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# A preliminary study to check the graft compatibility and success percentage of curry leaf (*Murraya koenigii* Spreng.)

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**Abstract**
Water deficit conditions hinder plant growth and development leading to diminished crop productivity. However, improving the crop productivity is need of the time to sustain the food security under ever increasing world population. Climate change altered the hydrological cycle which limit the water source for irrigation. Curry leaf (*Murraya koenigii*) is an important culinary plant of Indian origin, mainly grown for leaf production. It is a water loving plant and cannot withstand water deficit condition which ultimately affects the leaf production. In this regard, grafting studies was carried out in curry leaf as a new innovative strategy with drought tolerant rootstocks to increase the leaf production under water deficit condition. Cleft grafting method was followed in this study. Senkambu, a popular cultivar of curry leaf was used as scion and curry leaf wild type, woodapple, orange jasmine and Bael were used as rootstocks. Among these four rootstock, curry leaf wild type recorded the highest graft success percentage (66) followed by wood apple (16) and orange jasmine (6). Bael showed 0% of success percentage. Hence, the success percentage of curry leaf wild type has to be increased through altering the environmental conditions and can be further exploited.

**Keywords:** Curry leaf, grafting, drought, rootstocks, graft compatibility

## Introduction
India has one of the richest plant-based ethno-medicinal traditions in the world and medicinal and aromatic plants are a very important national resource (Rajasekharan and Ganeshan, 2002) [10]. Curry leaves which have been traditionally used in the Indian culinary system from time immemorial, as a rich source of antioxidants (Ningappa *et al.*, 2008) [8]**.** The use of herbs to treat disease is almost ubiquitous among non-industrialized societies and is often more affordable than purchasing expensive modern pharmaceuticals (Salomi *et al.*, 2016) [12].
Curry leaf is also known as a miracle plant which belongs to the family *Rutaceae* (Singh *et al*., 2014). which consist of six sub-family. Among them, curry leaf comes under the sub-family of Aurantioideae. The genus Murraya has nearly 14 species worldwide and two genus *viz.*, *Murraya koenigii* Spreng. and *Murraya paniculate* (Jackfruit) are native to India (Jain *et al.*, 2017). The leaves are indispensible part of South Indian cuisine which improves the flavour of foodstuff. It is commonly known as "Meetha Neem" and grown as deciduous shrub or a small tree up to a height of 6 meters (Parnami *et al.*, 2018) [6].
The leaves have a slightly pungent, bitter and feebly acidic taste and they retain their flavour and other qualities even after drying. Curry leaf is commercially propagated by seeds or suckers. Curry leaf seeds are considered as recalcitrant seeds as they cannot resist the effects of drying or exposure to temperatures less than 10ºC and thus cannot be stored for long periods (Sivasubramanian *et al*., 2012) [13]. Moreover, it is highly cross pollinated crop and shows variability among the plant population. Attempts to propagate curry leaf through air layering have not been successful (Philip *et al*., 1981). Main focus of the research work is to bring out and showcase a new propagation technology for Curry leaf (*Murraya koenigii*.Spreng.) in the field of horticulture. In this regard, grafting studies was carried out in curry leaf to identify a suitable and drought tolerant rootstock to get uniform plant population under water deficit condition.

## Materials and Methods
The investigation was undertaken at the Department of Spices and Plantation Crops, HC & RI**,** TNAU, Coimbatore during the year 2019-2020 to bring out a grafted curry leaf plants to increase yield and to overcome drought. Grafting was done by selecting the desired type of scion senkambu which is one of the most recognized and cultivable type by the Mettupalayam farmers in Coimbatore district of Tamil Nadu.

Four rootstocks are selected among *Rutaceae* family which are drought tolerant. Among four rootstock, one is of same genus *i.e.*, *Murraya paniculate*($T_4$), another two are from different genus namely *Limonia acidissima* ($T_2$), *Aegle marmelos* ($T_3$) and Wild Curry leaf type ($T_1$) was collected from Shevaroy hills of Tamil Nadu. Scions were procured 10 days before grafting and age of the rootstock was around 1 year old. Grafting method used in this study was wedge or cleft grafting. The best time for grafting was when the scion and rootstock have the same graftable girth. Grafting was done under shadenet at early morning or in the late evening. The experimental design adopted in this study was CRD with five replications each consisting of 10 plants. Survival rate of each treatment were noticed and recorded to determine whether there were significant differences among the different rootstocks.

**Cleft/ Wedge grafting**

V shape cut was given on the rootstock and the scion was shaped to fit into the V Shaped cut of the rootstock (Fig.1). After interlocking the scion and rootstock, graft union portion was tied with grafting tape and covered with graft cover to create humidity for earlier sprouting. Then the plants are shifted to mist chamber for nearly 15 – 20 days at >95%, 25-30ºC and then transferred to shadenet house for further growth. As when the graft union is formed, the grafting tape was removed and regular watering was given. Water sprout from the rootstock should be removed periodically for proper supply of water and nutrient to the scion. At 60$^{th}$ day after grafting, per cent of grafting success was recorded and microtome study was done to check the graft compatibility.

**Microtome study**

In order to study the ultra structural changes and compatibility in the grafted curry leaf plant, microtome study was taken up and anatomical observation were carried out at 60$^{th}$ day after grafting. The graft union portion was fixed in FAA for 24 hours (FAA: 10:50:5:35 proportion of formalin, alcohol, acetic acid and water).

**Statistical analysis**

Observations *viz.*, graft success percent, days taken for sprouting, average shoot length, number of leaves per leaflet, length of leaflet and length of leaf were recorded in each replication and the datas were subjected to statistical analysis using SPSS software (Nei, 1978).

**Result and Discussion**

In the present study, four drought tolerant rootstocks from *Rutaceae* family were selected and their performance were assessed by analyzing certain growth parameters like number of days taken for sprouting after grafting, average shoot length, leaflet number, number of leaves / leaflet (cm), length of leaflet (cm) and leaf (cm) and graft success petcentage (%)**.**The results are discussed below for grafting of desired type of scion with four different rootstocks, to identify a suitable rootstock for curry leaf against water deficit condition.

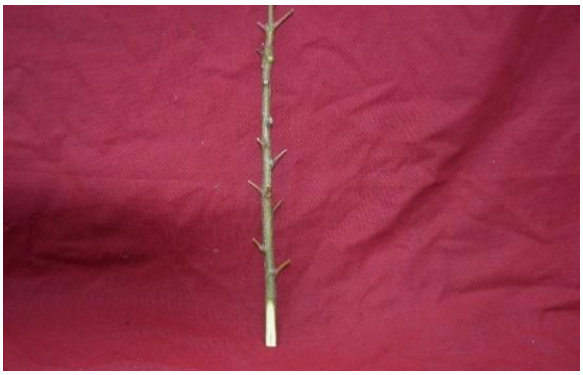
**Fig 1:** Collection of scions from farmers field, Karamadai, Coimbatore

Rootstock

Scion

V shape cut in Rootstock

Tieing the graft portion with grafting tape



Scion end is shaped to fit into the rootstock

Grafted plants covered with Polythene sleeves

Interlocking of scion and rootstock

Grafted plants under mist chamber

**Table 1:** Performance of curry leaf grafted plants for growth parameters

| Graft combinations | Graft success Percentage (%) | No. of days taken for sprouting | Average shoot length | Leaflet number | Number of leaves / leaflet (cm) | Length of leaflet (cm) | Length of leaf (cm) |
|---|---|---|---|---|---|---|---|
| Senkambu grafted on to Curry leaf wild type rootstock ($T_1$) | 66 | 12.00 | 7.87 | 9.2 | 10.6 | 10.38 | 2.6 |
| Senkambu grafted on to Wood apple rootstock ($T_2$) | 14 | 7.54 | 2.31 | 9.0 | 10.5 | 6.8 | 1.4 |
| Senkambu grafted on to Bael rootstock($T_3$) | 0 | 6.30 | - | - | - | - | - |
| Senkambu grafted on to Orange jasmine rootstock ($T_4$) | 6 | 12.94 | 2.12 | 1.5 | 7 | 3 | 0.85 |
| | SP | DAG | ASL | LLTN | NOL/L | LLT | LL |
| Sed | 2.97 | 1.31 | 0.41 | 0.75 | 1.03 | 0.69 | 0.16 |
| CD (p=0.05) | 6.30** | 2.78** | 0.86** | 1.59** | 2.18** | 1.46** | 0.34** |

**Graft success Percentage**

Rate of survival was assessed in terms of percentage of success after 60 days of grafting. There was significant difference in graft success percentage among four rootstocks. Due to graft incompatibility between rootstock and scion different rate of survival percentage was obtained. The success percentage is more when senkambu was grafted on curryleaf wild type (66%) followed by wood apple (14%) and orange jasmine (6%). Successful grafting (Compatibility between scion and rootstock) was due to cell division in the scion and rootstock at the grafting union (dedifferentiation and redifferentiation of the callus tissue), rapid connection between the vascular bundles of the scion and rootstock (Shehata *et al*., 2000) [14]. However, none of the plants were

survived when senkambu scion grafted on to bael rootstock which indicates the graft incompatibility. Different factors such as inherent system of cellular incompatibility, formation of plasmodesmata, vascular tissue connections and the presence of growth regulators and peroxidases may have an influence on graft success. Macromolecules (phloem proteins, RNA, hormones) that are present in the sap phloem might be also important during vascular differentiation in compatibility process. (Pina and Errea, 2005) [2].

**Number of days taken for sprouting**

The senkambu scion grafted onto Bael rootstock took least number of days for sprouting (6.3) than other graft combinations. However, this graft combination shows graft incompatibility. Early sprouting was due to consequent higher level of photosynthates and/or dry matter production (Amrita *et al.*, 2019) [1]. Followed by Bael, wood apple, curry leaf wild type and orange jasmine rootstock took 7.54, 12.00 and 12.94 days for sprouting respectively.

**Average shoot length (cm)**

Average shoot length was observed at 15$^{th}$, 30$^{th}$, 45$^{th}$ and 60$^{th}$ days after grafting. Curry leaf wild type showed the maximum shoot length (7.87cm) followed by wood apple (2.12 cm) and orange jasmine (2.12 cm). Senkambu scion grafted on to curry leaf wild type rootstock showed 0.5 to 1 cm shoot growth for every fifteen days. Whereas, the senkambu scion grafted woodapple rootstock showed 0.25 cm increase in shoot length. Probably this may be due to better growth of grafts and weather condition like temperature and humidity, which played important role in growth of grafts. (Gohil *et al.*, 2019) [3] and growth reduction is associated with auxin destruction, ascorbic acid changes, physiological and biochemical interference (Singh *et al.*,2000) [11]

**Average leaflet number**

Average leaflet number was observed at 60$^{th}$ day after grafting. Senkambu scion grafted on to curry leaf wild type rootstock recorded the highest leaflet number (9.2) followed by woodapple (9.00). Least leaflet number (1.5) was observed in orange jasmine. Production of higher number of leaflet was due to relative increase in anticlinal division (Suja et al. 2016)

**Average number of leaves / leaflet (Nos)**

Average number of leaves / leaflet was observed at 60$^{th}$ days after grafting. Among the four graft combinations, senkambu scion grafted on to curry leaf wild type rootstock produced higher number of leaves/leaflet (10.6) followed by woodapple (10.5). Orange jasmine recorded the least number of leaves/leaflet (7.0). Increase in number of leaves might be due to the active growth of both rootstock and scion followed by favourable climatic conditions for the cambial activity and in turn favouring growth of grafts (Uchoi., 2012)

**Average length of leaflet (cm)**

Senkambu scion grafted on to curry leaf wild type rootstock recorded the highest length of the leaflet (10.38 cm) followed by woodapple (6.8 cm). Even though, Orange jasmine (*Murraya paniculata*) belongs to same genus it showed least value (3 cm) for the same. The maximum leaf area in early grafting dates may be due to the early healing of graft union, which in turn produced maximum leaflet area (Rehman *et al.*, 2000) [9]

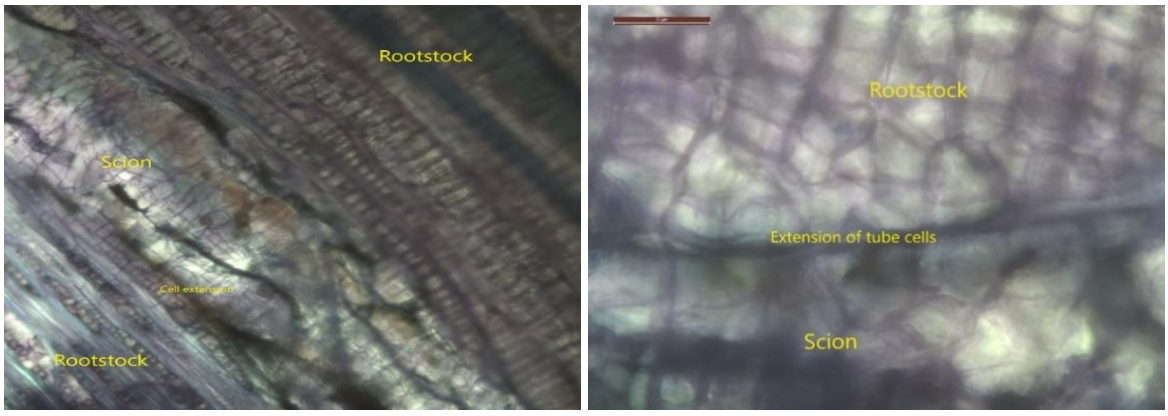
**Average length of the leaf (cm)**

Average length of leaf was recorded in all the four graft combinations. Among them, Senkambu scion grafted on to curry leaf wild type rootstock recorded 2.6 cm followed by Senkambu + wood apple rootstock graft combination (1.4 cm) and Senkambu + Orange jasmine (0.85cm). Inequality in leaf length may reflect a fundamental structural aspect of a leaf population which is maintained at (or constrained to) a relatively constant level regardless of plant density (Berntson *et al.*, 1991) [4]

From above all the parameters, curry leaf wild type shows the highest graft success percentage, shoot length, leaflet number, number of leaves/leaflet, average length of leaflet (cm) and leaf (cm). As the economic part is leaf, this indicates that when senkambu (a preferred cultivable type grown by farmers from karamadai, Coimbatore) scion grafted with curry leaf wild type collected from Shervoys hills found to produce number of leaves per leaflet and length of the leaf. Increases in stem girth of scion after grafting was positively correlated with the number of leaves, leaflet length and leaflet width. Carbohydrate, the main energy source for plant activity is thought to be one of the limiting factors in the successful vegetative propagation of plants. Higher accumulation of carbohydrates contributes towards good leaf characteristics, which leads to higher success rate of grafting (Dhakar *et al.*, 2017) [5]

**Histological study**

Longitudinal sectional was taken was at 60$^{th}$ day after grafting which shows the growth of callus and extention of cells to connect with the cells of senkambu (Fig.2).




10X-Overview of callus growth at the graft union portion 40X-Extension of tube cells of scion and rootstock at graft union portion.

**Fig 2:** Anatomical view of graft union portion

## Conclusion

Among the four rootstocks used, senkambu scion grafted onto curry leaf wild type rootstock ($T_1$) showed better graft compatibility and high success percentage followed by wood apple ($T_2$). Study has to be reconfirmed as this is a first kind of grafting work in curry leaf to see the success percentage. Success may be improved through altering the environment and using different age of scions.

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