



Tissue culture Banana Cultivation in Araria district of Bihar- A Review

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ABSTRACT

Plant tissue culture defines as the Science of growing plant cells, organs and tissues that isolated from the mother plant, on artificial media. Tissue culture banana plant includes techniques and methods appropriate to research into many botanical disciplines and several practical objectives.

Araria District consist of nine blocks, out of which three blocks namely Araria, Bhargama and Raniganj have been selected for banana cultivation related showcasing for the year 2020-2021. The selection of farmer on the basis of maximum number of cultivars in the village represent small holding and interested in plant replacing with new G9 variety of banana cultivation.

Banana growing cultivation has been identified and increasing properly. The increasing area under banana crop is about 4 hac in 2020 in different village at Araria District and the productivity 400- 500 Q/Acre. The productivity of banana nearly doubled because farmers are using tissue culture plant material in Araria District.

Key words: Plant Tissue culture, Sucker, Araria, Plant health, Bihar

INTRODUCTION

In India, per capita production of banana is the highest in the world, with an annual production approaching about 15 million t/year (Lescot and Ganry, 2010), eaten cooked or brewed into beer (Gold *et al.*, 2002; Biribwa *et at.*, 2010; Lescot and Ganry, 2010).

Tissue culture banana has been massing micro propagation. At present year several laboratories together work in Bihar and producing over 500 million plants. The total yield of banana per acre ranks higher than that of many other tropical fruits crops and already there is a large market for banana fruits and therefore is the high demand for planting material in Bihar.

In Bihar, Banana is among the most important staple crops. Direct impact of plant tissue culture on present day in agriculture field and has been the direct cause for face- lift of modern agriculture in Bihar.

In Bihar, small holder systems, new banana are traditionally planted with suckers.

HISTORY

- Tissue Culture Banana is a globally important fruit crop.
- Total annual production of tissue culture banana is about 400-500 Q/Acre under Biotech Kisan Hub in Araria District.
- Most of the tissue culture Banana plant is grown by planting suckers.

- The technology development in agriculture is very fast, which is developed by BAU Sabour (Variety- G9) that results in developing Tissue Culture Technique.

Number of beneficiaries covered during review period

Name of the Partner Institutions	Distribution of Farmers				Reverse Migrant Farmers Returned to their villages during the COVID -19 Pandemic/Lock down
	Male	Female	SC	ST	
KVK, Araria (2020)	10	-	1	-	1
KVK, Araria (2021)	10	-	-	-	1
Total	20	-	1	-	2

Why Tissue Culture Banana Plant Choosing

- Generally, suckers may be infected with nematodes and some other Pathogens but tissue culture banana plant is contamination free and prepared in laboratory.
- During variation in age and size of sucker, the banana crop is not uniform properly, harvesting is prolonged and management of banana becomes difficult.
Therefore, for planting generally tissue culture plants are recommended. They are healthy, uniform, disease free and authentic.
- Properly hardened secondary seedlings are only recommended for planting.

Requirement for Banana growth

- Basically, Banana is a tropical crop and it grows well in temperature range of about 13.c - 38.c with RH regime of 75 – 85%.
- Temp^r high causes sun scorching.
- Wind velocity high that exceeds 80 km phrs damages the crop.

Variety of Banana

Grand naine is gaining popularity and may soon be the most preferred variety due to its tolerance to biotic stresses and good quality bunches.

Planting time

- Mrig Baug (Kharif) month of Planting: - June – July
- Kanda Baug (Rabi) month of Planting: - Oct – Nov.

Crop Geometry

Suitable spacing for Banana crop is about 1.82 * 2.0 m is being recommended. It accommodates 1200 plants per acre keeping row direction North – South with wide spacing 1.82 m between the rows. In which place where humidity is very high and temp^r falls down upto 5 -7°C and the planting distance should not be less than 2.1 m * 1.5 m.

Soil for Banana Planting

- Soil for tissue culture banana plant should have good drainage, adequate, moisture and fertility.

- For banana cultivation, deep, rich loamy soil with PH between 6 – 7.5 is most preferred.
- Soil that contains not too acidic and not too alkaline, rich in organic material in which high nitrogen content, adequate phosphorus level and plenty of potash are good for Tissue Culture Banana cultivation.

Planting Material

Sword Suckers weighing approximately 500 – 100 gm mostly virus free are commonly used as propagating material.

Characteristics of Tissue Culture Banana Plant

- Height – 6 – 8”
- Excellent rooting with root bowl.
- Spacing – 1.82 m to 2 m
- Yield – 400-500 Q/ Acre
- Total no. of figures min – 280, max- 340, season throughout the year.
- Maturity – Primary hardened stage 6 – 7”.
Secondary hardened stage 15” ≤.
- Special Qualities – Totally disease free, fast fruiting and high yielding.

Uses of plant tissue culture

The use of tissue culture banana planting material is a most effective method of providing pest and disease-free plants. Although there are many benefits to using tissue culture banana plants. However, tissue culture banana plant technology is more expensive for the Banana grower than conventional suckers. Tissue culture banana plant production is the limited use of certification for plant quality and health; that’s especially important in order to prevent the spread of viruses.

Demonstration of superior planting material alone like virus free or disease-free plant, however, does not ensure improved productivity. There is only evidence that farmer who has adopted tissue culture bananas that have benefitted substantially in terms of higher the yields and increase incomes for household purpose.

However, the use of banana plant tissue culture is increasing for commercial purpose, because they

- Are pest and disease free (exception fastidious bacteria and viruses).
- Grow more vigorously, allowing for faster and bigger yields.
- Produce more uniform bunches that allowing for more efficient local market and other marketing sector.
- During short time periods, it can be produced in large quantities and permitting faster distribution of planting material and new cultivars.

As such as, the use of banana plant tissue culture can support banana farmer to make the transition from subsistence to small scale commercial farming (Dubois, 2011) that’s how, banana plant tissue culture plantlets require the appropriate handling and management practices to optimize their medicinal benefits. Sometimes banana plant tissue culture technology might therefore not be appropriate for all banana grower or in all situations at any time period. Also, unsustainable production and distribution practical of banana plant tissue culture are threatening this relatively recent technology.

Training of Banana plant tissue culture nursery operators and tissue culture banana farmers

We conducted a comprehensive training of prospective banana plant tissue culture nursery operators and farmers, in off campus and on campus of Krishi Vigyan Kendra, Araria; training like Banana farmer were recruited in locations where use of plant tissue culture is more economically justifiable (e.g. Close to the main or local banana market) and using banana leaflets that emphasized the profit-making aspect of selling or growing tissue culture banana as a business enterprise.

Training program differed in two ways such as- training modules conduct on KVK Araria which included marketing, business, financing as well as for tissue culture farmers in Araria district, group formation and group dynamics.

Tissue culture banana plant materials and process in laboratory

Raw materials

Single distilled water, nutrient medium and phytohormones, meristems/buds.

Process

Following process involve for making banana plant tissue culture in laboratory.

- I. Collection of healthy plant material from the banana field.
- II. Surface disinfection
- III. Cutting of meristems/buds aseptically
- IV. Culturing the shoot buds/meristems
- V. Contincing the culture of said meristems/small shoot buds organized shoot buds/shoot are formed
- VI. Harvesting
- VII. Reculturing
- VIII. Transferring the shoots for partial hardening.

Contamination

Contamination in tissue culture banana plant may be caused by endogenous bacteria that escape initial disinfection or by some micro-organisms which not visible by naked eyes, introduced during tissue culture, manipulations. In condition of banana plant tissue culture, both types of contaminants may survive in the plant material for several sub culture cycles and over extended periods of time without expressing symptoms in the tissue or visible signs in the culture medium.

Some antibiotics are successful in controlling bacterial contaminants in tissue culture banana plants.

Land Preparation

Before Planting of banana crops, grow the green manuring crop like daincha, Cowpea etc and burry it in the soil. Land for tissue culture banana planting can be ploughed 2-4 times and leveled. For break the clod and bring the soil to a fine tilt, use rotavator or harrow. During soil preparation basal dose of FYM is added & thoroughly mixed properly into the soil.

Pit size of about 45 c.m *45 c.m*45 c.m is normally required for tissue culture banana planting.

The pits are to be refilled with top soil mixed with 10 kg of FYM (weed decomposed), 250 gm of Neem cake and 20 gm of conbofuron. Prepared land pits for tissue culture banana plant are left to solar radiation which helps in killing the harmful insects, is effective against soil borne disease and aids aeration. In saline alkali soil where PH is above 8 pit mixture is to modified to incorporate organic matter.

In addition to organic matter which is present in soil that helps in reducing salinity while in addition of purlite improves, porosity and aeration. Alternative to planting in pits in banana planting in furrows. It depending on soil strate one can choose appropriate method for planting as well as spacing and depth at which plant is required to be planted.

Water management

Banana is a water loving plant, it requires a large quantity of water for maximum productivity. Banana production should be must have supported by an efficient irrigation system like drip irrigation.

For tissue culture banana, water requirement has been worked out to be 2000 mm per Annum. Application of drip irrigation and mulching technology for tissue culture banana has reported improved water use efficiency. Saving of water is about 56% and increasing yield by 25-35 % under drip irrigation.

Irrigate the plants immediately after planting. Apply sufficient water in banana field and also maintain field capacity. Excess drip irrigation will lead to cause root zone congestion due to removal of air from soil pores, thereby it affecting

plant establishment and growth and hence drip irrigation method is must for proper water management in tissue culture banana.

Month (Maug Baug)	Qty. (lpd)	Month (Kende baug)	Qty. (lpd)
June	05	October	05-06
July	06	November	04
August	05	December	05
September	07	January	05
October	08	February	8-10
November	10-15	March	11-13
December	12	April	15-18
January	11	May	18-20
February	10	June	11
March	15-17	July	13
April	21-23	August	15
May	25-30	September	15-17

Fertigation

Tissue culture banana requires high amount of nutrients, which are often supplied only in part by the soil. Tissue culture banana crop requires 20 kg vermicompost, 1 kg neem khalli, 1kg boan meal, 300 gm Nitrogen, 45- 50 gm phosphorous and 400 gm Potash/Plant.

In order to avoid loss of nutrients from conventional fertilizers i.e loss of N through leaching, evaporation, volatilization and loss of P & K by fixation in soil, application of water soluble or liquid fertilizers through drip irrigation (fertigation) is encouraged. A 27-30 % increase in yield is observed using fertigation.

Pest and disease management

A large number of viral, bacterial, fungal disease, insect pests and nematodes in pest the banana crop as well as it reduces the Production, Productivity and Quality of crop.

Pest

Rhizome weevil (*cosmopolites sordidus*), Thrips (*Chactanapho trips*, *signipennis* and *heliaothrips*), Aphids (*Pentalonia nigronervosa*), fruit scarring battle (*Besilepta subcostatum*), Nematodes.

Fungal Disease

Head rot (*Erwinia Caratovora*), Panama wilt (*Fusarium oxysporium*), Sigatoka leaf spot (*Mycospharella spp.*).

Viral Disease

Banana Mosaic Virus (BMV), Banana Bunchy Top virus (BBTV), Banana Bract Mosaic Virus (BBMV), Banana Streak Virus.

Weeding

Before planting Glyphosate spraying (Round up) at the rate of 2 lit. /hac is carried out to keep the plantation weed free. Hence for that one or two manual weeding are necessary.

Micronutrients foliar spray

Application applied for $znso_4$ (0.5 %), $Fcso_4$ (0.2%), $Cuso_4$ (0.2 %) and H_3Bo_3 (0.1 %) can be adopted to improve physiological, morphological and yield attributes of banana. Spray solution of micronutrients is prepared by dissolving the following in 100 lit. of water.

Zinc Sulphate	500 gm
Ferrom Sulphate	200 gm
Cotton Sulphate	200 gm
Boric Acid	100 gm

For every 10 lit. of mix. 5-10 ml of sticker solution such as Teepol should be added before spraying.

Desuckering

For reducing internal competition with mother plant removal of unwanted suckers is a critical operation in tissue culture banana plant.

Pruning of leaves

During regular check of tissue culture banana plant, some rubbing leaves damages the fruit, therefore such leaves should also be pruned. Infected leaves and older leaves also be pruned as required. Green leaves from tissue culture banana plant should not be removed.

Earthing up

From time to time, must have keep the soil loose by harrowing. 3-4 month after planting earthing up should be done i.e raising the soil level around the base of the plant by 10-12”.

It is best to prepare a raised bed and keep the drip line on bed 2-3” away from the plant. It also helps to plant protected by wind damage as well as production losses to some extent.

Removal of male buds: (Denavelling)

Increased bunch weight and fruit development is done throughout by removal of male. In this case male buds are removed from the last 1-2 small hands with a clean cut keeping a single finger in the last hand of tissue culture banana.

Bunch spray

Monocrotophos (0.2 %) spraying after emergence of all hands that takes care of the thrips. Thrips attack discolors the fruit skin makes it unattractive.

Bunch Covering

Bunch covering of tissue culture banana plant using dried leaves of the plant is economical and bunch prevents from direct exposure to sunlight. For enhancing Quality of fruit, bunch cover must be required, but in rainy season this practice should be avoided.

Bunch sleeving is done to protect fruits against dust, insect, spray residue and birds. For this blue plastic sleeves are recommended. This also increases temp^r around developing bunch and it helps in early maturity.

Dehandling of false hands of bunch

Some incomplete hands in a bunch which are not fit for Quality produce, these hands should be removed soon after bloom, which helps in improving the weight of other hands.

Propping

During heavy weight of bunch, the tissue culture banana plant goes out of balance (control) and the bearing plant lodge and production and quality of fruits are adversely affected. Therefore, they should be propped with the help of two bamboos or one bamboo forming a triangle by placing them against the stems on the leaning side.

Harvesting

At the physiological maturity stage, banana should be harvested for better post-harvest quality of fruit. The tissue culture banana fruit is dimacteric and can reach consumption stage after ripening operation.

Removal of bunch

When figures of second hand from top are $\frac{3}{4}$ rounded with the help of sharp sickle 30 c.m above the 1st hand, harvest may be delayed up to 100-110 days. Harvesting bunch should generally be collected in well-padded tray and brought to the collection site. Since this hastens ripening and softening, Bunches should be kept out of light after harvest.

For exportation, hands are sharp cut into units of 5-16 fingers, graded for both girth and length. It is carefully placed in polylined boxes to hold different weight. It depends on exportation requirements.

Post-Harvest Operation

In running tap water, fruit are cleared or dilute sodium hypochlorite soln to remove the latex and treated with thiobendasole, air dried and it graded on the basis of size of fingers s already stated, ventilated CFB boxes of 14.5 kg capacity or as per requirement with polythene lining and pre-cooled at 13 - 15. temp^f and at about 80-90 RH.

Such material should then be sent under cool chain at about 13. for marketing purposes.

Major benefits accrued to the farmers

Field demonstration of tissue culture banana in farmers field with G9 variety in 10 Acre for the year of 2020-2021, having total yield 45.23 tones (452 Q) and having average economics given below:

i) **Economic: Rs. /Acre**

Cost of cultivation	108230/-
Gross Return	291108/-
Net Profit	182879/-
B:C	2.71

(Planting of banana suckers done in the month of August- Sept for the year of 2021-2022, and crop is now in growing stage. Hence cost of cultivation is yet to finalize, however, till date the amount spent is reflecting in this column.)

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