

# RESEARCH PROGRAMME

## **Studies on rootstock and identification of elite commercial mango graft combination for Punjab conditions**

### DISSERTATION II REPORT

**BY**

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**In partial fulfillment for the award of the degree  
Of  
Master of Science (Fruit Science)**

**Under the guidance of**

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## CERTIFICATE

Certified that this synopsis of Kuldeep Singh, Registration No. 11615292 with the study entitled, **“Studies on rootstocks and identification of elite commercial mango graft combinations for Punjab condition”** has been formulated and finalized by the student himself on the subject.

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## **Introduction**

Mango originated from South East Asia, tends to be utilized in many different forms as in unripe and ripe one. In several parts of world like Java and Philippines, the leaves of mango used to cook as vegetable (Munde, 2011). The total area occupied by mango in India is estimated in average around 2500 lakh ha with production about 180.02 lakh tonnes (NHB, 2016). The crop tends to extensively grown in states of Andhra Pradesh, Uttar Pradesh, Karnataka, Bihar, Gujarat, Tamil Nadu, West Bengal, Orissa etc. The agro climatic conditions of other states like Bihar, Punjab are also suitable for mango production.

Mango is propagated by vegetative method or by seeds. Though seed propagation is the easiest method of propagation, being cross-pollinated crop, this method has to be discouraged, as it will not produce true-to-type progenies, besides resulting in longer gestation period. The requirement of a good propagation method should aim at producing uniform and true to type planting material. Among the different methods of asexual propagation, grafting is a critical physiological process with distinct developmental phases, being influenced by environmental parameters, age of rootstock, method of grafting and cultivar used.

In mango, rootstocks play a vital role in production of successful vegetative propagation. Among several propagation techniques in mango, the commercial nursery propagation is through grafting. The response of existing polyembryonic mango types in seedling production as rootstock and graft affinity of several scion and stock combinations in commercial mango types under Punjab region is lacking. So, this experiment comes with a solution to overcome the issues in identification of elite rootstocks and suitable graft combinations for commercial nursery production targeting mango industries.

To identify elite rootstocks and suitable graft combinations for commercial nursery production is an essential practice of achieving sustainable mango production.

## **OBJECTIVES**

The present study is to be taken up with the following objectives

1. To assess the performance of available polyembryonic mango types in seedling production for rootstock
2. To observe the affinity of various graft combinations in growth and developmental behaviour with commercial cultivars of mango

# Review of Literature

## Affinity for graft combinations in fruit crops

Cohen *et al.* (2007) stated that the success of grafting depends on the identification of stress and pathogen-resistant rootstocks and on compatibility of graft union in terms of fast formation of vascular connections between rootstock and scion. In similar, Verma *et al.* (2010) carried out an experiment to standardize the rootstock in grapes. The grape cultivar Pusa Urvashi was grafted on different rootstocks viz., Pusa Navrang, Dogridge A, SO4 and H-144. The days required for sprouting of grafted plants was 19.40 days. Pusa Navrang as rootstock was proven the most compatible with Pusa Urvashi as scion partner for growth parameters.

Mohona Banik (2014) stated that lemon seedlings were grafted with BAU-3 lemon which recorded the minimum number of days taken for sprouting (11.64 days) produced after grafting under Bangladesh conditions. Sivudu *et al.* (2014) reported that Banganapalli grafted on Bangalora rootstock recorded the minimum days required for sprouting of grafts (12.11 days). The experiment was carried out in Anantharajupet conditions.

## Success percentage for graft combination

Gurudutta *et al.* (2012) reported that different cultivars of scions like Langra, Dashehari, Amrapali and Mallika were grafted on Kurukkan rootstock under Raipur conditions. The maximum success percentage (93.33 %) was recorded in Dashehari variety followed by Langra. Jadhav *et al.* (2014) studied the percentage of grafting in twelve varieties of mango on local rootstock. The maximum success percentage was recorded (95 %) in Totapuri cultivar of mango.

Kumar and Thakur (2016) studied that the mango stones of different unknown commercial cultivars used for raising seedling rootstocks and Dashehari variety used as scion. The growing media used in the study the soil + sawdust was found to be the best growing mixture in respect of sprouting, survival and overall performance of stone grafts over other growing mixtures. Thakur and Shah (2013) studied that survival of mango grafts received when grafts made with scion sticks stored in wrapping in moist cotton cloth + wax coating at cutting side and stored at room temperature condition for three days.

Singh *et al.* (2014) studied that the higher survival percentage was exhibited by 5 days and 10 days old rootstock, which shows suitability for this technique. It was revealed that stone/epicotyl grafting performed better in terms of growth and survival when rootstocks up to 10 days old were used for grafting.

## Survival percentage of grafts

Islam *et al.* (2004) stated that the maximum survival percentage of Amrapali was 52.98 per cent than Gopalbhog (38.58 %) under Bangladesh conditions. Nalage *et al.* (2010) reported that the maximum survival percentage was recorded in Kesar variety of mango grafted on local variety rootstock.

Simon *et al.* (2010) carried out an experiment on rootstock growth and development for increased graft success in mango. The maximum survival percentage of rootstock after grafting was about 73.5 per cent. Sivudu *et al.* (2014) reported that Banganapalli grafted on Bangalora rootstock recorded the maximum survival percentage (67.18 %).

### **Performance of grafts for phenological characters**

Shantagouda *et al.* (2008) reported that the Alphonso variety grafted on Nekkare rootstocks showed the maximum graft survival percentage (64.77%) whereas Alphonso grafted on Baneshan rootstocks showed the maximum graft height and graft diameter under Karnataka conditions. Sivudu *et al.* (2014) stated that Banganapalli grafted on Bangalora rootstock recorded the maximum graft height (17.92 cm) under Anantharajupet conditions.

Bhuiyan *et al.* (2010) stated that girth was highly influenced by the different combinations of rootstock and scion from 42 to 52 months. The highest girth (24.65 cm) of scion was recorded in plants produced by grafting of Amarpali scion onto Amarpali rootstock followed by Gopalbhog scion onto Gopalbhog rootstock. Thus, the results revealed the superiority of plants produced by grafting of same scion onto the rootstock of same variety of mango.

Kudmulwar *et al.* (2008) performed grafting under Parbhancondition using local variety rootstock of custard apple (*Annona squamosa* L.) with Balanagar scion and reported the highest number of leaves (21.93) in plants produced after grafting.

Ram *et al.* (2012) recorded the maximum number of leaves on Amrapali scion at 30 and 60 days after stone grafting on different cultivars of mango under Lucknow conditions. Kalalbandi *et al.* (2014) reported that the maximum number of leaves was recorded (14.44) in Kalipatti variety of sapota grafted on Khirni rootstock under Marathawada conditions.

Sivudu *et al.* (2014) reported that Banganapalli grafted on Bangalora rootstock recorded the maximum leaf length. The experiment was carried out in Anantharajupet conditions.

### **Physiological characters for graft combinations**

Shaban (2010) conducted an experiment on comparative study of some polyembryonic mango rootstocks. Sukkary, Zebda, Sabre and 13-1 rootstocks were used for grafting. Cultivars of mango like Zebda, Ewais and Keitt were grafted on Sukkary, Zebda, Sabre and 13-1 rootstocks. The maximum leaf area was recorded (86.8 cm<sup>2</sup>) in plants produced by grafting of Keitt grafted on Zebda rootstock. Among all the rootstocks, Zebda rootstock was found to be best rootstock.

The water transport and mineral element assimilation by injured vessels resulted in reduction of growth. The vascular tissue disorders in graft interface between scion and rootstock after grafting resulted in incompatibility. The abnormal accumulation of phenols at incompatible graft interface was reported in cherry (Gebhardt and Feucht, 1982, Soumelidou *et al.*, 1994 and Zarrouk *et al.*, 2006).

Fayek *et al.* (2004) found that in olive, Chimlai seedling rootstock was the most promising rootstock for grafting with three olive cultivars and recorded the maximum leaf chlorophyll content. Dashehari grafted on Bappakai rootstock recorded significantly maximum chlorophyll content in leaves followed by Muvandan and EC 95862. Among all the rootstocks, Bappakai was the best rootstock for Dashehari (Chandan *et al.*, 2006).

## Material and Methods

The present investigation on “**Studies on rootstocks and identification of elite commercial mango graft combinations for Punjab condition**” planned for the study in nursery area of LPU farm, SAGR, Lovely Professional University, Phagwara during the year 2017-18.

The details of experimental materials and methodologies adopted during the course of study are furnished below.

The experiment is planned for performance from March 2017 to April 2018.

### Treatment details

#### Experiment 1

Treatments	Mango rootstocks
T <sub>1</sub>	Safeda
T <sub>2</sub>	Chausa
T <sub>3</sub>	Langra
T <sub>4</sub>	Totapuri
T <sub>5</sub>	Dashehari

No. of rootstocks : 5 (locally available elite mango cultivars)

No. of replications : 4

Design of experiment: CRD

#### Experiment 2

Factor 1 (No. of rootstocks) : 5 (locally available elite mango cultivars)

Factor 2 (No. of scions) : 3 (commercial varieties of Punjab region)

Total No. of treatments: 15

No. of replications: 3

Design of experiment: FCRD



In this semester, as per the proposed plan, the research activity commenced in the month of March, 2017 with the collection and sowing of mango stones. Locally available five elite mango types *viz.*, Safeda, Chausa, Langra, Totapuri and Dashehari were utilized to assess the performance of mango types in seedling production for rootstock in first batch of experiment.

In second batch of experiment, those rootstocks were utilized to study the affinity for graft compatibility, growth and developmental behaviour with two grafting methods *viz.*, Cleft and Side on existing scion cultivars of Chausa, Dashehari and Achari Aam. The grafting activity performed from May, 2017 to August, 2017.

### **OBSERVATIONS RECORDED**

Periodically, observations were recorded on the following parameters.

### **MORPHOLOGICAL CHARACTERS**

- Days taken for germination
- Plant height (cm)
- Plant girth (cm)
- No. of leaves per plant
- Leaf length (cm)
- Leaf width (cm)
- Graft success percentage [@ 7 DAG] (%)
- Graft survival percentage [@90 DAG] (%)
- Rootstock girth (cm)
- Scion girth (cm)
- Leaf length (cm)
- Height of graft (cm)
- Number of leaves per graft

## Work Done

The following activities were performed from August 2017 to November, 2017.

- Collection and sowing of mango stones
- Assessment of rootstock performance
- Performance of grafting
- Observation of growth and development phenomenon in grafts

## Experiment 1

**Assessment on the performance of mango seedlings for identification of elite rootstock**

### **1. Days taken for germination**

<b>Rootstocks</b>	<b>Duration for germination</b>
Safeda	21.83
Chausa	25.16
Langra	24.06
Totapuri	22.66
Dashehari	24.83
<b>Mean</b>	<b>23.71</b>

### **2. Plant height (cm)**

<b>Rootstocks</b>	<b>30 DAS</b>	<b>60 DAS</b>	<b>90 DAS</b>	<b>Mean</b>
Safeda	9.26	21.36	32.30	<b>20.97</b>
Chausa	7.42	16.98	21.68	<b>15.36</b>
Langra	8.05	17.66	28.72	<b>18.14</b>
Totapuri	8.33	19.22	30.84	<b>19.46</b>
Dashehari	7.83	17.35	21.92	<b>15.70</b>
<b>Mean</b>	<b>8.18</b>	<b>18.51</b>	<b>27.09</b>	<b>17.93</b>

### 3. Plant girth (cm)

<b>Rootstocks</b>	<b>30 DAS</b>	<b>60 DAS</b>	<b>90 DAS</b>	<b>Mean</b>
Safeda	1.06	1.84	2.16	<b>1.69</b>
Chausa	0.74	1.07	1.75	<b>1.19</b>
Langra	0.68	1.32	1.82	<b>1.27</b>
Totapuri	1.12	1.98	2.60	<b>1.90</b>
Dashehari	0.52	1.02	1.70	<b>1.08</b>
<b>Mean</b>	<b>0.82</b>	<b>1.45</b>	<b>2.01</b>	<b>1.43</b>

### 4. Number of leaves per plant

<b>Rootstocks</b>	<b>30 DAS</b>	<b>60 DAS</b>	<b>90 DAS</b>	<b>Mean</b>
Safeda	4.83	8.12	9.46	<b>7.47</b>
Chausa	4.12	7.84	9.33	<b>7.10</b>
Langra	4.30	7.86	9.42	<b>7.19</b>
Totapuri	5.02	8.24	9.88	<b>7.71</b>
Dashehari	4.04	7.78	9.14	<b>6.99</b>
<b>Mean</b>	<b>4.46</b>	<b>7.97</b>	<b>9.45</b>	<b>7.29</b>

### 5. Leaf length (cm)

<b>Rootstocks</b>	<b>30 DAS</b>	<b>60 DAS</b>	<b>90 DAS</b>	<b>Mean</b>
Safeda	6.13	12.28	14.1	<b>10.84</b>
Chausa	5.06	11.12	11.33	<b>9.17</b>
Langra	5.76	11.94	13.26	<b>10.32</b>
Totapuri	7.12	13.84	15.04	<b>12.00</b>
Dashehari	4.68	10.04	11.23	<b>8.65</b>
<b>Mean</b>	<b>5.75</b>	<b>11.84</b>	<b>12.99</b>	<b>10.20</b>

## 6. Leaf width (cm)

<b>Rootstocks</b>	<b>30 DAS</b>	<b>60 DAS</b>	<b>90 DAS</b>	<b>Mean</b>
Safeda	1.27	2.47	4.06	<b>2.60</b>
Chausa	1.21	2.41	3.86	<b>2.49</b>
Langra	1.25	2.45	3.88	<b>2.53</b>
Totapuri	2.23	3.43	4.34	<b>3.33</b>
Dashehari	1.18	2.38	3.23	<b>2.26</b>
<b>Mean</b>	<b>1.43</b>	<b>2.63</b>	<b>3.87</b>	<b>2.64</b>



**Collection of stones for mango cultivars**



**Germination from mango stone**



**Emergence of young sapling**



**Sapling transfer to polybag**



**View of mango rootstocks under experimentation plot**

## RESULT AND DISCUSSION

The results of the study on “Studies on rootstocks and identification of elite commercial mango graft combinations for Punjab condition” are presented in this chapter.

Observations on ‘Morphological traits’ viz., Days taken for germination, Plant height (cm), Plant girth (cm), No. of leaves per plant, Leaf length (cm), Leaf width (cm), Graft success percentage [@ 7 DAG] (%), Graft survival percentage [@90 DAG] (%), Rootstock girth (cm), Scion girth (cm), Leaf length (cm), Height of graft (cm) and Number of leaves per graft were recorded. The results of the observations were presented as below.

### **Days taken for germination**

The duration for germination of the stones exhibited variation among rootstocks. Among all, Safeda registered minimum duration for germination (21.83) followed by Totapuri (22.66), whereas Chausa recorded maximum number of days for germination (25.16).

### **Plant Height (cm)**

The mean value on ‘Plant Height’ after transplanting the saplings from beds to polybags revealed variations among different treatments. Among all the rootstocks, Safeda registered maximum mean value for ‘plant height’ (9.26, 21.36 and 32.30 cm) at 30, 60 and 90 days after sowing, whereas Chausa recorded the least ‘plant height’ (7.42, 16.78 and 21.68 cm) in all stages of observation.

### **Plant girth (cm)**

The mean value on ‘Plant girth’ after transplanting the saplings from beds to polybags revealed variations among different treatments. Among all the rootstocks, Totapuri registered maximum mean value for ‘Plant girth’ (1.12, 1.98 and 2.60 cm) at 30, 60 and 90 days after sowing, whereas Dashehari recorded the least ‘Plant girth’ (0.52, 1.02 and 1.70 cm) in all stages of observation.

### **Number of Leaves per Plant**

The mean value on ‘Number of leaves per plant’ after transplanting the saplings from beds to polybags revealed variations among different treatments. Among all the rootstocks, Safeda registered maximum mean value for ‘Number of leaves per plant’ (5.02, 8.24 and 9.88) at 30, 60 and 90 days after sowing, whereas Dashehari recorded the least ‘Number of leaves per plant’ (4.04, 7.78 and 9.14) in all stages of observation.

### **Leaf length (cm)**

The mean value on ‘Leaf length’ after transplanting the saplings from beds to polybags revealed variations among different treatments. Among all the rootstocks, Totapuri registered maximum mean value for ‘Leaf length’ (7.12, 13.84 and 15.04 cm) at 30, 60 and 90 days after sowing, whereas Dashehari recorded the least ‘Leaf length’ (4.68, 10.04 and 11.23 cm) in all stages of observation.

**Leaf width (cm)**

The mean value on 'Leaf girth' after transplanting the saplings from beds to polybags revealed variations among different treatments. Among all the rootstocks, Totapuri registered maximum mean value for 'Leaf girth' (2.23, 3.43 and 4.34 cm) at 30, 60 and 90 days after sowing, whereas Dashehari recorded the least 'Leaf girth' (1.18, 2.38 and 3.23 cm) in all stages of observation.

**Experiment 2**

The second batch of experiment is under observation and would be gets analyzed in upcoming days as proposed work in the study.

Based on first batch of experiment, the mango rootstock of cv. Totapuri found to perform better with major morphological traits.

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