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# Effect of different plant spacing on growth and yield of okra (*Abelmoschus esculentus*) under subabul (*Leucaena leucocephala*) based alley cropping system

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**Abstract**
This experiment was laid out during July-September 2016 at forest nursery, Sam Higginbottom University of Agriculture, Technology and Sciences, U.P. in Randomized Block Design. Characters studied regarding growth attributes were plant height (cm), number of leaves per plant, number of branches, while regarding to yield attributes, number of fruits per plant, individual weight of fruit per plant, yield of fruit per plant(g) and yield per hectare (t/ha). Among all the treatments, spacing 60 cm x 30 cm was found best. On the basis of this investigation it is concluded that spacing 60 cm x 30 cm is best for okra, variety Anjali should be adopted in Allahabad (U.P.).

**Keywords:** Spacing, alley cropping, okra and yield

## Introduction
Agroforestry integrates trees into farmland and rangeland and in so doing diversifies and sustains production for increased benefits for farmers and the environment. Agroforestry system complement conservation agriculture systems in the provision of soil cover, animal feed, nutrients, household fuel and hillside protection against soil erosion and wind erosion control through shelter belts (Sims *et al*., 2009). Agroforestry system complement conservation agriculture systems in the provision of soil cover, animal feed, nutrients, household fuel, hillside protection against soil erosion and wind erosion control through shelter belt.

Alley cropping, also known as hedgerow intercropping, involves managing rows of closely planted (with in row) woody plants with annual crops planted in alleys in between hedges. The woody plants are cut regularly and leaves and twigs are used as mulch on the cropped alleys in order to reduce evaporation from the soil surface, suppress weeds and/or add nutrients and organic matter to the top soil. Where nitrogen is required for crop production, nitrogen-fixing plants are the main components of the hedgerows. (Chundawat, 1993)

Distance recommended for planting of okra (branching type) is 60 cm x 30 cm and for non branching type is 45 cm x 30 cm. During spring summer season with less plant growth these spacings are kept at 45 cm x 20 cm or less. Seed should be sown at a depth of 2.5 cm. Recommended nutrients for okra is 25t/ha FYM, 125kg N, 75kg P and 63kg K/ha. Half amount of nitrogen and full amount of P and K should e applied as basal dose while remaining half of the N should be given as top dressing 35-40 days after sowing the seeds. Zinc up to 2% as soil application or 2mg/litre of foliar spray of molybdenum @ 20mg/litre foliar spray for increasing fruit yield. Irrigation is done at an interval of 5-6 days.

*Leucaena leucocephala* also known as subabul belongs to the family Leguminosae/ Mimosoideae. Subabul is a native of Central America; has been introduced in many tropical countries, as in plains of India. The "Hawaiian Giant" variety is being widely cultivated in most states under Social Forestry and Agroforestry Schemes, for fodder, fuel, charcoal, small timber, poles, etc.

Wood is hard, strong, heavy and easily workable for a variety of carpentry purposes; makes cheap constructional timber; used for poles, fence posts, etc. It is suitable for pulp, for manufacture of paper in conjunction with long-fibred pulp (i.e. bamboo pulp). It makes excellent firewood and charcoal.

Leaves, pods and seeds are nutritious fodder and relished by cattle, sheep and goats. However, a toxic alkaloid mimosine is present in leaves of some varieties that can be injurious to cattle health, it is, therefore, important to use low mimosine strain leaves and mixed with other forage. Leaves and twigs are also used for composting. It is suitable for afforestation of grass lands, denuded watersheds and hill slopes, wind-breaks, fire-breaks; agroforestry and ornamental planting. (Chaturvedi 2011)

## Materials and method

### Details of experiment

The experiment was carried out in Randomized Block Design with the 3 replications having 8 treatments combination with a variety Anjali are allocated randomly in all plots. The details of treatments are given below.

### Treatment spacing

$T_1$ - 45 cm x 15 cm
$T_2$ - 50 cm x 20 cm
$T_3$ - 55 cm x 25 cm
$T_4$ - 60 cm x 30 cm
$T_5$ - 65 cm x 35 cm
$T_6$ - 70 cm x 40 cm
$T_7$ - 75 cm x 45 cm
$T_8$ - 80 cm x 50 cm

## Results and Discussion

### Plant height (cm)

1. At 30 DAS, it was observed that different treatment of spacing significantly affect the plant height (cm). The maximum plant height was found in treatment $T_1$ (34.47 cm) followed by treatment $T_2$ (33.153 cm) and minimum plant height was found in $T_8$ with 29.24 cm.
2. At 45 DAS, it was observed that different treatment of spacing significantly affect the plant height (cm). The maximum plant height was found in $T_1$ (51.07 cm) followed by $T_2$ (50.16 cm) and minimum plant height was found in $T_8$ (46.25 cm).
3. At 60 DAS, it was observed that different treatment of spacing significantly affect the plant height (cm). The maximum plant height was found in $T_1$ (70.093 cm) followed by $T_2$ (68.687 cm) and the minimum plant height was found in $T_8$ with (64.807cm).
4. Soni *et al.*, (2006) [24] also reported that plant height and number of internodes were maximum under closer spacing.

**Table 1:** Effect of different plant spacing on plant height (cm) of okra (*Abelmoschus esculentus*) under subabul (*Leucaena leucocephala*) based on alley cropping system

| Treatment | 30 DAS | 45 DAS | 60 DAS |
|---|---|---|---|
| $T_1$ | 34.47 | 51.07 | 70.093 |
| $T_2$ | 33.153 | 50.16 | 68.687 |
| $T_3$ | 33.097 | 49.107 | 68.32 |
| $T_4$ | 32.36 | 48.747 | 66.703 |
| $T_5$ | 32.17 | 48.393 | 66.337 |
| $T_6$ | 31.307 | 47.527 | 65.673 |
| $T_7$ | 30.253 | 47.113 | 65.153 |
| $T_8$ | 29.24 | 46.25 | 64.807 |
| F test | S | S | S |
| S.Ed.(±) | 0.487 | 0.262 | 0.228 |
| C.D.(P=0.05) | 1.054 | 0.567 | 0.493 |

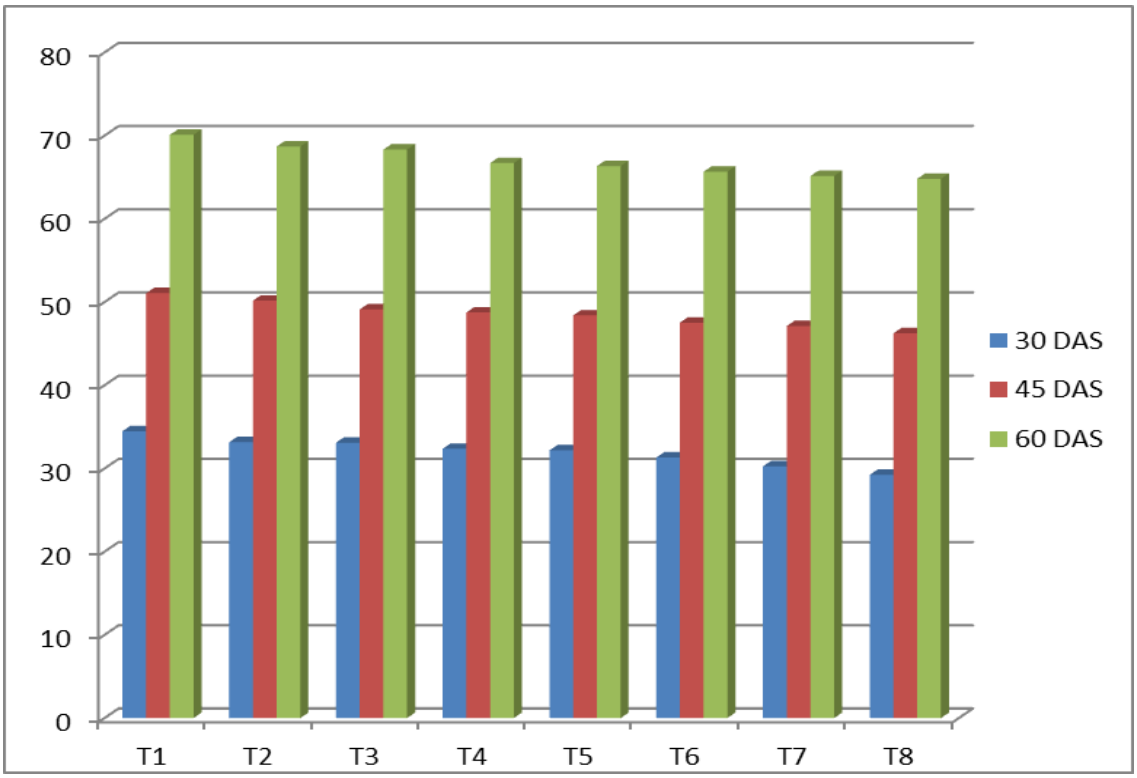


**Fig 1:** Effect of different plant spacing on plant height (cm) of okra (*Abelmoschus esculentus*) under subabul (*Leucaena leucocephala*) based on alley cropping system

### Number of branches per plant

At 30 DAS the maximum number of branches per plant was observed in $T_8$ (2.10) followed by $T_7$ (1.807) and minimum number of branches was found in $T_2$ (1.18).

At 45 DAS, the maximum number of branches per plant was observed in $T_8$ (4.05) followed by $T_7$ (3.63) and minimum number of branches was found in $T_2$ (2.46).

At 60 DAS, the maximum number of branches per plant was observed in $T_8$ (4.92) followed by $T_7$ (4.72) and minimum number of branches was found in $T_2$ (3.1). Soni *et al.*, (2006) [24], Maurya *et al.*, (2013) [11] and Madisal et al., (2015) also reported similar results.

**Table 2:** Effect of different plant spacing on number of branches per plant of okra (*Abelmoschus esculentus*) under subabul (*Leucaena leucocephala*) based on alley cropping system

| Treatment | 30 DAS | 45 DAS | 60 DAS |
|---|---|---|---|
| T1 | 1.237 | 2.573 | 3.447 |
| T2 | 1.177 | 2.460 | 3.187 |
| T3 | 1.270 | 2.653 | 3.433 |
| T4 | 1.350 | 3.010 | 3.700 |
| T5 | 1.447 | 3.200 | 4.200 |
| T6 | 1.667 | 3.387 | 4.517 |
| T7 | 1.807 | 3.633 | 4.717 |
| T8 | 2.100 | 4.050 | 4.917 |
| F test | S | S | S |
| S.Ed.(±) | 0.013 | 0.026 | 0.008 |
| C.D.(P=0.05) | 0.029 | 0.056 | 0.018 |

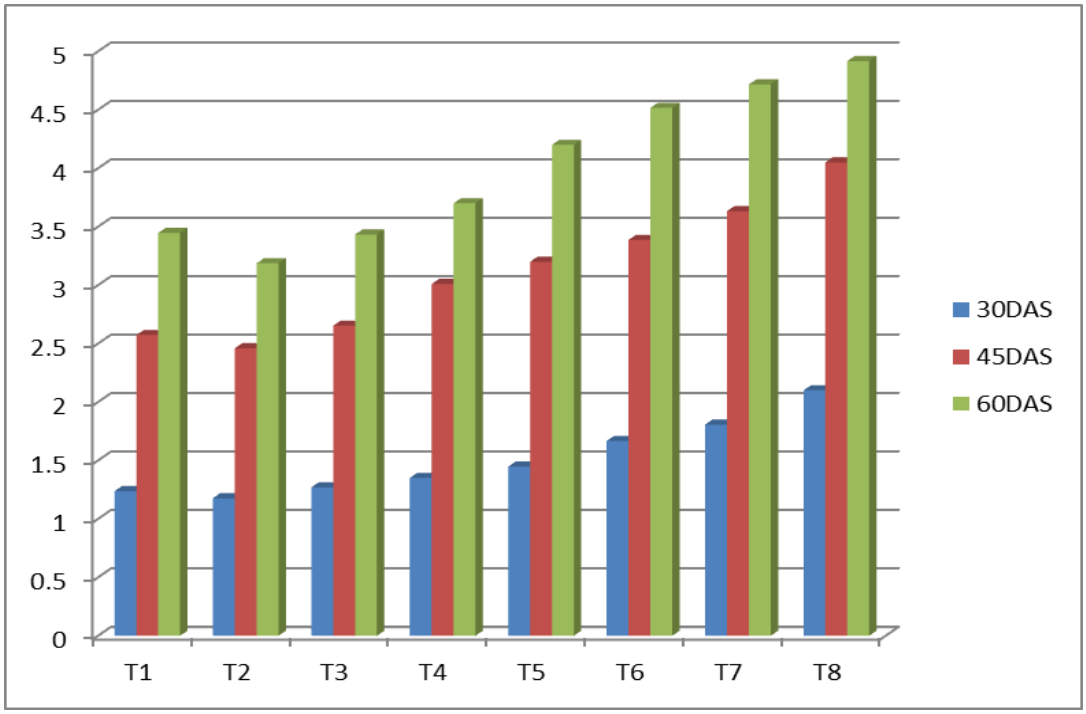


**Fig. 2:** Effect of different plant spacing on number of branches per plant of okra (*Abelmoschus esculentus*) under subabul (*Leucaena leucocephala*) based on alley cropping system

**Number of leaves per plant**

At 45 DAS, the maximum number of leaves per plant was observed in $T_8$ (17.46) followed by $T_7$ (14.79) and minimum number of leaves was found in $T_2$ (11.12).

Soni *et al.*, (2006) [24] and Madisal *et al.*, (2015) also reported maximum number of leaves under wider spacing.

**Number of fruits per plant**

The maximum number of fruits per plant was observed in $T_8$ (12.87) followed by $T_7$ (12.13) and minimum number of fruits was found in $T_2$ (10.93). Kadam *et al.*, (1995), Amjad *et al.*, (2001) and Ekwu *et al.*, (2012) [8, 1, 5] also reported maximum number of fruits per plant at the widest spacing.

**Fruit weight per plant (g)**

The maximum fruit weight per plant (g) was observed in $T_8$ (14.73) followed by $T_7$ (14.62) and minimum weight of fruit was found in $T_1$ (13.75). Amjad (2001) [1] reported similar result.

**Yield per plant (g)**

The maximum fruit yield per plant (g) was observed in $T_8$ (212.69) followed by $T_7$ (202.02) and minimum fruit yield per plant was found in $T_1$(129.85) at harvest.

**Yield (t/ha)**

The maximum fruit yield (t/ha) was observed in $T_1$ with 59.16 followed by $T_4$ with 5.793and minimum fruit yield was found in $T_8$ with 4.250 at harvest. Firoz *et al.*, (2007) [6] also reported that spacing 60 x 30 cm showed the highest yield.

**Table 3:** Effect of different plant spacing on number of leaves per plant, number of fruits per plant, fruit weight per plant (g), yield per plant (g) and yield (t/ha)

| Treatment | Number of leaves per plant | Number of fruits per plant | fruit weight per plant (g) | Yield per plant (g) | Yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$ | 11.844 | 11.200 | 13.753 | 129.85 | 4.923 |
| $T_2$ | 11.122 | 10.933 | 14.133 | 138.22 | 5.253 |
| $T_3$ | 12.710 | 11.400 | 14.277 | 153.40 | 5.557 |
| $T_4$ | 12.978 | 11.567 | 14.423 | 170.422 | 5.793 |
| $T_5$ | 13.363 | 11.667 | 14.527 | 181.7 | 5.323 |
| $T_6$ | 14.367 | 11.733 | 14.557 | 191.186 | 4.897 |
| $T_7$ | 14.789 | 12.133 | 14.620 | 202.02 | 4.543 |
| $T_8$ | 17.456 | 12.867 | 14.730 | 212.685 | 4.250 |
| F test | S | S | S | NS | S |
| S.Ed. (±) | 0.494 | 0.073 | 0.047 | 1.847 | 0.054 |
| C.D.(P = 0.05) | 1.070 | 0.767 | 0.102 | 4.001 | 0.117 |

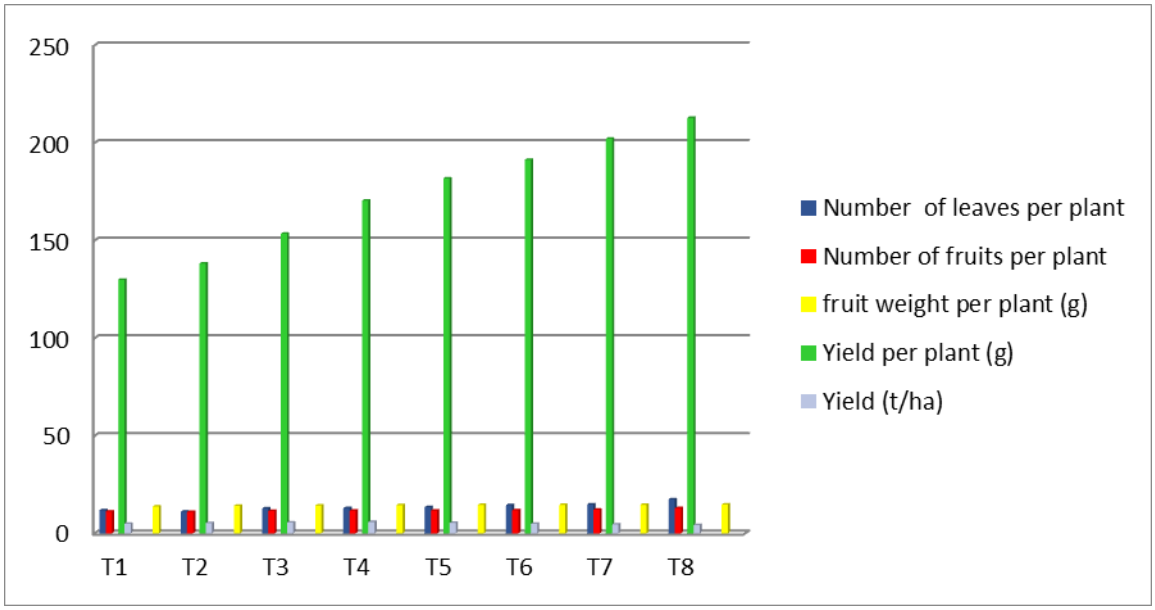


**Fig. 3:** Effect of different plant spacing on number of leaves per plant, number of fruits per plant, fruit weight per plant (g), yield per plant (g) and yield (t/ha)

Cost of cultivation per ha, Gross return (Rs/ha), Net profit (Rs/ha) and Benefit cost ratio of each treatment.

| Treatment | Cost of cultivation | Yield(t/ha) | Selling rate (Rs/t) | Gross Return (Rs/ha) | Net Return (Rs/ha) | Benefit cost ratio |
|---|---|---|---|---|---|---|
| $T_1$ | 24,450 | 4.92 | 15,000 | 73,800 | 49,350 | 1:2.02 |
| $T_2$ | 24,350 | 5.25 | 15,000 | 78,750 | 54,400 | 1:2.23 |
| $T_3$ | 24,250 | 5.56 | 15,000 | 83,400 | 59,150 | 1:2.43 |
| $T_4$ | 24,150 | 5.79 | 15,000 | 86,850 | 62,700 | 1:2.60 |
| $T_5$ | 24,050 | 5.32 | 15,000 | 79,800 | 55,750 | 1:2.31 |
| $T_6$ | 23,950 | 4.89 | 15,000 | 73,350 | 49,400 | 1:2.06 |
| $T_7$ | 23,850 | 4.54 | 15,000 | 68,100 | 44,250 | 1:1.85 |
| $T_8$ | 23,750 | 4.25 | 15,000 | 63,750 | 40,000 | 1:1.68 |

## Conclusion

The present study concluded that $T_4$ (60 cm x 30 cm) is the best spacing in comparison to other treatments with regards to its yield (t/ha). In terms of economy, the treatment $T_4$ is found to be the best with Gross return of Rs. 86,850, Net return of Rs. 62,700 and Benefit cost ratio of 1:2.60. Therefore, variety, Anjali of okra with spacing 60 cm x 30 cm is recommended in terms of high yield under Subabul based alley cropping system during *Kharif* season in Allahabad condition.

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