

**1. Title: Large scale multiplication of indigenous Datepalm trees through tissue culture**

**2. Category:** Agriculture/Horticulture

**Type:** Production of superior quality tissue culture date palm plantlets

**3. Challenges:**

Date palm (*Phoenix dactylifera* L.) is one of the oldest tree known to mankind. It is popularly referred as “*Kalpavriksh 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 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 field. Tissue culture raised planting material is best option to overcome these difficulties faced by the date growers.**

#### **4. Initiative:**

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.

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 there 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.

#### 5. Key result/insight/interesting fact:

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 = <b>2,00,000.00</b>	80 x 100 x 50 = <b>4,00,000.00</b>	80 x 100 x 50 = <b>4,00,000.00</b>
Initiation of Flowering	>5 years	3 – 4 years depends upon age	3 - 4 years
Disease free planting	Uncertain	Uncertain	Confirm disease

<b>material</b>			free
<b>Number of planting material obtained per tree</b>	High	Maximum 20 good offshoots	Atleast 1500 plants per offshoot.
<b>Number of planting material obtained per tree life cycle</b>	Extremely high	20	=1500 * 20 = 30,000 per plant life cycle
<b>Export possibility</b>	Very less	Moderate	Extremely high
<b>Fruit maturity</b>	Uneven	Uneven	Uniform
<b>Molecular testing for assured sex</b>	Difficult	Not required	Done ( <i>Only at AAU, Anand</i> )
<b>Offshoots sale from one tree</b>	Variable 15-20	20	1500 * 20 = 30000 (only one offshoot multiplication is consider)
<b>Extra income for date palm farmers and growers for sale of offshoots @ Rs. 1000 per offshoots</b>	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.

## **6. Impact:**

Date palm plantlets produced under the RKVY funded project has been distributed among state farmers of different regions and even other states also. These plantlets are successfully established in the field with >95% survival rate and some plantlets has also started flowering which clearly indicates that the impact of the technology is huge and it is among the very few technologies in Biotechnology field which has been demonstrated from Laboratory to Land in true sense. State farmers are among the major beneficiary of the technology as their socio-economic status has been increased due to introduction of tissue culture plants which fetch them higher price of their produce.

## **7. Lessons learned:**

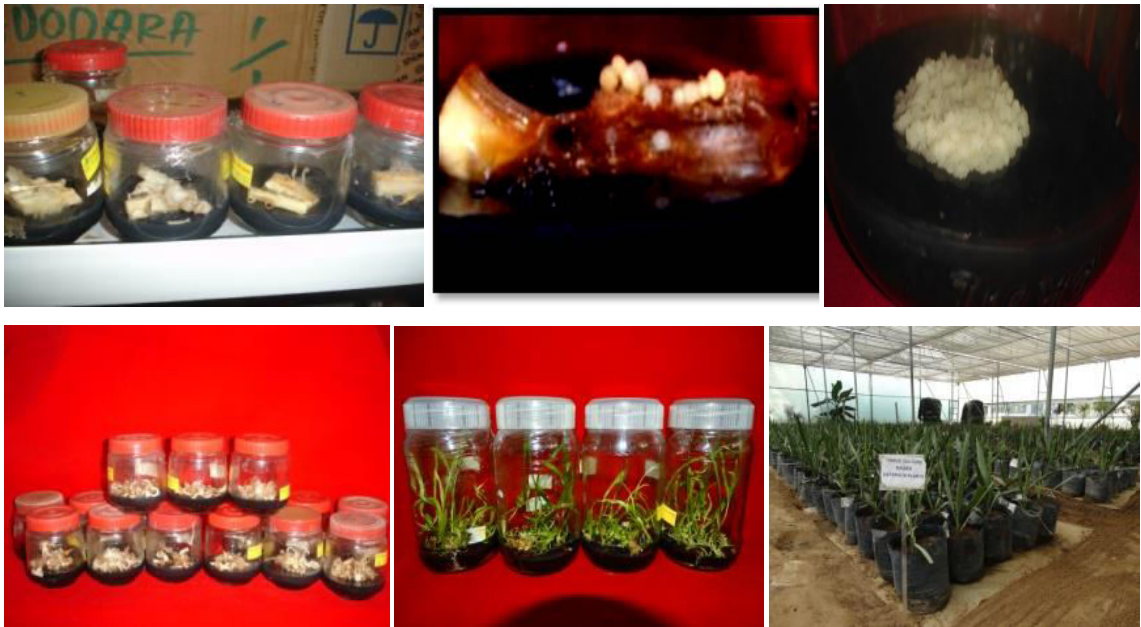
Date palm is a highly recalcitrant horticulture species which is extremely difficult to propagate through in vitro techniques. Due to date palm inherent nature of being heterozygous, each tree is a genotype having difference in their ability to respond towards in vitro techniques. In addition to heterozygosity, availability of superior quality trees are also very few in numbers, which makes it even more difficult to convince the farmers or growers to provide offshoots/suckers of these plants for its multiplication. Date palm protocol is also very long in terms of in vitro production for which 16 hrs light, temperature ( $25 \pm 2^{\circ}\text{C}$ ) and regular sub-culturing are required which limits commercial date palm multiplication because breakeven point in date palm tissue culture takes approximately 5.0 years depending upon genotype response.

The salient finding of the project is combinations of sixteen media which could be applied to almost all the genotypes available in the *Kutchh* region. Depending upon the genotype response, these media formulations could be utilized to overcome inherent late ability of genotype to respond to in vitro conditions. The success of red date palm plantlets production by the Centre has played a pivotal role in establishing a good mutual relationship between the farmers and the Centre scientists. The farmers of state willingly provide their offshoots and even in some cases the single mother plant only because of red date palm success obtained in the project. With the introduction of tissue culture subsidy for the construction of laboratory, setting up hardening facilities like green house

and poly house under the National Horticulture Mission has largely overcome the problem of investment for starting up tissue culture laboratory.

The micro-propagation protocol developed by the Centre is robust enough that any genotype could be multiply under in vitro conditions. This success has been repeatedly demonstrated by the Centre by establishing and obtaining callus multiplication of various local elite genotypes. However, the Centre would also like to explore possibilities for multiplication of male date palm using in vitro techniques. The variability in fruit characteristic found in date palm is largely because of metaxenia effect i.e. effect of pollen. During the project period, the scientist and workers of Centre came across few specific male date palm trees which are exclusively utilized for pollination. These male date palm plants could be multiplied by the Centre so that metaxenia effect could be addressed.

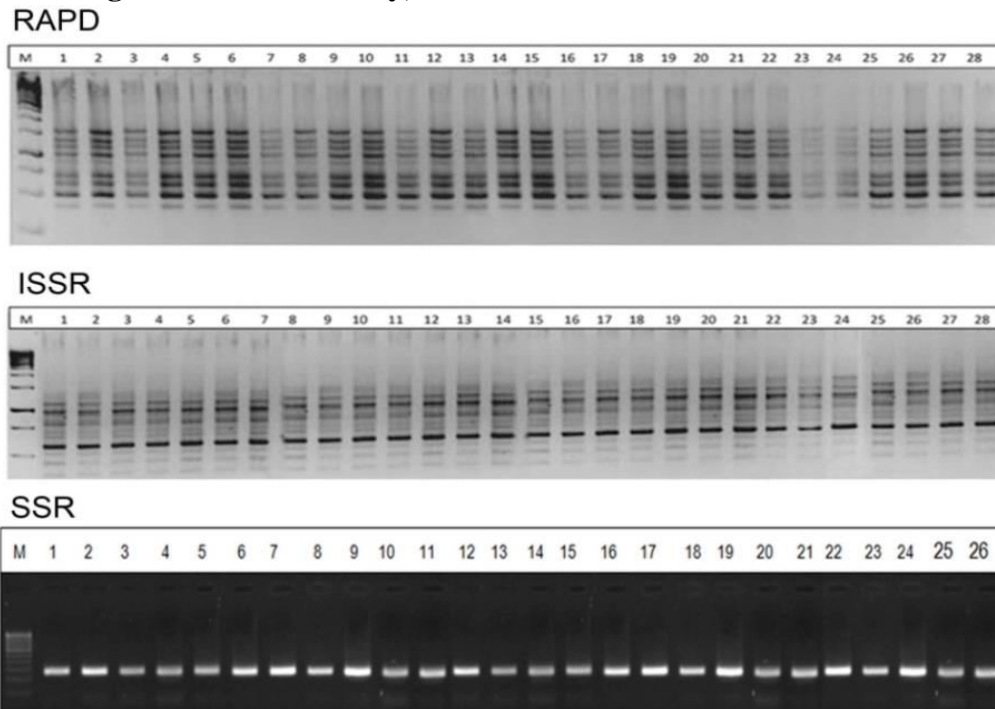
#### 8. Supporting Quotes and Images



**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**



**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.

**The contact person for the success story and person in-charge for the Centre is:**

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## 9. Checklist

No.	Question to consider	Yes	No
1	Is the story interesting to the target audience of the Project/activity report?	Yes	
2	Does the story explain what new insights the project Brings? What is the main lesson learned from this story? Does the story describe a key insight on what works and what doesn't and something that future project could build on	Yes	
3	Does the story describe the outcomes the project produced And the people who are benefitting? What changes—in skills, knowledge, attitude, practice, or policy—has the project brought, and who is benefitting from these Changes?	Yes	
4	Does the story make a compelling point that people will Remember? Does the story show how the project makes a difference to improving livelihoods and lessening Poverty?	Yes	
5	Does the story provide an interesting fact that people will Remember? For example, how much yields increased, how many hectares of land could become more productive From this innovation or technology?	Yes	
6	Does the story explain what kind of impact this innovation Or technology could have if scaled up?	Yes	
7	Does the story show which partners contributed and how?	Yes	
8	Does the story include quotes from Stakeholders or Beneficiaries?	Yes	
9	Have I provided links to other media (journal articles, website news, newsletter, blogs, annual reports of other Programme/ project) that also feature this story?		No
10	Have I provided the contact details of people who can Provide more information?	Yes	