Name of the project	**Production of disease free banana (Musa sapentium) plants through tissue culture technique for establishment of nursery and distribution of low cost plantlets among farmers**
Funding agency	**Department of Biotechnology (DBT)**
Year of start	**2017-18**
Year of completion	**2019-20**
Name of PI and Co-PI	**Dr. R.S. Sengar**
Total budget	**10.96 lakh**

Significant achievements:

- Fifteen high quality banana varieties namely Agniswar, Alpan, Ambell, Chenkadali, Dudhsagar, Grand Naive (G-9), Elakkie bale, Gragaricsarpara, Honda, Jatikel, Karpurachakkarkell, Matti, Monthan, Nendran and Robusta collected from different research centres are being maintained under field conditions at SVPUA&T, Meerut.
- An efficient and reliable surface sterilization procedure has been optimized for successful establishment of banana germplasm under in-vitro conditions for clonal propagation at commercial scale to fulfil farmer's demand.
- Five varieties of banana namely Grand Naive (G-9), Elakkie bale, Monthan, Nendran and Robusta were successfully established under in-vitro conditions onto the full strength MS medium fortified with 100 mg/L Myo-inositol + 2.0 mg/L BAP+ 0.5 mg/L IAA + 50 mg/L Ascorbic acid + 30 g/L sucrose and solidified with 2.5 g/L Gelrite (BM, media). Shoot multiplication was very good on full strength. MS medium supplemented with 100 mg/L Myo-inositol + 4.0 mg/L BAP+0.5 mg/L IAA + 50 mg/L Ascorbic acid + 30 g/L sucrose and solidified with 2.5 g/L Gelrite (BM I media).
- One day training programme for farmers was also organized at SVPUA&T, Meerut to aware western Uttar Pradesh farmers towards banana cultivation and for skill development among farmers to generate quality planting materials in banana for sustaining yield and their income. More than 100 farmers from various places of western Uttar Pradesh participated in the training programme and learned the banana cultivation by using recommended agronomical and scientific practices for enhancing the production with low cost inputs.
- Both the banana cultivars namely Grand naine and Nalla Bontha showed highest frequency of shoot regeneration and rooting at 30 g/1 sucrose concentration, hence it can be considered as best carbon source for culture media.Victorious shoot regeneration was recorded from shoot-tips on agar gelled MS medium supplemented with 2.0 mg/1 BAP + 1.0 mg/1 NAA. Addition of kinetin decreases the frequency of shoot regeneration.
- The highest frequency of rooting was recorded on half strength basal MS media fortified with 0.5 mg/1 IAA and 1.5 mg/1 IBA alone in cv. Grand naine, while cv. Nalla Bontha showed highest root frequency on half strength MS media supplemented with 0.5 mg/1 IAA .
- Protocol has been developed for multiplication of banana (G9) and trial was conducted at the farmer’s field.
- Two trainings and demonstration programme on production of disease free banana

have been accomplished. More than 250 farmers belonging to the various places of western Uttar Pradesh participated in the programme and learned the techniques of disease free banana production and its cultivation under field condition.

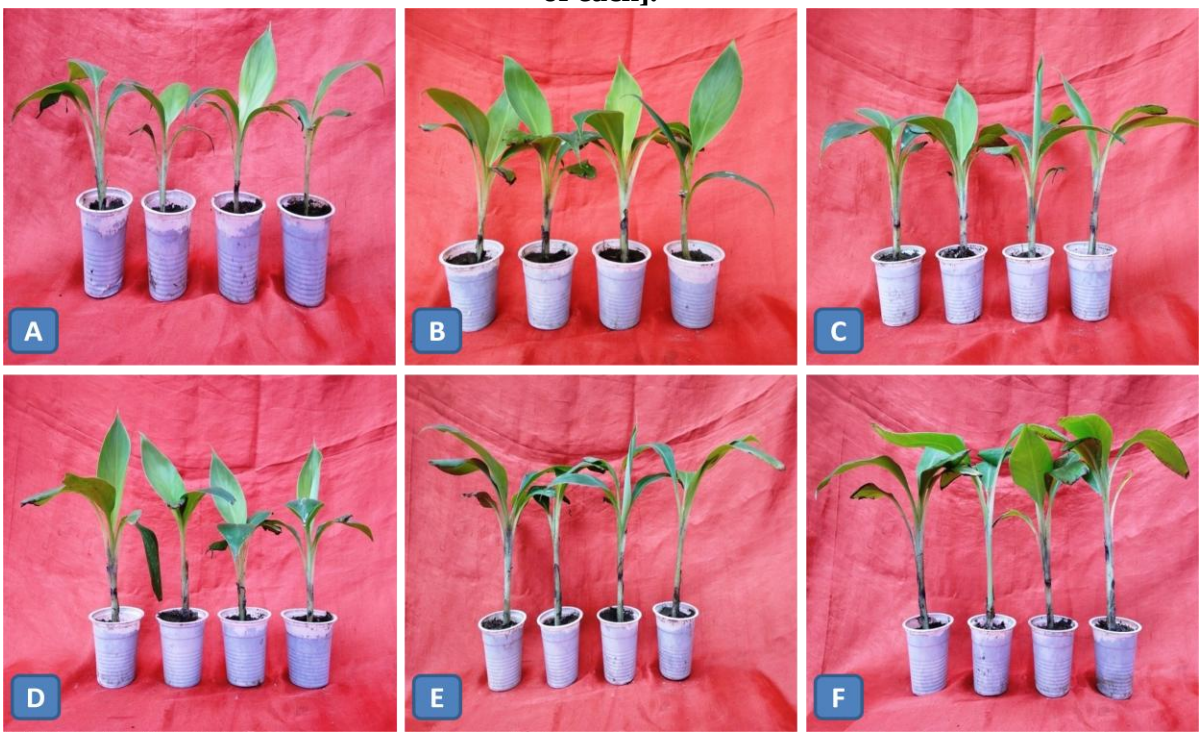
In Vitro shoot proliferation and multiplication in banana variety Grand Naine (G-9) on basal MS media supplemented with 5.0 mg/L BAP + 0.5 mg/L IAA + 50 mg/L Ascorbic acid + 30 g/L sucrose and solidified with 2.5 g/L Gelrite.

***In Vitro* shoot proliferation and multiplication in banana variety Nendran on basal MS media supplemented with 5.0 mg/L BAP + 0.5 mg/L IAA + 50 mg/L Ascorbic acid + 30 g/L sucrose and solidified with 2.5 g/L Gelrite.**

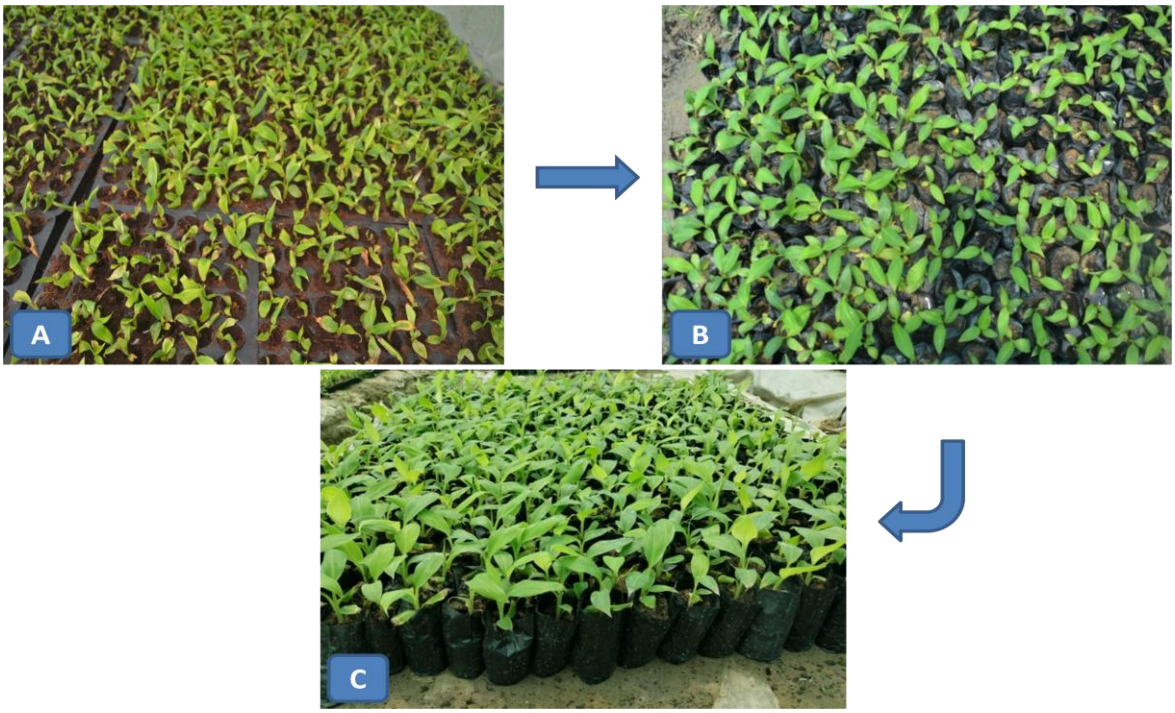
***In Vitro* shoot proliferation and multiplication in banana variety Monthan on basal MS media supplemented with 5.0 mg/L BAP + 0.5 mg/L IAA + 50 mg/L Ascorbic acid + 30 g/L sucrose and solidified with 2.5 g/L Gelrite.**

In vitro root induction and proliferation in Grand Naine (G-9) by liquid pulse treatment of two auxins such as α-naphthaleneacetic acid (NAA) and indolebutyric acid (IBA) [50 mg/L of each].

In vitro root induction and proliferation in Monthan by liquid pulse treatment of two auxins such as α-naphthaleneacetic acid (NAA) and indolebutyric acid (IBA) [50 mg/L of each].



Hardening of tissue culture raised plants of banana variety Grand Naine using different substrates. Here, [A] Autoclaved Field Soil + Coco peat (2:1), [B] Autoclaved Field Soil + FYM (2:1), [C] Autoclaved Field Soil + Coco peat + Vermiculite (1:1:1), [D] Autoclaved Field Soil + Vermiculite (1:2), [E] Autoclaved Field Soil + Coco peat + FYM (1:1:1) and [F] Autoclaved Field Soil + Coco peat + FYM + Vermiculite (1:1:1:1).



Hardening of tissue culture raised plants of banana variety Grand Naine (G-9) prior to field transplantation. Here, (A) Primary hardening of tissue culture raised banana plant (B) Secondary hardening of tissue culture raised banana plants and (C) Tissue culture raised banana hardened plants in polybags ready to field transfer.

Tissue culture raised hardened plants of banana variety Grand Naine (G-9) in ready to transfer under field conditions.




Training and awareness programme on banana cultivation practices for farmers belonging to western U.P. and the distribution of tissue culture raised banana plants.

Technology transferred to Shri Rajneesh Tyagi, Village-Datiyana, Hapur, Uttar Pradesh.

Technology transferred to the farmers of District-Baghpat, Uttar Pradesh.

Prof. Nagendra Kumar Singh, Project Director, NRCPB, New Delhi visited banana nursery field.

Banana field nursery view at its flowering and fruiting stage at SVPUA&T campus.

One day training and awareness programme on banana cultivation practices for

farmers belonging to the different districts of western Uttar Pradesh.

One day training and awareness programme on banana cultivation practices for farmers belonging to the several districts of western Uttar Pradesh and the distribution of tissue culture raised banana plants.

Training and demonstration/awareness programme for farmers from Village-Puttha, District-Meerut, Uttar Pradesh.

Field demonstration and awareness programme for farmers belonging to the different villages of Meerut district located nearby the university campus.

Delegates from France visited the banana nursery field.

Farmers from Meerut visited banana nursery field crop growing at university campus and collected fruitful informations regarding banana cultivation.

Technology transferred to the farmers from Village-Agara, District-Bijnor, Meerut, Uttar Pradesh.

Recommendations:

- Combination of different surface disinfectants comprising 0.1 % mercuric chloride for 4 min, 70% Ethanol for 30 sec and 5% sodium hypochlorite for 6 min in sequential steps followed by washing with sterilized distilled water proved best for establishment of high frequency sterile cultures with low toxicity and death rates.
- Both mercuric chloride and sodium hypochlorite were successfully used in culture media as media sterilants. The use of 0.1 % sodium hypochlorite in culture media as a media sterilant could be a reliable and cost effective alternative of media sterilization with higher survival percentages of established cultures instead of autoclaving of culture media
- Genotypes cv. Grand naine and cv. NallaBontha differ broadly in their response to drought stress and plants hold different adaptation traits to manage water deficit conditions under in-vitro condition. Based on morphogenetic responses (shoot regeneration and rooting), physiological (Relative water content) and biochemical responses (Proline content), the genotypes NallaBontha was found to be more efficient than Grand naine genotypes. Further it was found that NallaBontha is drought tolerant in comparison to Grand naine, which is a drought sensitive genotype. Therefore variety NallaBontha recommended for cultivation in drought conditions.