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Off-field sucker production of post-harvest banana corms under different hormonal and nutritional regime

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ABSTRACT

Banana is the most important fruit crop of the world. The production of banana propagules for different scales of its cultivation and for the farmers of different resource capacity is an important researchable issue. An improved macro-propagation technique for production of suckers from isolated corms under controlled laboratory condition may be a cheap and easy adoptable alternative to the micro-propagation of banana. An experiment on banana (*Musa* spp.) post-harvest corm was conducted at the Department of Plant Physiology, BCKV Mohanpur, to study the induction of sucker through different hormonal and nutritional intervention, which was laid out in Completely Randomized Design and replicated three times. Five treatments viz., T_1(Control treatment with water spray), T_2 (Thio-urea 0.15%), T_3 (nutrient mixture of urea @450 mg l^{-1} + Thio-urea @70 mg l^{-1} + CalciumNitrate @ 700 mg l^{-1}+ Calcium monophosphate @150 mg l^{-1} + Magnesium chloride @80 mg l^{-1}+ Boric acid @5 0mg l^{-1}), T_4 (Thiourea @0.15% + BAP@ 4ppm), T_5 (nutrient mixture of T_3 + BAP @4ppm). The substrate used for planting the corms were a mixture of sawdust + Trichoderma @ 15g kg^{-1} of sawdust + vermicompost @ 15g kg^{-1} of sawdust. Observations recorded were weight of the corm, days to appearance of the first primary suckers, number of primary suckers, number of secondary suckers, number of tertiary suckers and total number of suckers. T_3 observed to be the best treatment in respect to all the response parameters like earliness in sprouting, primary, secondary and tertiary sucker productivity.

Key words*: BAP, Macro-propagation, Post-harvest Corm, Sawdust, Sucker.*

Introduction

Banana is a crop with dual propagation abilities, sexual through seeds and asexual through suckers. Seed propagation is common in wild species which are diploid and undergo normal meiosis, fertilization and seed set. Sucker propagation is the only natural means of their perpetuation; artificial methods of propagation include macro-propagation and micropropagation. The high rate of multiplication of banana propagules can be achieved through tissue culture. *In vitro* banana production technology is a superior technology over traditional method (sucker-propagated) of banana production with respect to multiplication in mass scale. Hwan *et al.* (1976) claimed that banana produced using the tissue culture technology are more vigorous, higher yielding and produce fruits of better quality than those produces by conventional means. However, farmers themselves cannot produce tissue cultured

materials themselves. It requires sophisticated laboratory and skilled hands and technical knowledge which are beyond farmers reach. Tissue cultured materials are costly and resource poor farmers cannot afford such initial investment. Tissue cultured plants appeared to require an intensive management from the day of planting, while early growth and development of conventional plants was mainly controlled by the number of nutrient reserves in the rhizomes (Eckstein and Robinson, 1995). Even though tissue culture produces more shoots compared to bud manipulation technique, the number of shoots, shoots height and percentage survival of plantlets from bud manipulation makes the bud manipulation technique a suitable alternative to tissue culture since it is farmer friendly and less expensive (Buah and tachie-Menson, 2015), therefore, healthy corms left in the field after harvesting can be used to produce suckers (Bakelana-ba-Kufimfutu , 2000). Evaluation of macro-propagation practice using sawdust as initiation media, supplemented with various biofertilizers results in highest number of uniforms sized tertiary bud production (Baruah *et al.,* 2015). In the present study, attempts have been made to enhance the rate of plantlet production through macro-propagation by the intervention of hormonal and nutritional regime.

Materials and Method

Investigation presented was carried out in 2019 at the Nutrio-physiology laboratory, Department of Plant Physiology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal. Bengal. The geographical location of Mohanpur is 22.95°N and 88.53°E. Banana cultivar 'Baish Chhara'was used for the experiment and the corms were collected from Banana plantation garden of AICRP – Fruit Crops, Horticulture Research Station, Mandouri Farm, Bidhan Chandra Krishi Viswavidyalaya. 'Baish Chhara' is one of the popular cooking types of bananas of Bengal. Its genomic composition is ABB. Its production of propagules through in vitro micropropagation or callus culture was not successful. It was also found out to be shy in response in production of sucker from the corm at the tray with substrate (saw dust/rice husk) without intervention of any bioregulators.

After harvesting of the banana bunch, the corm (rhizome) was removed from a well-watered field and detopped just above the juncture of the corm and aerial shoot (Fig. 1 A) and clean properly by washing under running water. Leaf bases and the roots were removed together with any dead tissue to reduce nematode infestation (Baiyeri and Aba, 2005) (Fig. 1 B). The apical meristem was then destroyed by making a cross-like (+) incision with the help of a sharp knife (Fig: 1C). The corm was further treated with Carbendazim @ 4 gL^{-1}, a systemic fungicide for 15 minutes to kill germs and air-dried in shade for 2 hours. The substrate used for planting of the corms were a mixture of sawdust + Trichoderma @ 15 $gram^{-kg}$ of sawdust + vermicompost @ 15 g -kg of sawdust. Corms were planted in a wooden tray and covered fully with sawdust. The corms were then watered immediately after planting.

The treatment details were given in the Table 1. Each treatment had three corms as replication, thus a total of 15 post-harvest corms were tested for sucker production against various treatments of bioregulators. Treatments were given at weekly intervals through application of foliar spray, the substrate was watered every alternate day to linger moisture. The newly produced suckers (Fig. 1 D) were excised from the mother corm at a weekly interval after development of the sprouts. The sucker that came out directly from the corm were considered as primary suckers (Fig. 1D). On excision of the primary suckers from the corm, new suckers may come out from the surface of the cut wound on the corm. Such suckers were considered as secondary suckers (Fig. 1 E) as they were not directly connected with the corm tissue, their connection with the corm tissue were via basal remnant tissues. The sucker that came out from the remnant of the secondary sucker were considered as the tertiary suckers (Fig. 1 F). Time taken for bud (primary buds-G1) regeneration from the decorticated suckers was recorded. Total number of primary (G1), secondary (G2) and

Table 1. Treatment combinations

Symbol	Treatment
T1:	Control (Water spray)
T2:	Thiourea 0.15%
T3:	Balance nutrient mixture: urea@ 450 mg l^{-1} + Thiourea@ 70 mg l^{-1} + Calcium Nirate@ 700 mg l^{-1} + Calcium monophosphate@ 150 mg l^{-1} + Magnesium chloride@ 80 mg l^{-1} + Boric acid@ 50 mgl^{-1}
T4:	Thiourea@ 0.15% (T1) + BAP@ 4 ppm
T5:	Balance nutrient mixture (T2) + BAP@ 4 ppm

tertiary (G3) buds formed at the end of 3rd month was recorded. Other parameters measured were days to appearance of the first and subsequent primary suckers, weight of the corm. The experiment was laid out in a Completely Randomized Design with five treatments and three replications.

Results and Discussion

Sucker productivity with all bio-regulators treatment were consistently higher than the control (Table 2). The response of the banana corm, cultivar 'Baish Chhara' to different treatment of bio-regulator in generating primary sucker ranged from 3.00 (T2) to 6.00 (T3). The production was doubled in the cases of treatment with balanced nutrient mixture but remained unchanged in the treatment with thiourea. Addition of BAP with thiourea (T4) increased slightly compared with the treatment with thiourea (T2) but addition of BAP with balance nutrient mix-

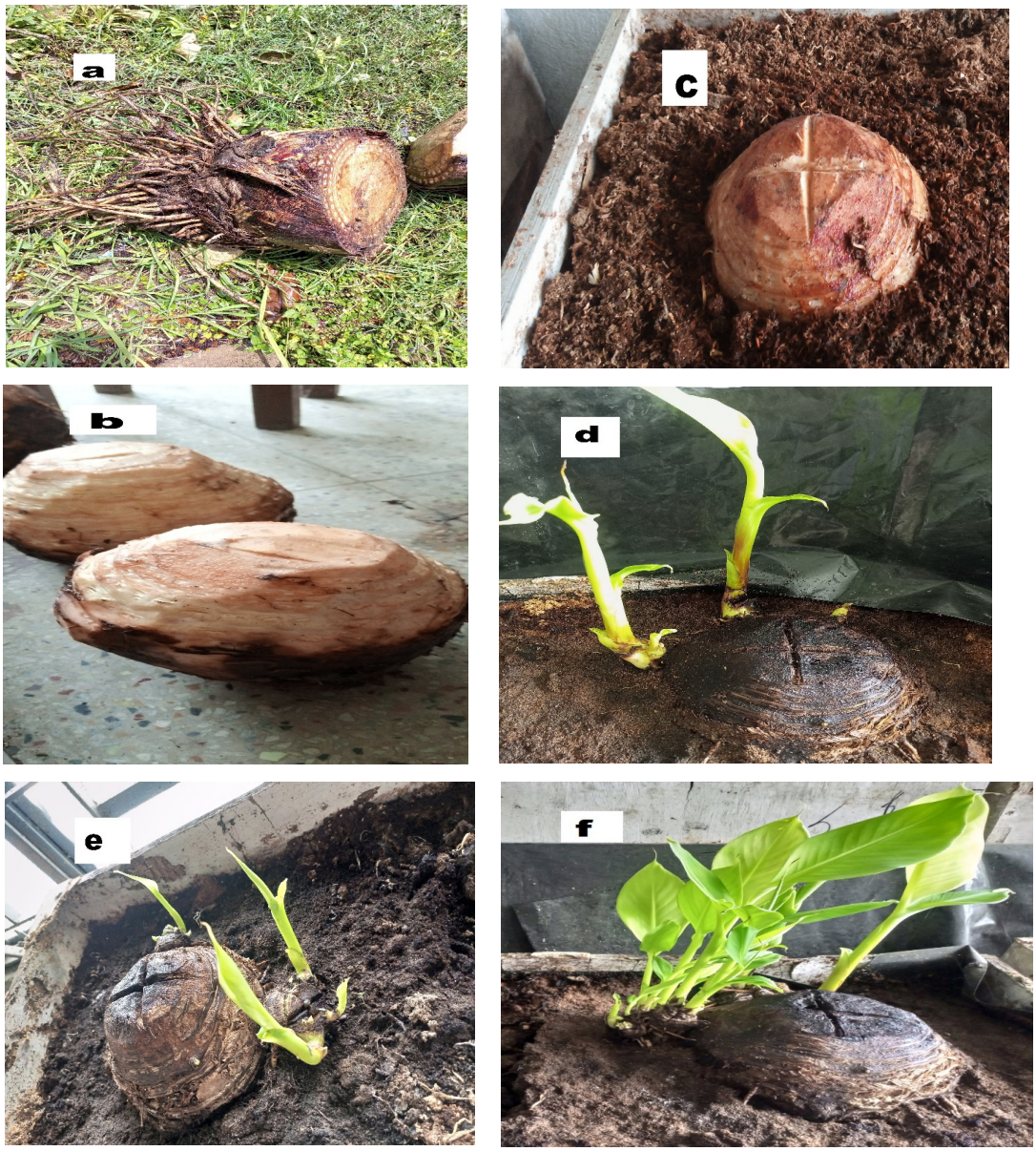

Fig. 1. (A) Detopped banana corm after removal from the field. (B) Removal of leaf sheet and roots followed by proper cleaning. (C) Cross incision marks on the apical meristem of a corm. (D) Development of primary sucker from the corm. (E) Development of secondary sucker from the corm. (F) Development of tertiary sucker from the corm

ture (T3) caused to decrease the production of primary sucker.

The secondary sucker production was limited to balance nutrient mixture (T3, 12.33), thiourea +BAP (T4, 5.66) and balance mixture + BAP (T5, 5.00). Banana cultivar 'Baish Chhara', that in an exceptional case only produced secondary sucker, failed to do that when treated with thiourea. But when treated with balanced nutrient mixture the secondary sucker production was impressively improved. But addition of BAP to each of the treatments caused disparate results: enhanced when applied with thiourea and declined when applied with balanced nutrient mixture.

The tertiary sucker production was found to occur only in the treatments with balance nutrient mixture T3 (4.0) and balance mixture + BAP T5 (2.0). Thecorm of the banana cultivar, 'Bais Chhara', that did not produce tertiary sucker, failed to do that even when treated with thiourea with or without BAP. But when treated with balanced nutrient mixture the tertiary sucker production was induced though it was found to decline when additionally, BAP was added to the treatment.

The total number of suckers generated from the post-harvest banana corm was most efficacious in balanced nutrient mixture (T3, 22.3) for sucker induction followed by balance mixture + BAP (T5, 10.66), thiourea + BAP (T4, 10.0) and thiourea (T2, 3.0). Sucker productivity with all bio-regulators treatment were consistently higher than the control. In most of the sucker induction studies BAP was reported to enhance thenumber suckers in all tiers: primary, secondary and tertiary (Silva *et al*., 1996; Manzur, 2001; Osei, 2007; Dayarani *et al*., 2013; Kindimba and Msogoya, 2014; Baruah and Kotoky, 2015; Thiemele *et al*., 2015**)** Cytokinin of course inducesaxillary buds but source of that cytokinin may be internal or external. Plant material respond to external application of the hormone when internal status is low but. When internal supply is high the external application of it may be toxic what probably happened when the corms are treated with balanced nutrient mixture along with BAP (T3). So, it appeared that treatment with balanced nutrient induces sufficient production of cytokine in internally.

Times taken for the banana corm to generate first primary sucker were efficiently reduce in all the treatment as compare to control (Table. 3). Treatment of the corms with either of thiourea (T2) or balanced nutrients mixture (T3) reduced number of days for sprouting to 6.33 and 7.66 days respectively and thus induced the corm to respond early. Treatment of the corms with thiourea was earliest to respond. However, when BAP was added to each of these two treatments (T4 and T5) the response was found to be delayed to 19.33 to 21.0 days respectively which is earlier than control (T1) with 31.43 days. BAP applications had no effect on the number of days to lateral shoot emergence (Opata *et al*., 2020)

The post-harvest banana corm of higher fresh weight with same treatment takes longer time to response (Table 3). It may be due to lower ratio of fresh mass and the treatment volume. So, it indicates that the volume or concentration of the treatment should be proportional to the mass of the corm. The result also shows that in most cases, the banana corm of higher fresh weight produces a greater number of suckers which may be due to the greater capacity of the large corms to supply basic substances (organic assimilates or minerals) for the sucker production. For induction of sucker production, balance nutrient mixture was found to best, it induces highest number of Primary secondary and

Table 2. Effect of different bio-regulators on the number of primary, secondary, tertiary and the sum total of sucker production from the corms of the banana cultivar 'Baish Chhara'

Treatment	Primary Sucker (mean)	Secondary Sucker (mean)	Tertiary Sucker (mean)	Total Sucker (mean)
T1	1.00	0	0	1.00
T2	3.00	0	0	3.00
T3	6.00	12.33	4.00	22.30
T4	4.30	5.66	0	10.00
T5	3.66	5.00	2.00	10.66
SE	0.76	1.856	0.577	2.801
CD	2.43	5.92	1.84	8.94

Table 3. Effect of different bio-regulators on the days to response with total number of suckers produce with reference to the weight (gram) of the corms of the banana cultivar 'Baish Chhara'.

Treatment	Weight (g) of corm (mean)	Days to respond (mean)	Total Sucker (mean)
T1	3346.66	34.43	1.00
T2	4300.00	7.66	3.00
T3	5533.33	6.33	22.30
T4	3966.66	19.33	10.00
T5	3200.00	21.00	10.66
SE	679.30	2.82	2.801
CD	N/A	8.99	8.94

tertiary it induces early sprouting and appearance of primary sucker. The corms of higher fresh weight, with same treatment, were late in response. The corms of higher fresh weight, with same treatment, produced a greater number of suckers.

Conclusion

'Baish Chhara' is one of the popular cooking types of bananas of Bengal. Its genomic composition is ABB. Its production of propagules through in vitro micropropagation or callus culture was not successful. It was found to be shy in response in production of sucker from the corm at the tray with substrate (saw dust/rice husk) without intervention of any bioregulators. balance nutrient mixture (T3) was found to best for induction of sucker production, it induces highest number of Primary secondary and tertiary it induces early sprouting and appearance of primary sucker. It may conclude that macro-propagation management of sucker is a suitable alternative to tissue culture since it is farmer friendly and less expensive. The healthy corms left in the field after harvesting could therefore be recovered and used to produce suckers.

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Disclosure statement

The authors declare that there is no known conflict of interests.

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