

Tissue Culture Date Palm - A Journey From Laboratory To Land



Background and Objectives

Date palm (*Phoenix dactylifera* L.) is one of the oldest tree known to mankind. It is popularly referred as “*Kalpariksh of Kutchh*” as it is an important fruit tree of arid and semi arid regions of the State owing to its high tolerance to environmental stresses especially abiotic. The commercial cultivation of date palm (mainly seedling origin) in India occurs in the western border, especially in the *Kutchh* district of Gujarat with about 18286 ha. with a production of 171522 MT of fresh fruits (<https://doh.gujarat.gov.in/horticulture-census.htm>).

The biggest constraint faced for the improvement of date palm following conventional breeding approaches includes its long generation cycles which generally takes more than 30 years to complete three backcrosses, if yield is the criteria for improvement then it takes even more time because the tree will bear fruits only after 3-4 years of plantation as well as yield stabilization takes further 3-4 years. Non-conventional approaches like Marker Assisted Selection is not possible as there is no true breeding population and very trace molecular work has been carried out till date.

Due to its cross-pollinated nature, date seeds are highly heterogeneous and heterozygous which give rise to 50% unproductive male trees and 50% female trees with poor or varying productivity in terms of both yield and quality. Date palm



cultivation is the only means of livelihood for majority of farmers belonging to *Kutchh* region of the state. Looking to aforesaid limitations in applying traditional and non-traditional approaches, mass multiplication of superior quality date palm is the need of time to increase the socio-economic status of the farmers and date growers.

Development of tissue culture protocol in date palm has many advantages over other traditional approaches which includes:

- Offshoots are produced more in numbers compared to seed grown date palm in the lifetime of a palm tree.
- Tissue culture plants bearing offshoots are true-to-type in nature and hence, in short duration a uniform population could be developed.
- Availability of planting material of local elite genotypes round the year.
- Selection of offshoots is carried out which are disease free, higher in yield and having good fruiting characteristics, hence export of fresh dates could be carried out by the farmers.
- Large scale plantation of elite plus trees can be increased due to more numbers of suckers.

Due to above said problems and difficulties in plantation farmers face major economic loss by cultivation of Date palm through seeds or suckers in their filed. Tissue culture raised planting material is best option to overcome these difficulties faced by the date growers.



Variability in Date palm

Intervention

Development of commercially viable protocol in date palm is one of the biggest problem as the complete protocol cycle requires atleast 2.5 - 3.0 years for development of plantlets which in some genotypes may also increased upto 4.0 - 5.0 years. The expenditure towards various tissue culture activities like selection of mother plants, development of aseptic cultures, callus initiation and multiplication and plantlets generation requires periodical sub-culturing and hardening facilities. Under the project sanctioned by the *Rastriya Krishi Vikas Yojna (RKVY)*, a commercially viable protocol of local elite genotypes of date palm made possible after initial of regeneration success.

With the support of Government of India and Government of Gujarat under the RKVY umbrella, the Centre received Rs. 123.50 lakhs over five years with 23.50 lakhs per year allotment. The project activities started with the survey and selection of superior mother plants from the *Kutchh* region of Gujarat State. Mother plants were carefully up-rooted from the farmers field and were brought to the Centre for

Advanced Research in Plant Tissue Culture of Anand Agricultural University, Anand for axenic cultures establishment. The development of axenic cultures was then followed by sequential transferring of cultures as per the growth and development of cultures into various plant growth regulators medium. *In vitro* hardened plantlets were then transferred to green house for four months followed by secondary hardening in poly house till their sale to farmers and date growers. All these process were carried out during the tenure of the project every year.

The biggest achievement of the project is not only the development of commercially viable protocol but during the project period the Centre of AAU has produced nearly 5000 plants of local elite genotype and popular variety and distributed to farmers of different regions. The Centre is one of its kind in providing molecular tested date palm plantlets in India with 100% assurance of true-to-type nature of plantlets with their mother plants. The farmers of state has willingly started to contact the Centre for providing offshoots/suckers for their multiplication which is also the other advantage as earlier farmers resist to provide their offshoots. The tissue culture raised plants provided to the farmers showed cent-per-cent establishment, early flowering i.e. nearly 3 years after planting and fruiting, and profuse suckering.

Outcome

The optimization of plant growth regulators concentrations and media combinations for each step of micropropagation protocol which could be utilized for large scale production of true-to-type date palm plantlets is the major breakthrough and achievement obtained during the project period.

As a result, the farmers and the date growers of the state as well as other parts of the country is immensely benefited in following ways:

- a) Assured sex of the plant will be extremely useful for the date growers in deciding the optimum sex ratio in the field.
- b) Reduction in male plantlets and increase in female plants will fetch more profit and increase the income of the farmers.

For example: A date palm tree can bear atleast 80 kg of fruit during one fruiting cycle and the selling price is Rs. 50 per kg. If we assume farmers have

three methods of date palm plants then the benefits by adopting tissue culture raised plantlets by the farmers will be as follows:

Attributes	100 plants through seedling (50% male plants)	100 plants through offshoots/suckers (100% female plants)	100 plants through tissue culture (100% female plants)
Sex (80 kg x Number of female plants x selling price)	80 x 50 x 50 = 2,00,000.00	80 x 100 x 50 = 4,00,000.00	80 x 100 x 50 = 4,00,000.00
Initiation of Flowering	>5 years	3 - 4 years depends upon age	3 - 4 years
Disease free planting material	Uncertain	Uncertain	Confirm disease free
Number of planting material obtained per tree	High	Maximum 20 good offshoots	Atleast 1500 plants per offshoot.
Number of planting material obtained per tree life cycle	Extremely high	20	=1500 * 20 = 30,000 per plant life cycle
Export possibility	Very less	Moderate	Extremely high
Fruit maturity	Uneven	Uneven	Uniform
Molecular testing for assured sex	Difficult	Not required	Done (<i>Only at AAU, Anand</i>)
Offshoots sale from one tree	Variable 15-20	20	1500 * 20 = 30000 (only one offshoot multiplication is consider)
Extra income for date palm farmers and growers for sale of offshoots @ Rs. 1000 per offshoots	20000.00	20000.00	3,00,00,000.00

The most interesting fact about date palm tissue culture technology is the selling price of per plant by the A. A. U. Anand. The selling price of red fruit local plant produced by A. A. U., Anand is Rs. 1500 per plantlet including molecular testing in comparison to Rs. 3000 - 4000 per plant without molecular testing by private companies. These difference in price is beneficial to both farmers and date growers as well as the Government of India as minimum of Rs. 500 per plant is saved towards subsidy for purchasing of tissue culture date palm plantlets by these farmers and growers.

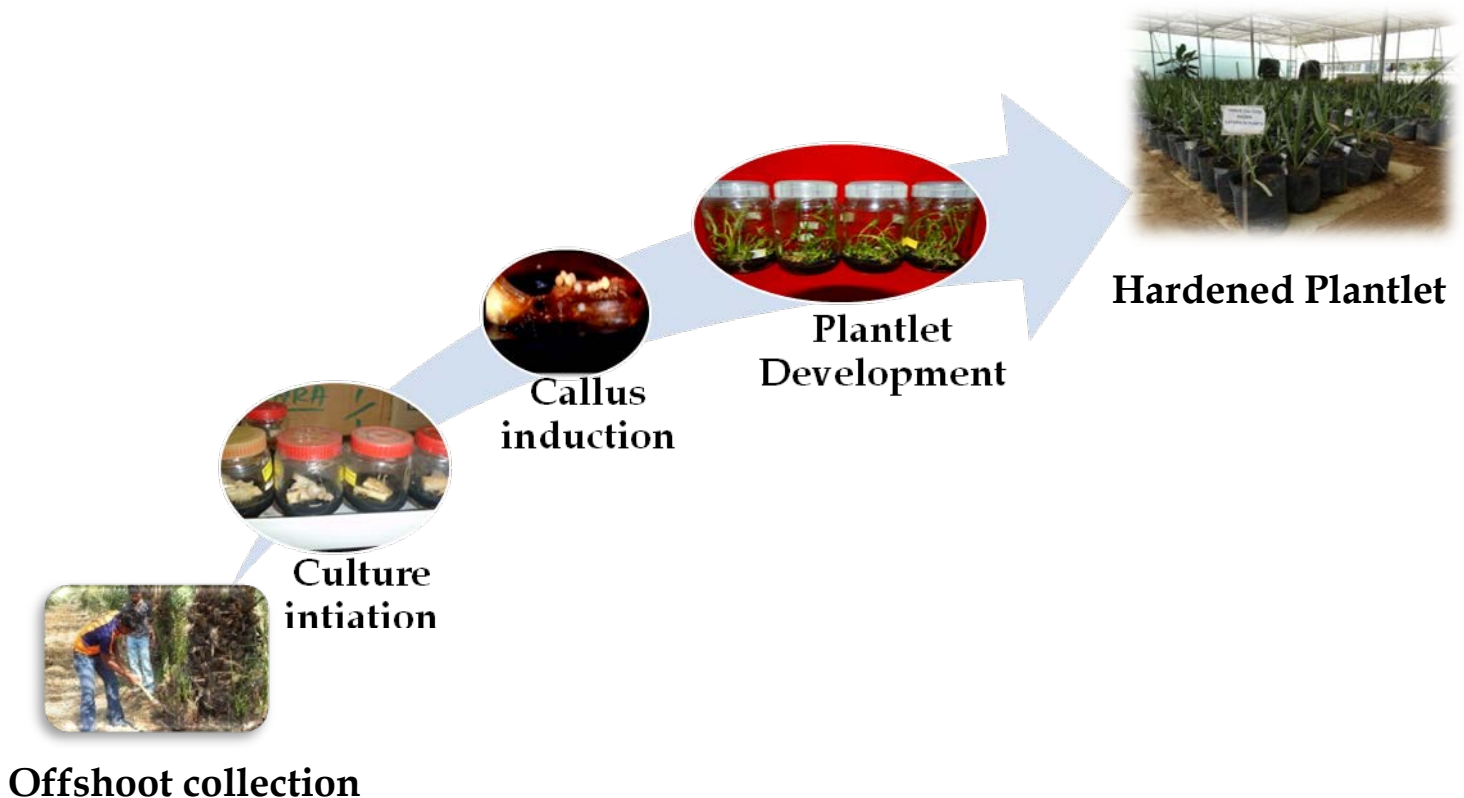
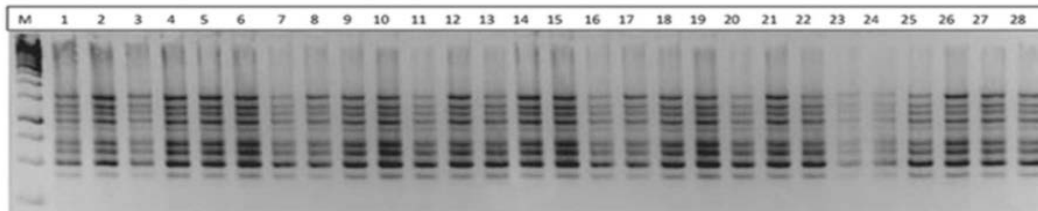


Fig. 1. Date Palm Tissue Culture Protocol Developed at AAU, Anand

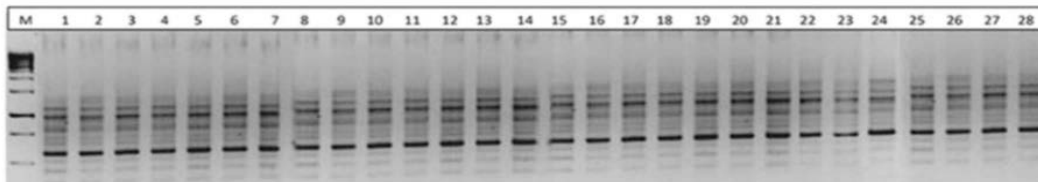


Fig. 2. Uniformity in field performance of tissue culture raised Date palm trees at Anand Agricultural University, Anand

RAPD



ISSR



SSR

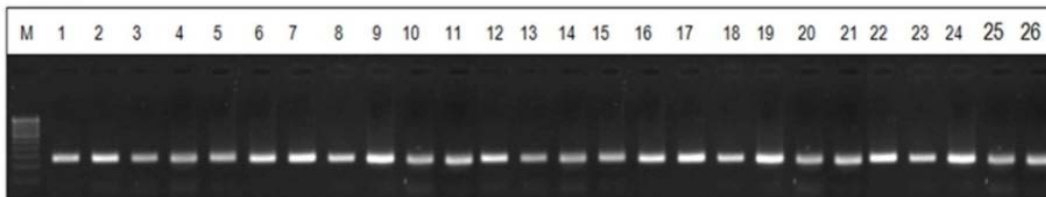


Fig. 3. Uniformity in the DNA banding pattern of tissue culture raised Date palm trees at Anand Agricultural University, Anand, tested through RAPD, ISSR and SSR markers

Additional Information

- ❖ The Centre for Advanced Research in Plant Tissue Culture of Anand Agricultural University, Anand would like to acknowledge for the successful demonstration of date palm tissue culture to the *Rastriya Krishi Vikas Yojna* (RKVY) a Government of India initiative for providing financial assistance towards meeting all the expenditure for tissue culture date palm technology development.
- ❖ The Centre would be highly grateful to **the state farmers and growers** for believing and having faith in the University scientists and researchers by providing their offshoots for the protocol development.
- ❖ The Centre take these opportunity to obliged all the *University officers* and *State's RKVY* officers for providing their valuable suggestions during the project period.
- ❖ The Centre will always be indebted to Retd. Professor and Head, *Dr. Subhash N. and his team* for their Hercules efforts in developing and demonstrating the tissue culture protocol for uplifting the socio-economic status of farmers of state and country.

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