossain *et al.* (2001) also reported same result. Saha *et al.* (1989) also reported that wider spacing produced more healthy plants than closer spacing. The yield per hectare was recorded maximum (20.99 t) from 60 × 30 cm² spacing and minimum from 60 × 50 cm² spacing (14.86 t). Similar results were also obtained by Gorachand *et al.* (1990) and Randhawa and Pannun (1969). They found maximum yield in the closer spacing. The highest yield per unit area was associated with the closest spacing due to accommodation of maximum number of plants.

Effect of picking interval: Picking interval significantly influenced the number of fruits per plant, fruit length, yield of fruit per plant as well as per hectare (Table 1). Picking interval between two successive harvesting severely affected the green pod yield per plant as well as per hectare of okra. The highest number of fruits (25.1) produced by the plants when fruits were harvested at two days picking interval which was statistically identical to three days interval of picking (22.1) but the number of fruits per plant was found lowest (11.7) when harvested at six days picking interval. Frequent harvesting of green pod might be increasing the plant to produce further fruit.

Table 2: Interaction effect of sowing time and spacing on yield and yield components of okra

| Sowing time x spacing | Plant population/plot at last harvest (No.) | Plant height (cm) | Days to 50% flowering | Fruit/plant (No.) | Fruit/length (cm) | Fruit breadth (cm) | Fruit yield/plant (g) | Fruit yield t ha ⁻¹ |
|-------------------------------|---|-------------------|-----------------------|-------------------|-------------------|--------------------|-----------------------|--------------------------------|
| T ₁ S ₁ | 23.0c | 143.0 | 50.0 | 18.2 | 14.9 | 1.74 | 374.0 | 12.37d |
| T ₁ S ₂ | 27.0b | 149.0 | 50.0 | 16.1 | 15.1 | 1.73 | 344.0 | 15.67c |
| T ₁ S ₃ | 39.0a | 161.0 | 50.0 | 15.7 | 14.9 | 1.78 | 335.0 | 19.66b |
| T ₂ S ₁ | 23.0c | 175.0 | 49.0 | 20.9 | 17.5 | 1.68 | 433.0 | 16.35c |
| T ₂ S ₂ | 27.0b | 181.0 | 49.0 | 20.3 | 17.5 | 1.69 | 415.0 | 18.08bc |
| T ₂ S ₃ | 39.0a | 195.0 | 48.0 | 19.5 | 17.0 | 1.66 | 399.0 | 22.31a |
| CV (%) | 2.5 | 8.0 | 3.6 | 7.1 | 6.9 | 5.4 | 6.5 | 8.3 |

In a column, means followed by same letter are not significantly different at 5% level of significant by DMRT.

Note: T₁ = Sowing at March 15, 1999, T₂ = Sowing at April 15, 1999, S₁ = 60 × 50 cm², S₂ = 60 × 40 cm², S₃ = 60 × 30 cm²

Table 3: Interaction effect of spacing and picking interval on yield and yield components of okra

| Spacing x picking interval | Plant population/plot at last harvest (No.) | Plant height (cm) | Days to 50% flowering | Fruit/plant (No.) | Fruit/length (cm) | Fruit breadth (cm) | Fruit yield/plant (g) | Fruit yield t ha ⁻¹ |
|-------------------------------|---|-------------------|-----------------------|-------------------|-------------------|--------------------|-----------------------|--------------------------------|
| S ₁ P ₁ | 23.0c | 157.0 | 51.0 | 27.5a | 14.9 | 1.65 | 583.0a | 19.09cd |
| S ₁ P ₂ | 23.0c | 160.0 | 51.0 | 23.2ab | 15.3 | 1.73 | 453.0cd | 17.52de |
| S ₁ P ₃ | 23.0c | 161.0 | 50.0 | 18.7b-d | 16.2 | 1.74 | 409.0de | 15.05e-g |
| S ₁ P ₄ | 23.0c | 156.0 | 48.0 | 17.7b-e | 16.7 | 1.71 | 304.0gh | 12.53hi |
| S ₁ P ₅ | 24.0c | 159.0 | 50.0 | 10.8f | 18.0 | 1.73 | 267.0hi | 10.13i |
| S ₂ P ₁ | 28.0b | 163.0 | 48.0 | 25.8ab | 15.1 | 1.68 | 527.0b | 22.16ab |
| S ₂ P ₂ | 27.0b | 162.0 | 50.0 | 22.0ab | 15.6 | 1.68 | 418.0d | 18.67d |
| S ₂ P ₃ | 27.0b | 163.0 | 51.0 | 16.0c-f | 15.5 | 1.76 | 361.0ef | 16.11ef |
| S ₂ P ₄ | 27.0b | 174.0 | 49.0 | 14.3d-f | 17.6 | 1.74 | 323.0fg | 14.67f-h |
| S ₂ P ₅ | 27.0b | 164.0 | 48.0 | 12.8e-f | 17.6 | 1.71 | 269.0hi | 12.77gh |
| S ₃ P ₁ | 40.0a | 185.0 | 49.0 | 21.8a-c | 14.9 | 1.77 | 453.0cd | 23.96a |
| S ₃ P ₂ | 39.0a | 179.0 | 49.0 | 21.2bc | 15.3 | 1.72 | 485.0bc | 22.41a |
| S ₃ P ₃ | 39.0a | 181.0 | 50.0 | 18.2b-e | 15.3 | 1.67 | 342.0fg | 21.52a-c |
| S ₃ P ₄ | 39.0a | 179.0 | 49.0 | 15.3d-f | 16.6 | 1.76 | 306.0gh | 19.73b-d |
| S ₃ P ₅ | 39.0a | 169.0 | 50.0 | 11.5f | 17.7 | 1.67 | 251.0i | 17.33de |
| CV (%) | 2.5 | 8.0 | 3.6 | 7.1 | 6.9 | 5.4 | 6.5 | 8.3 |

In a column, means followed by same letter are not significantly different at 5% level of significant by DMRT.

Note: S₁ = 60 × 50 cm², S₂ = 60 × 40 cm², S₃ = 60 × 30 cm², P₁ = Picking at 2 days interval, P₂ = Picking at 3 days interval, P₃ = Picking at 4 days interval, P₄ = Picking at 5 days interval, P₅ = Picking at 6 days interval

Rashid (1983) also reported that fruit setting in okra increases with a higher frequency of picking. Length of the fruit increased at long picking interval. Longer picking interval allowed the pods to have more growth and development before harvesting. Saha *et al.* (1989) also reported the same result. Picking interval significantly influenced fruit yield per plant as well as per hectare. The highest fruit yield per plant was recorded when harvested at two days picking interval (521 g) and the lowest fruit yield (262 g) per plant when harvested at six days picking interval. The highest pod yield was obtained when harvested at two days interval (21.74 t ha⁻¹), which was statistically identical to three days picking interval (19.53 t ha⁻¹). But the lowest fruit yield was recorded when harvested at six days picking interval (13.41 t ha⁻¹). This variation arises because two or three days picking interval encourage the plants to produce higher number of fruits per plant, which in turn produced highest fruit yield/ plant as well as per hectare.

Combined effect of sowing time and spacing: The combination of sowing time and spacing significantly influenced the plant population per unit area and fruit yield per hectare (Table 2). Maximum number of plant (39) per plot was recorded in the combination of T₁S₃ and T₂S₃

and the minimum (23) in T₁S₁ and T₂S₁ combination. The highest fruit yield (22.31 t ha⁻¹) was obtained from T₂S₃, this may be due to maximum number of plant accommodates per unit area and the lowest (12.37 t) from T₁S₁ combination.

Combined effect of spacing and picking interval: Data revealed that there were significant effect by the combination of spacing and picking interval in respect of plant population at last harvest, number of fruit per plant, fruit yield per plant and fruit yield per hectare (Table 3). Plant population at last harvest was significantly higher (40) at S₃P₁ and the lowest (23) at wider spacing in all picking. The maximum number of fruit per plant (27.5) was observed at two days picking interval with 60 x 50 cm² and the minimum (10.8) at six days picking interval with same spacing. The highest fruit yield (583 g) per plant also obtained from wider spacing with two days picking interval and the minimum (251 g) from six days picking interval with 60 x 30 cm². The highest fruit yield (23.96 t ha⁻¹) was recorded from closest spacing in accordance with two days picking interval and the lowest (10.13 t ha⁻¹) from wider spacing with six days picking interval.

Table 4: Interaction effect of sowing time, spacing and picking interval on yield and yield components of okra

| Spacing x picking interval x sowing time | Plant population/plot at last harvest (No.) | Plant height (cm) | Days to 50% flowering | Fruit/plant (No.) | Fruit/length (cm) | Fruit breadth (cm) | Fruit yield/plant (g) | Fruit yield t ha ⁻¹ |
|--|---|-------------------|-----------------------|-------------------|-------------------|--------------------|-----------------------|--------------------------------|
| S ₁ P ₁ T ₁ | 23.0e | 139.0 | 52.0 | 26.3bc | 14.5 | 1.74 | 538.0bc | 17.90h-j |
| S ₁ P ₂ T ₁ | 23.0e | 140.0 | 51.0 | 22.0f-h | 13.2 | 1.71 | 448.0ef | 16.69i-l |
| S ₁ P ₃ T ₁ | 23.0e | 155.0 | 49.0 | 19.3i-l | 15.2 | 1.79 | 394.0hi | 12.62o-q |
| S ₁ P ₄ T ₁ | 23.0e | 140.0 | 49.0 | 12.7n-p | 14.9 | 1.74 | 294.0no | 10.43qr |
| S ₁ P ₅ T ₁ | 23.0e | 139.0 | 50.0 | 10.7pq | 16.9 | 1.74 | 195.0q | 9.20r |
| S ₂ P ₁ T ₁ | 28.0c | 146.0 | 48.0 | 25.0b-d | 14.1 | 1.66 | 485.0d-e | 21.74b-e |
| S ₂ P ₂ T ₁ | 27.0cd | 148.0 | 50.0 | 20.3 h-j | 14.1 | 1.69 | 385.0i | 17.40i-k |
| S ₂ P ₃ T ₁ | 27.0cd | 149.0 | 51.0 | 12.3n-p | 14.6 | 1.76 | 330.0k-n | 15.11k-n |
| S ₂ P ₄ T ₁ | 27.0cd | 153.0 | 50.0 | 11.3o-p | 16.9 | 1.79 | 290.0no | 12.86n-p |
| S ₂ P ₅ T ₁ | 27.0cd | 151.0 | 49.0 | 11.3o-q | 15.6 | 1.76 | 230.0pq | 11.25p-r |
| S ₃ P ₁ T ₁ | 40.0a | 167.0 | 49.0 | 21.0g-l | 14.1 | 1.73 | 432.0fg | 22.98a-c |
| S ₃ P ₂ T ₁ | 39.0ab | 162.0 | 49.0 | 19.3i-l | 14.2 | 1.83 | 450.0ef | 21.03c-e |
| S ₃ P ₃ T ₁ | 39.0ab | 162.0 | 51.0 | 16.7m | 13.9 | 1.76 | 317.0l-n | 20.77c-f |
| S ₃ P ₄ T ₁ | 39.0ab | 159.0 | 50.0 | 12.0op | 15.6 | 1.89 | 240.0p | 17.55j |
| S ₃ P ₅ T ₁ | 39.0ab | 157.0 | 49.0 | 9.7q | 16.6 | 1.68 | 238.0pq | 15.99j-m |
| S ₁ P ₁ T ₂ | 23.0e | 176.0 | 49.0 | 28.7a | 15.3 | 1.57 | 627.0a | 20.27d-g |
| S ₁ P ₂ T ₂ | 24.0de | 180.0 | 50.0 | 24.3c-e | 17.4 | 1.74 | 459.0ef | 18.34g-j |
| S ₁ P ₃ T ₂ | 23.0e | 167.0 | 50.0 | 18.0k-m | 17.2 | 1.69 | 424.0f-h | 17.48i-j |
| S ₁ P ₄ T ₂ | 23.0e | 172.0 | 48.0 | 22.7e-g | 18.5 | 1.67 | 315.0l-n | 14.63l-o |
| S ₁ P ₅ T ₂ | 24.0de | 179.0 | 48.0 | 11.0pq | 19.2 | 1.71 | 339.0j-m | 11.05p-r |
| S ₂ P ₁ T ₂ | 28.0c | 179.0 | 48.0 | 26.7ab | 16.0 | 1.69 | 569.0b | 22.59a-d |
| S ₂ P ₂ T ₂ | 27.0cd | 177.0 | 50.0 | 23.7d-f | 17.0 | 1.66 | 451.0ef | 19.93e-h |
| S ₂ P ₃ T ₂ | 28.0c | 178.0 | 50.0 | 19.7i-k | 16.3 | 1.75 | 391.0g-l | 17.12i-k |
| S ₂ P ₄ T ₂ | 28.0c | 195.0 | 49.0 | 17.3lm | 18.3 | 1.69 | 356.0i-l | 16.48i-m |
| S ₂ P ₅ T ₂ | 27.0cd | 177.0 | 46.0 | 14.3n | 19.7 | 1.65 | 308.0mn | 14.28m-o |
| S ₃ P ₁ T ₂ | 39.0ab | 203.0 | 48.0 | 22.7e-g | 15.7 | 1.82 | 474.0e | 24.94a |
| S ₃ P ₂ T ₂ | 38.0b | 195.0 | 48.0 | 23.0d-g | 16.3 | 1.62 | 520.0cd | 23.79ab |
| S ₃ P ₃ T ₂ | 40.0a | 201.0 | 48.0 | 19.7i-k | 16.7 | 1.58 | 366.0i-k | 22.26b-e |
| S ₃ P ₄ T ₂ | 39.0ab | 198.0 | 47.0 | 18.7j-m | 17.6 | 1.62 | 372.0ij | 21.91b-e |
| S ₃ P ₅ T ₂ | 39.0ab | 180.0 | 50.0 | 13.3no | 18.8 | 1.66 | 264.0op | 18.67f-l |
| CV (%) | 2.5 | 8.0 | 3.6 | 7.1 | 6.9 | 5.4 | 6.5 | 8.3 |

In a column, means followed by same letter are not significantly different at 5% level of significant by DMRT.

Note: T₁ = Sowing at March 15, 1999, T₂ = Sowing at April 15, 1999, S₁ = 60 × 50 cm², S₂ = 60 × 40 cm², S₃ = 60 × 30 cm², P₁ = Picking at 2 days interval, P₂ = Picking at 3 days interval, P₃ = Picking at 4 days interval, P₄ = Picking at 5 days interval, P₅ = Picking at 6 days interval

Combined effect of sowing time and picking interval: All the parameters were statistically identical in the combination of sowing time and picking interval.

Combined effect of sowing time, spacing and picking interval: Plant population per unit area, number of fruit per plant, fruit yield per plant as well as fruit yield per hectare were significantly influenced by the combination of spacing, picking interval and sowing time (Table 4). Maximum plant population (40) was recorded in S₃P₁T₁ and S₃P₃T₂ where as minimum (23) in S₁P₁T₂, S₁P₂T₁, S₁P₃T₂, S₁P₄T₁, S₁P₄T₂ and S₁P₅T₁ combination. Highest number of fruit (28.7) per plant was recorded from S₁P₁T₂, which was statistically identical with S₂P₁T₂ (26.7). As a result statistically highest fruit yield (627 g) per plant obtained from S₁P₁T₂. The highest fruit yield (24.94 t ha⁻¹) was obtained from S₃P₁T₂, which was statistically identical with S₃P₂T₂ (23.79 t ha⁻¹). The lowest fruit yield (9.20 t ha⁻¹) was recorded from S₁P₅T₁ combination.

The overall results implied that the sowing of BARI Dheros-1 on mid April with a closer spacing of 60 × 30 cm² and picking at two or three days interval may be recommended for okra cultivation.

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