*J. Hortl. Sci.*
**Vol. 6(1):56-58, 2011**

*Short communication*

# Nursery output maximization in mango under low-hill conditions of Himachal Pradesh

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## ABSTRACT

**Studies to standardize nursery production techniques in mango for output maximization were conducted during 2004-2009. Three separate experiments were laid out to work out optimum spacing, fertilizer level and time of transplant of mango seedlings. Best result in terms of nursery output per unit area was observed in seedlings transplanted at a spacing of 30cm x 20cm during mid-August to mid-September. It was also observed that a higher proportion of early-transplanted seedlings became graftable by March. Thus there exists a wide scope for raising greater number of mango grafts in a year, as, these grafts attain saleable size by July-August, if suitable irrigation and nutrition is provided. Seedling survival improved with different levels of manure and fertilizer application. Overall saleable plant material generated was highest with application of 10kg FYM + 25g N + 16g $P_2O_5$ + 60g $K_2O$ per $m^2$ bed-area.**

**Key words:** Mango, nursery, spacing, fertilizer, transplanting

Fruit crops provide food, nutritional and economic security, besides being a means for crop diversification. Low hill-region of Himachal Pradesh is suitable for cultivation of a number of fruit crops, but mango is leading in this zone. Average productivity of this crop in the state is around 0.93t/ha (Anonymous, 2009) which is far below the national average. Among other factors, non-availability of sufficient amount of planting material of optimal quality is one of the major bottlenecks hampering productivity of mango in the state. Healthy and uniform planting material of high quality is a prerequisite for establishing a productive orchard. Nursery rising, presently undertaken by various public and private institutions, is being done on the basis of personal experience of growers. No package of recommendations is available for this commercial venture. Thus, for maximizing output of quality nursery, it is of utmost importance to standardize nursery techniques to suit local growing-conditions. The present studies were designed for standardization of nursery techniques for output maximization under low-hill conditions of Himachal Pradesh.

Studies were conducted at the experimental farm Neri of Dr. Y.S. Parmar University of Horticulture and Forestry, Regional Horticultural and Forestry Research Station, Bhota, Hamirpur during the years 2004-2009. The farm is located at an altitude of 620m amsl experiencing average mean maximum and minimum temperatures of 31.3$^0$C and 12.4$^0$C, respectively, and is representative of the low-hill region of Himachal Pradesh. Relative humidity here is around 60.9 %. Soil texture of the nursery was clay-loam with pH value of 6.6. Organic matter content of the nursery soil was 0.38% at onset of the experiment. Available N and P were low, and K content was medium. Initially, the study purported to standardize spacing for maximization of nursery output. Three spacings, viz., $S_1$ - 30cm x 10cm, $S_2$ -30cm x 20 cm and $S_3$-30cm x 30cm with five replicates, were tried in completely randomized design (CRD). Five beds of 2m x 1m comprised the replication and each bed was treated as a unit for observation. Observations were recorded on seedling survival and on proportion of graftable seedlings by March and July each year. Data on graft-success was also recorded for different treatments. Output maximization of the nursery was judged by number of saleable grafts produced per unit area. Seedlings were collected from the ground underneath locally grown mango trees, at the green leaf stage. During the period study (2004-06), transplantation was carried out from July to September each year.

Considerable amount of variation was observed in growth and development of transplanted seedlings with respect to time of transplant. Therefore, the second experiment was planned for standardizing transplanting time for mango seedlings, with the following treatments:

$T_1$ : Seedlings transplanted during 1$^{st}$ fortnight of July

$T_2$ : Seedlings transplanted during 2nd fortnight of July

$T_3$ : Seedlings transplanted during 1st fortnight of August

$T_4$ : Seedlings transplanted during 2nd fortnight of August

$T_5$ : Seedlings transplanted during 1st fortnight of September

$T_6$ : Seedlings transplanted during 2nd fortnight of September

Each treatment was replicated thrice with five plots (2m x 1m) for each replicate. The stones of local mango varieties were collected and were allowed to germinate in nursery beds in 3-4 inch thick layer of FYM. Copper colored seedlings on turning green were transplanted into nursery beds at a spacing (which was found to be the best in first experiment) 30cm x 20cm. The seedlings were then allowed to grow and were veneer grafted in March and July. Observations recorded were similar to that in the first experiment. In both the experiments described above, seedlings were manured @10kg FYM at the time of transplantation.

The third experiment was laid out to standardize manure and fertilizer dose to raise a healthy mango nursery. The following treatments were applied:

$F_1$ : 10kg FYM + 25g N + 16g $P_2O_5$ + 60g $K_2O$ per $m^2$ bed-area

$F_2$ : ½ $F_1$

$F_3$ : $2F_1$

FYM, P and K were applied at the time of bed-preparation and N was applied in two split doses (one month after transplanting and the other in February end). Each treatment was replicated thrice, with five plots (2mx1m) for each replicate. Observations recorded were similar to those in experiments 1 and 2. Data for all three experiments was pooled and analyzed as per standard procedures of Gomez and Gomez (1984).

Data pertaining to seedling-spacing is presented in Table 1. It is evident that survival of transplanted seedlings was not influenced significantly by different spacing treatments. In all, 72 to 74% survival of seedlings was observed under various treatments. This reflects that as far as survival of transplanted seedlings was concerned, even a spacing of 30cm x10cm is sufficient. Under wider spacing, it was observed that higher proportion of seedlings attained graftable size by March. Highest number of graftable seedlings was achieved in 30cm x 30cm spacing (though, it was statistically at par with 30cm x 20cm spacing). Grafting success % was also higher in this treatment. Proportion of seedlings that attained graftable size by July was also higher under 30cm x 30cm spacing, but was statistically at par with 30cm x 20cm. Grafting success in July grafted seedlings was also higher under the treatment 30cm x 20cm. GTZ-ITFSP (2010) reported that the best spacing for transplanting mango seedlings was 30cm x 30cm. Mukherjee and Majumdar (1964) too reported that spacing affected success in veneer grafting in mango. Overall nursery-output, i.e., saleable grafts generated per $m^2$ area, was also highest under the treatment 30cm x 20cm. Higher proportion of saleable grafts under this treatment may be attributed to higher plant-density here in comparison to 30cm x 30cm spacing and higher proportion of graftable seedlings grafting success in comparison to 30cm x 10cm spacing. Hence, 30cm x 20cm may be designated as optimum spacing for raising mango grafts.

As for the time of seedling transplantation (Table 2), survival of transplanted seedlings was highest when these were transplanted during the second fortnight of August and was statistically at par with those first in the transplanted fortnights of August and September. Faruque and Fakir (1973) reported that time of seedling transplanting had a significant effect on growth and performance in a mango nursery. These studies further revealed that mid–June transplanted seedlings had the lowest mortality, under Bangladesh conditions. In our studies, it was observed that early transplantation resulted in a higher proportion of graftable seedlings by March. Grafting success in March and July was not influenced by any of the treatments. It can be inferred from these findings that a larger proportion of early-transplanted seedlings became graftable by March. Hence, there exists a wide scope for raising greater number

**Table 1. Effect of spacing on performance of mango nursery**

| Treatment (spacing in cm) | Seedling survival (%) | Seedlings grafted in March | | Seedlings grafted in July | | Saleable grafts per $m^2$ |
|---|---|---|---|---|---|---|
| | | Graftable seedlings (%) | Graft success (%) | Graftable seedlings (%) | Graft success (%) | |
| $S_1$30x10 | 72 | 42 | 68 | 62 | 68 | 8.0 |
| $S_2$30x20 | 74 | 54 | 76 | 72 | 76 | 11.64 |
| $S_3$30x30 | 73 | 60 | 71 | 78 | 74 | 6.24 |
| $CD_{0.05}$ | NS | 6.4 | 7.2 | 6.2 | 4.8 | 2.33 |

**Table 2. Effect of time of transplant on performance of mango nursery**

| Treatment (time of transplant) | Seedling survival (%) | Seedlings grafted in March | | Seedlings grafted in July | | Saleable grafts per $m^2$ |
|---|---|---|---|---|---|---|
| | | Graftable seedlings (%) | Grafting success (%) | Graftable seedlings (%) | Grafting success (%) | |
| $T_1$ 1st fortnight of July | 62 | 48 | 64 | 82 | 74 | 10 |
| $T_2$ 2nd fortnight of July | 69 | 42 | 65 | 84 | 75 | 11 |
| $T_3$ 1st fortnight of August | 70 | 43 | 61 | 80 | 74 | 13 |
| $T_4$ 2nd fortnight of August | 75 | 40 | 62 | 81 | 76 | 15 |
| $T_5$ 1st fortnight of September | 72 | 32 | 64 | 82 | 72 | 13 |
| $T_6$ 2nd fortnight of September | 56 | 15 | 66 | 80 | 70 | 7 |
| $CD_{0.05}$ | 5.6 | 8.7 | NS | NS | NS | 2.3 |

**Table 3. Effect of fertilizers on performance of mango nursery**

| Treatment (fertilizers dose) | Seedling survival (%) | Seedlings grafted in March | | Seedlings grafted in July | | Saleable grafts per $m^2$ |
|---|---|---|---|---|---|---|
| | | Graftable seedlings (%) | Grafting success (%) | Graftable seedlings (%) | Grafting success (%) | |
| $F_1$ 10kg FYM, 25g N, 16g $P_2O_5$, 60g $K_2O$ per $m^2$. | 73 | 72 | 72 | 83 | 79 | 12.7 |
| $F_2$ Half the dose of $F_1$ | 54 | 58 | 59 | 65 | 64 | 8.2 |
| $F_3$ Double the dose of $F_1$ | 70 | 74 | 71 | 85 | 70 | 10 |
| $CD_{0.05}$ | 8.4 | 6.9 | 7.9 | 9.2 | 7.9 | 2.3 |

of mango grafts in a single year, as, these grafts can attain saleable size by July-August if suitable irrigation and nutrition is provided. GTZ-ITFSP (2010) has recommended that the best transplanting-time is at the 5-leaf stage or about 5cm seedling-height. Our study shows that the highest proportion of saleable seedlings can be obtained in seedlings transplanted during the 2nd fortnight of August; But, statistically, this was not found to be superior to early-August and early-September transplanting.

Nutrition is one of the major aspects of nursery-raising and results pertaining to this are presented in Table 3. It is observed from the data that seedling-survival improved with manure and fertilizer application. Survival was maximum with the full dose of fertilizers ($F_1$) and was statistically at par with that in double the dose ($F_3$). Graftable proportion of seedlings by March significantly improved by application of double dose ($F_3$) but was statistically at par with $F_1$. Graft success was highest in March in treatment $F_1$. The proportion of plant in the nursery that attained graftable size by July was also highest in $F_2$, although statistically at par with $F_1$. Overall saleable plant-material was highest with application of 10kg FYM + 25g N + 16g $P_2O_5$ + 60g $K_2O$ per $m^2$ bed-area, i.e., treatment $F_1$. No systematic studies are available on manure and fertilizer application in mango nursery under different locations. More number of location-and site specific studies on this aspect could further add to the existing scant information on nursery-raising.

It can be concluded from results discussed above that, for maximization of mango nursery output, the seedlings raised should be transplanted by end of August to mid-September at a spacing of 30cm x 20cm in nursery beds manured @ 10kg FYM + 25g N + 16g $P_2O_5$ + 60g $K_2O$ per $m^2$ bed-area.

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*(MS Received 30 September 2010, Revised 15 March 2011)*