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# Enhancing the Practices of Tissue Culture Banana among Marginal Farmers of Bihar

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***Abstract:*** ***Banana cultivation is the main agricultural practice in Bihar and is predominantly grown by small scale farmers both as a household food security and as a source of income throughout the year. Banana plantation in this geographical niche is highly infested with various diseases and melody is aggravated by traditional practices of planting material. Plant tissue culture method is one stop solution to culminate various diseases and increase yield capacity, which are biggest threats of the conventional farmers. Despite the commercialization of banana tissue culture in India over the past few decades, its adoption is very slow in Bihar. In the present study, the problems of cultivating of tissue cultured banana have been highlighted. It has been observed that lack of farmer friendly policies are main reason for slow adoption of banana cultivation in Bihar. Henceforth it is suggested that the farmers should be encourage to adopt tissue culture technology to get higher yield and commercial value for their produce. Meanwhile, this will prove to be a great opportunity for self-employment, which is the need of time.***

***Keywords: Bihar; Banana; Tissue culture; Challenges; Policies.***

## 1. Introduction

Bihar is located in the eastern region of Indo-Gangetic plain of North India between latitude 24°-20'-10" N ~ 27°-31'-15" N and longitude 83°-19'-50" E ~ 88°-17'-40" E It is the third most populous state in India and its 80 % of population is employed in agriculture sector, which is much higher than the national average (NRCDPP 2017). Entire economic progression of the state depends on the dynamics of agriculture. However 82% of landholding population is marginal having less than one hectare of land. Bihar is endowed with fertile Gangetic alluvial soil with abundant water resources, particularly ground water (Kumar and Maulick 2016). The agriculturists in the state grow a variety of crops in different soil categories available in different agro-climatic zones. Bihar produces 18.75 mMT. of horticulture product from 1.14 mHa. cultivable land in the year and major share pertains to vegetables (77.43%) and fruits (22.57%). It is the sixth largest producer of fruits in India with a turnover of 4.23 mMT. during 2016-17. Banana alone covers 0.0343 mHa. of land in Bihar with a production rate of 0.17 mMT. and ranks 4$^{th}$ in

 

terms of area and 6th in terms of annual production in the country ( Kumar 2017, FAOSTAT 2014, NHB: 2016-17, Hazarika *et al.* 2014, Mustaffa 2011, Saxena 2014, Murugan Sankaran 2014, Niraj 2011 ).

Banana is the 5th largest agricultural commodity in world trade after cereals, sugar, coffee and cocoa. It is cultivated in more than 130 tropical countries as the most important staple crop covering an area of 5.14 mHa. and producing 105.32 mMT (Kumar 2017, FAO 2012, Mustaffa 2011, Saxena 2014, Murugan Sankaran 2014). In India, more than 300 varieties have been recorded till date, however the actual number is about 70 because a particular variety is known by more than one name in different geographical location ( Murugan Sankaran 2014 , NHM 2012, RAU 2007, Niraj 2011 ). In Bihar, banana is predominantly grown by small scale farmers both as a household food security and as a source of income especially by the rural poor people for regular income throughout the year. The economically important banana varieties grown in Bihar for dessert purpose are Chini Champa of Ney Poonam (AB) group, Dwarf Cavendish of Cavendish (AAA) group, Alpan and Champa of Poovan (Mysore subgroup AAB) group, Malbhog of Rasthali (Silk subgroup AAB) group whereas for culinary purpose are Bathessa, Gauria, Kothia and Muthia of Monthan (ABB) group. The major banana growing districts are Vaishali, Bhagalpur, Khagaria, Katihar, Purnia and Samastipur. They are endowed with congenial climatic conditions favorable for banana growth and development (Murugan Sankaran 2014, Pradeep *et al.* 1992, NHM 2012, Robinson 1990,1996, Saxena 2014 ). The current economic and food security scenario of banana growing belt speculates that their production and marketing takes place in a context characterized by lack of supportive policies, environment and institutional arrangements. The production in the state is highly affected by infestation with various pests thereby dithering them as a potentially reliable food and commercially economical crop. The condition is exacerbated due to traditional practices by marginal farmers in Bihar. They interchange planting materials and in this way pest/disease is easily transmitted from plant to plant which is major concern for reduced banana production (Kadam *et al.* 2017, Karembu 2007, Yadav 2005). As a result, food security, employment opportunities and household incomes of marginal farmers depends upon their cultivation has been threatening. The demand for banana fruit is increasing in Bihar at a faster rate over time, so is the demand for healthy plant material also increasing simultaneously. The traditional clonal propagation methods cannot cope up with the continuous demand for new healthy planting materials. In this regards, advances in plant biotechnology in last decade especially in plant tissue culture techniques have made a great impact on the cultivation of banana (Bapat and Iqbal 1998, 1998, Karembu 2007 ,Karule *et al.* 2016, Kitto 1997, Murashige and Skoog 1962). The origin of the commercial *in vitro* propagation of banana in India had emerged as one of the feasible biotechnology tool in the year 1983 by intense work by Dr. R. Dore Swamy and his team at Indian Institute of Horticultural Research, Bangalore (Ahmed *et al.* 2014, Alagumani 2005 , Dore Swamy *et al.*, 1983 Guledgudda and Olekar 2002 Hanumantharaya *et al* 2009, Karule *et al.* 2016, Kitto 1997, Murashige and Skoog 1962, Shukla 2015). Tissue culture forms an essential biotechnological tool for propagating disease free planting material (Selvarajan *et al.* 2011).Small portion of plant obtained from a desirable variety are grown under aseptic conditions in controlled environment to produce thousands of healthy plantlets within a year. The plantlet

 

produced through this process does not embrace genetic modification hence tissue culture raised bananas are excluded from the category of genetically modified crops (Ahmed *et al*. 2014, Alagumani 2005, Hanumantharaya *et al*. 2009, Kadam *et al.* 2017, Karule *et al.* 2016, Kitto 1997).

The objective of writing this brief is to prepare a better understanding of the role of tissue culture as an emerging technology in enhancing food security, economic development and poverty alleviation of marginal farmers of Bihar. The manuscript seeks to solicit the requisite policy support for scaling the benefits of the technology to high potential banana growing areas of the state. The author also wants to reflect that the process of transfer of banana tissue culture technology among small scale or marginal farmers in Bihar would facilitate growth and development of the technology driven banana subsector with new market outlook and future prospect.

## 2. Discussion

Banana is a highly perishable commodity but has high nutritional values. Its production performs well in most agro-ecological zones in the state. Out of the 38 district in Bihar, at least 10 have high potential for banana cultivation and production. The economically important banana pests/diseases impacting on its production in Bihar are nematodes, weevils and fusarium wilt (panama wilt). The causal organism pathogens are spread through infected banana suckers that farmers use for cultivation. The tissue culture banana has laid a strong foundation and has created avenues for applying advanced biotechnology tools such as genetic engineering. The tool, for instance could entail introduction of diverse banana varieties for disease resistance. The principal goal of introducing tissue culture technology at commercial scale is to mitigate production constraints associated with lack of disease free planting material, availability of plantlets throughout the year without constrained seasonal variation and uniform maturity for the harvest of the fruits. Tissue culture technology has found the most appropriate tools to mitigate the mentioned problems reverse the declining trend in banana production and enhance farmer's access to healthy planting materials. In India, states like Gujarat, Maharashtra have adopted tissue culture technology for banana cultivation and have evidenced successful outcomes and it opens the window to identify this technology adaptation issues to overcome the current situation of farmers of Bihar. Thus technology diffusion research, socio-economic and market studies are essential to understand the problems faced during cultivation and marketing of banana in Bihar ( Niraj 2011, Padma Rani and Mani 2016, Qaim 1999, Rajesh *et al*. 2015, Raman and Umanath, 2016, Showk Sedeer 2007, Shukla 2015, Selvarajan *et al*. 2011, BCIL 2005).

### 2.1 Targeted Policies

Targeting of policies has been recommended either at the state or district level to influence farmers about scope of tissue culture raised banana plantlets by addition or modification in the current existing scenario. The livelihood of farmers in the state need to be transformed, so the first recommended target policy must be to focus on increasing their per capita income. It can be achieved by diversification of markets and utilization of banana product through

 

value addition. It is required to channelize the market strategies and transportation facilities for selling banana fruits to major cities of just like other economically strong banana producers from of Maharashtra and Gujarat. Banana is a highly perishable commodity and its processing would prolong its shelf life, giving farmers the flexibility to sell when prices are favorable. Adopting novel production and marketing strategies, value addition and products diversification of banana into juice, fortified flour, instant soup, wine and fiber will provide enormous opportunities for consumption of improved banana product with high value addition. Thus, farmers stand a high chance of exploiting niche markets from processed and value added banana products compared to the farm fresh fruit.

Agriculture is the backbone of Bihar's economy and single largest private sector occupation there. The policies for diversification of markets and utilization of banana (demand) require another policy for farmer to increase the production of banana (supply).The production of banana has been only achieve by reliable and sustained supply of high quality planting materials. The high demand for clean banana plantlets present a window of opportunity for banana tissue culture in Bihar that can be tapped by existing companies or new ones intending to venture into the banana subsector. A number of issues were keenly observed and analyzed at various stages for adopting and adapting to the tissue culture banana technology in Bihar. To acquire technology driven concept of banana cultivation in Bihar it requires development of farmer friendly environment and policies. Some are outlined below.

- Create a model project to show successful application of plant biotechnology in banana cultivation and conduct station trials in main banana growing areas to disseminate the technology and gather information for evaluation of tissue cultured banana performance under optimum condition in that geographical niche.
- NGO expertise in community mobilizations, group organization and capacity building may be contracted to implement the model project.
- To develop on station and on farm activities linked with farmer and extension services, NGOs may be contracted to ensure tissue cultured banana distribution, marketing and utilization.
- To extend the benefits of tissue culture banana production, self-help group among marginal farmers at village and block level may be introduced.
- Development of cooperative society for the marginal farmers at village level should be promoted as a platform for exploitation of entrepreneurial opportunities. It will facilitate large scale adaptation of the technology, hardening and distribution of plantlets as well as post-harvest utilization and marketing of banana fruits to increase household incomes arising out of sale.
- Majority of cultivated banana varieties of Bihar are susceptible to several diseases, hence G 9 (Grand Naine; Big dwarf / Giant Cavendish of AAA group) variety may be introduced to farmers. It is a high yielding cavendish variety brought to India from Israel during 1995 and adopted for commercial production. It has shorter ratooning time and is more productive and most important commercial clone worldwide due to its production of large bunches and fingers, delicious to eat, larger shelf life as compare

 

to native varieties, attractive yellowish green color at maturity and internationally acceptable both as fresh fruit and in processed form due to high pulp: peel ratio.

- Undertake mass propagation of local desired varieties in order to conserve the local germplasm of banana.
- Establishment of low cost village labs and satellite nurseries in the local areas.
- To address the problem of limited distribution of plantlets, mechanisms of establishing hardening nurseries and village laboratories in close proximity to farmers should be given high priority.
- With increased adoption of the technology and opening up of more distribution and hardening nurseries, the requirement for establishment of disease diagnostic centers and virus indexing facility is also essential.
- Quality control at laboratory level is vital to prevent mixing of varieties and minimizing production of off-type plantlets. Such mechanism would also ensure that all materials produced in the labs meet phytosanitary requirements
- There are limited established distribution and marketing systems for the plantlets. Therefore, planting material should be transported in potted form which ensures wider reach to remote rural areas and reaching out to the poorest of the poor farmers.

Formation of banana grower association is required to coordinate operations and provide services to farmers for strengthening their production and marketing linkages. The association will support farmers to tap the benefits of collective bargaining and marketing and minimize duping from middlemen enabling farmers to fetch better prices. Market research will disseminate information to farmers about fair trade, pricing and marketing trends. It will increase farmers bargaining power and they will be able to learn from each other and level of community cohesiveness will also increase among them. Linking production to value addition and understanding the market is crucial for farmers to maximize benefits.

### 2.2 Challenges

Studies conducted on technology adoption rates revealed that farmers were constrained by lack of capital and it limits the diffusion of tissue cultured banana plantlets among the farmers of Bihar. Relatively higher cost of tissue cultured plantlets compared to conventional suckers is a main challenge for farmers. Limited scope of marketing, value addition to banana and policies to nurture the growth and development of technology are also encountered as challenges to adopt the concept of tissue culture technology in Bihar.

## 3. Conclusion

Banana is one of the most important staple crop of Bihar and its cultivation is widespread. But there is apparent distinction between cultivation for livelihood and large scale commercial cultivation. Introduction of tissue culture techniques for banana need defined state level policies and holistic approach to motivate farmers for embracing the technology. Banana plants grown with the help of tissue culture method are the immediate solution to poor yield and unavoidable pest infestation/disease infections which are the biggest threat to banana cultivation in Bihar. It will also

 

provide new business and dynamic employment opportunities among marginal farmers of the state in terms of production, value addition, marketing and transportation. New investment opportunities for tissue culture industry and banana hardening nursery will also emerge after adoption of the technology and will contribute to the direct and indirect employment of the marginal farmers of Bihar.

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