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BCIL Extends Technical Handholding Support to African Nationals for Capacity Building on Plant Tissue Culture

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Abstract: Plant tissue culture is the proven technology for production of true to type and diseases free plants. India has made significant progress in commercial plant tissue culture over last three decades with presence of more than 200 companies having aggregate capacity to produce approximate 500 million plants annually. Quality management system which is known as National Certification System for Tissue Culture Plants (NCS-TCP) has further propelled growth of this sector in India and made this sector as well-organized industry committed for supply of quality plants to the farmers. NCS-TCP is a mandated activity of DBT, Government of India. It is being managed by Biotech Consortium India Limited (BCIL) since its inception. Farmers are widely benefitted by cultivation of NCS-TCP certified quality planting material. BCIL conceptualized the idea of showcasing success of Indian plant tissue culture and quality management system in other potential counties and proposed to initiate capacity building programme. Ministry of External Affairs (MEA) approved this concept to conduct capacity building programme for African Nationals. Tissue culture technology has the potential to play key role in contributing sustainable development goals (SDGs) in underdeveloped and developing African countries. This article provides details about this initiative, its relevance and outcome in promoting plant tissue culture technology in African context.

Keywords: Plant tissue culture, Africa, BCIL, MEA, DBT, Sustainable development.

1. INTRODUCTION

Plant tissue culture technology is widely used for large scale production of quality plants. Other than

its use as a tool of research, plant tissue culture techniques in recent years, have become of major industrial importance in the area of plant

propagation, disease elimination, plant improvement and production of secondary metabolites. Small pieces of tissue (explants) can be used to produce hundreds and thousands of plants in a continuous process [1]. Tissue culture techniques offer opportunity for fast multiplication of superior clones in relatively small time and space throughout year [2]. Plant tissue culture basically deals with the maintenance and culture of plant cells and organs *in-vitro* by providing them with nutritionally and environmentally supportive conditions.

In India, commercialization of plant tissue culture started in mid-1980. During last one-decade, Indian plant tissue culture sector has witnessed exponential growth in terms of number of new tissue units, increase in the gross production capacity and introduction of various new crops. Currently more than 200 commercial units are operational with the production capacity ranging from 0.5 million to 70 million plants per annum. The current cumulative annual production capacity of micropropagation companies is approximate 500 million plants per annum. Commercialized crops include 70 % banana (mostly for domestic market), 20 % ornamental (mostly for export markets) and remaining covers potato, sugarcane etc [3]. BCIL has very close association with Indian tissue culture industry by virtue of managing National Certification System for Tissue Culture Raised Plants (NCS-TCP). BCIL is an organization created by the initiative of Department of Biotechnology (DBT), Government of India and financed by All India Financial Institutions for accelerated commercialization of biotechnology. Idea was conceived by BCIL to replicate success of plant tissue culture to other potential developing countries.

2. GENESIS OF PROGRAMME

Being a home to around one-third of the world's population, India and Africa are essential players in reshaping an emerging world. There is scope for

greater cooperation between India and the African continent towards sustainable development, agricultural growth, energy access, blue economy, education and skill enhancement. Indian government is emphasizing agricultural cooperation with African countries give priority to food production and improving levels of nutrition in order to increase the resilience of local and traditional food systems and biodiversity.

Biotech Consortium India Limited (BCIL) was entrusted with the responsibility to organize training programme for the African nations, with financial support from Ministry of External Affairs (MEA), Government of India and guidance of Department of Biotechnology (DBT), Government of India.

It was approved to train total 270 candidates in different categories/training modules. BCIL organized first training programme in January 2017 and so far, 198 candidates have been trained in 9 batches. The programme focuses on training of students, staff of tissue culture companies, scientists, progressive farmers, extension officers and potential entrepreneurs to build their technological capabilities.

3. RELEVANCE

Agricultural cooperation between India and Africa is of great significance. According to a report by New Partnership for Africa's Development (NEPAD), one in four undernourished people of the world reside in Africa. With Agriculture being the main economic sector in many African countries, agricultural development is an essential ingredient in economic progress and poverty alleviation since most of the poor sections of the society depend on agriculture as a source of livelihood.

Africa can learn from India's experience where India has made significant advances in agriculture since the days of green revolution and Indian technologies can contribute towards Africa's green revolution. [4] [5] Similar agro-ecological conditions

and small holder-based farming systems in India and Africa make a formidable case for greater agricultural collaboration between India and Africa. Low farm productivity, fragmented production systems and limited use of modern technologies are prime factors costing the African agriculture to suffer with various problems ranging from poor crop quality to damage to the crops through diseases and viruses.

3.1. Plant Tissue Culture in Developing Countries of Africa

In the developing countries of Africa, applied research and scaling up of plant tissue culture began recently. In countries such as Tunisia, Morocco and Egypt, commercial micropropagation is applied for ornamentals and date palm, whereas in most of the East-African countries like Kenya and Uganda micropropagation is done for banana. *In-vitro* techniques in are considered to be an effective technology for:

- Micropropagation of superior plant material;
- Maintenance and storage of germplasm;
- Elimination of virus in vegetatively propagated plants;
- Mutation induction and mutational breeding systems of vegetatively propagated plants;
- Establishing somaclones for breeding;
- Rescuing embryos to overcome hybrid sterility in distant hybridization[6]

Tissue culture technologies are being used for propagation and genetic improvement of several important crops in Africa. It has been found that cost of production of tissue culture plants are significantly higher due to poor quality management and high rate of contamination.

3.2. BCIL's African Plant tissue culture programme

African farmers have been facing problems such as limited access to elite varieties, lack of good planting material and increasing incidences of viral diseases resulting in huge challenges for food and nutritional security. Plant tissue culture is a proven technique for producing true to type crop, free of any diseases or pests. Comprehensive capacity-building programme on commercial micro-propagation in Africa, aimed to empower the plant tissue culture sector in Africa which may contribute in solving the problem of scarcity of food in the continent. Through plant tissue culture techniques disease-free and true-to-type plants can be produced with higher yield. This technique can help the farmers in the African nations to produce plants, allowing them to be a better product for sale in the market.

Though, plant tissue culture technology is an effective solution, but its application in Africa is limited by several technical constraints namely lack of trained personnel, plant disease diagnosis technology and genetic fidelity testing. As a result, cost of production of tissue culture plant in Africa is significantly higher than in India. It is expected that implementation of this project by BCIL would facilitate growth of plant tissue culture/micropropagation Industry in African countries.

4. PARTICIPANT COUNTRIES

Eastern and central African region were identified to provide good potential for use of plant tissue culture technology, during conceptualization of the project which includes Cameroon, Eritrea, Ethiopia, Kenya, Madagascar, Mozambique, Namibia, Nigeria, Rwanda, Sudan, South Sudan, South Africa, Tanzania, Uganda, Zambia and Zimbabwe. So far, the programme has seen participation from 198 candidates from 24 different nations as listed at Table 1.

Table 1
Participation status of various African countries till March 31, 2019

COUNTRY	NUMBER OF PARTICIPANTS	COUNTRY	NUMBER OF PARTICIPANTS
BOTSWANA	3	NAMIBIA	1
CHAD	17	NIGERIA	28
COMOROS	1	SENEGAL	3
EGYPT	1	SEYCHELLES	3
ERITREA	4	SOMALIA	1
ESWATINI	1	SOUTH SUDAN	4
ETHIOPIA	4	SUDAN	16
KENYA	36	TANZANIA	12
MADAGASCAR	2	TUNISIA	13
MALAWI	14	UGANDA	10
MAURITIUS	1	ZAMBIA	8
MOZAMBIQUE	8	ZIMBABWE	7

Coverage of this programme in different African countries is depicted at map placed Figure 1:



Figure 1: Map indicating participating countries till 5th batch completed by March 2019

5. TRAINING COVERAGE

Biotech Consortium India Limited (BCIL) had organized training in four modules in nine different batches. Module-I was designed so as to train

laboratory staff and scientists of African tissue culture companies for effective management of operations, virus indexing and genetic fidelity testing. The main motive behind this training was to impart the African candidates with knowledge for quality management of such tissue culture raised plants. The second module was organized aiming to generate trained employable manpower for commercial plant tissue culture setup in African micro-propagation industry, providing them training in various aspects of production of tissue culture raised plants. Entrepreneurship development programme (3rd module) was an important aspect for comprehensive capacity building programme on commercial micro-propagation. Therefore, as part of the programme, entrepreneurship development training in plant tissue culture was organized, covering technical handholding support from preparing business plan to turnkey implementation. Also, as a part of fourth module, training for farmers and other agricultural extension officers from various African nationalities was also organized, with the aim to encourage them in adopting the tissue cultured crops, by enlightening them about the vast range of

benefits of such tissue culture raised plants over the conventional plants. The training programme also desired to create widespread awareness amongst the farmers from the respective African countries of the

trained candidates, ensuring extensive knowledge transfer from the best Tissue culture facilities in India. Indicative photographs of training programme are at Figure 2.



Figure 2: Representative photographs of training programme (Clockwise from top left (A) Training on virus indexing for African Laboratory Staff and Scientists; (B) Training of African candidates on production of plants through micropropagation; (C) African farmers during their field visit to tissue cultured Banana plantation; (D) Potential entrepreneurs observing the primary-hardened plants and learning the business model)

6. FEEDBACK

Feedback of the participating candidates was found very positive. Candidates were highly satisfied by the training and amazed by the progress made by plant tissue culture companies in India. Candidates were benefited with the wide range of lectures and hands-on training in India's best commercial plant tissue culture laboratories. The candidates appreciated the

content of the programme, where it provided a right balance between theory and practical knowledge and training at commercial set up. The training provided a platform for these candidates to learn and improve their plant tissue culture knowledge and further encourage other individuals in their respective countries, thus providing a widespread awareness and capacity building on plant tissue culture.

6. CONCLUSION

The training programme served as mode to promote the plant tissue culture techniques in Africa. Adoption of plant tissue culture in African agricultural sector would enable African farmers to cultivate superior crops. Training on virus indexing and genetic variability testing would enable production facilities to predetermine the fate of the produce, whether the produced crop is disease free, since in some cases the disease symptoms are expressed once the crop is fully developed. Hence virus indexing would enable saving time and control the spread of infection into other healthy crops, if planted in the vicinity of the infected plant. With usage of tissue culture-generated plant, productivity per unit will be increased, particularly for horticulture crop.

This training may open up new entrepreneurial avenue in potential regions. Since scarcity of quality food remains a major issue for the African countries, plant tissue culture would play major role in increasing the crop yield and providing effective solution to the increasing demand of the food for a growing population. Like in case of banana, replacing the conventional planting methods of use of suckers, with tissue cultured plantlets, the productivity of banana can be enhanced to up to 40-50 kg/plant [7]. The training was found as an eye opener and boosted confidence of African candidates towards the potential of tissue culture technology, especially in meeting the food security of the population of Africa [8].

7. WAY FORWARD

Plant tissue culture technology has vast potential to produce superior quality planting materials, but this potential has not been fully exploited in the many developing African countries. In India, Standards prescribed under the National Certification System for Tissue Culture Raised Plants (NCS-TCP) provide guidance to entrepreneurs for meeting the quality requirements

in establishment and operation of commercial unit in terms of infrastructure, package of practices and quality of end products [9]. In the subsequent phase, African countries may have programme like NCS-TCP for which current capacity building programme will become as base and precursor. This programme is also expected to open a new door for collaboration between Indian and African tissue culture companies.

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