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Macropropagation Techniques in Bamboos: A Review

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ABSTRACT

Bamboo has been the integral part of socio and cultural part of human life from time immemorial due to its multifarious and versatile utility and it also plays a important role in women empowerment. Bamboo has a variety of uses ranging from its conventional usage in building, pulp and paper manufacture, to cottage industries and household use. Due to the uncertainty of sporadic flowering, long flowering cycle, unavailability and short viability of seeds, bamboos are usually propagated by vegetative propagation. In this paper, we presented short overview of various macropropagation techniques for bamboos. Macro propagation of bamboos is straightforward, inexpensive and uses local resources, depending on the aims and the facilities available. It is very helpful for the sustained production of field plantable bamboo saplings. In the area of bamboo research, it has also opened up a lot of new doors. It is very adaptable since bamboos can be mass-propagated using offsets, rhizomes, layering, culm or branch cuttings.

Key words: Bamboos, Branch cuttings, Culm cuttings, Macropropagation, Propagation.

Bamboos are the versatile arborescent grasses belonging to family *Poaceae*. Bamboos form the valuable natural resource of India because of its adaptability to various site conditions with large species diversity, great role in poverty alleviation and improvement of rural and tribal livelihood, ever increasing number of uses and environmental benefits. Due to its wood properties like hardness, lightness, flexibility, desirable appearance and tensile strength it can be a suitable substitute for timber and wood in many applications including furniture and construction industries (Hogarth and Belcher, 2013). Nowadays, bamboo is becoming more and more a farm crop than being a major non-timber forest produce.

India has the World's second largest bamboo resource and the largest area under bamboo plants, with 136 species, 23 genera covering 13.96 Mha. With the launch of National Bamboo Mission in 2006-07 as a Centrally Sponsored Scheme in India and Amendment in Indian Forest Act 1927 for omission of bamboo grown in non-forest areas from the "definition of a tree", hurdles in bamboo cultivation are minimising (FSI, 2019). With the reincarnation of interest on bamboos large scale plantation activities have been initiated in India and worldwide, for the successful planting programme we greatly depend on the quality planting material. Although the seed propagation is the cheapest among the propagation methods, due to the uncertainty of sporadic flowering and long flowering cycle, unavailability and short viability (3-6 months) of seeds, the best option is to multiply the bamboos through vegetative propagation (Banik, 1994).

The vegetative propagation methods in bamboo can be divided into macro and micro propagation techniques. Macropropagation methods in bamboo comprise of rhizome planting, offset planting, culm cuttings, branch cuttings and air layering (Kumar, 1991; Seethalakshmi *et al*., 2008) among which, rhizome planting and culm cuttings are the most widely used methods of vegetative propagation. Conventional vegetative propagation methods such as offset planting, layering and rooting of culm cuttings has been successfully employed in many bamboo species. However, these methods are limited by number of propagules and the propagation through destructive nature. The rooting of branch cuttings is the least studied propagation method in bamboos which is very simple, easy and non-destructive. Hence in this paper, bamboo propagation by different vegetative methods in different bamboo species especially macro-propagation through branch cutting is reviewed.

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Macropropagation techniques in bamboos

Studies on macro-propagation are very old. For instance, Cabanday (1957) compared the rooting performance of whole culms, two node cuttings and single-node cuttings of bamboos. Results indicated that the single-node cuttings gave the greatest number of rooted shoots per culm used, although the success rate was not the highest. Abeels (1962) had reported the methods of bamboo propagation by cutting and layering. McClure (1966) gave the required features of a truly successful cutting as one which carries a bud that developed into a rhizome from which new rooted shoots had arisen. He used the term rhizome in a black and white sense which may have obscured the potential transition between partially rhizomatous shoot bases and true rhizomes. Similarly Dai (1981) showed that whole culms partially severed between the nodes were more productive than uncut culms, although these culms still had the rhizomes

attached. The different macropropagation methods used in bamboo are offset planting, rhizome cutting, culm cuttings, layering and branch cuttings. The different propagation methods are described in brief in the following sections.

Offset method

Offset propagation is an age-old method in bamboos (Ahlawat *et al*., 2002). An offset is the lower part of a single culm with 3-5 nodes and with the rhizome axis basal to it and its roots. Offsets are collected from the one-to two-year-old culms. To prepare the offset, the culm is cut with a slanting cut and the rhizome to which it is attached is dug up and cut off to a suitable length to include well developed buds (Pandalai *et al.,* 2002). There are some limitations for offset planting like, offsets are bulky and heavy and are few in number (Seethalakshmi *et al.,* 2008). The excavation and transportation costs may be high and if more are excavated the regeneration of the parent clump can be lost. Survival, which is theoretically 100 per cent, can be much lower. Cumbersome and labour-intensive method, difficulty in transport and damages during excavation makes offset method very expensive for large scale bamboo plantations (Kebede *et al*., 2017). Kebede *et al*. (2017) compared offset and rhizome planting of *Yushania alpina* in Banja district of Ethiopia and found no significant difference for number of sprouted shoots. According to Hasan (1977), the final establishment of offset was 5% in *M. baccifera*, 9% in *B. tulda*, 33% in *O. nigrociliata* and 40% in *D. longispathus*. Some bamboo species with strong walls, such *B. vulgaris*, have success rates that can reach 100%. Study in Ethiopia reported zero mortality in *Yushania alpina* by offset planting (Kebede *et al*., 2017).

Rhizome cutting

Rhizomes are traditionally used to propagate non-clump-forming species where rhizomes are long and slender: the leptomorph type (Banik, 1994) and rarely used to propagate clump-forming species such as *Dendrocalamus* spp. and *Bambusa* species. In order to ensure the successful propagation, rhizomes should be healthy and be “fresh” in colour, 2-3 years old, not damaged and should possess roots. Rhizomes without culms are cut 50-60 cm long with about 10-15 nodes and with roots. February to March appears to be the best time for both collecting and transplanting. If the region has a cold climate the best planting time is April, if it is warm then it should be the cooler month (Seethalakshmi, 2015). Offset planting and rhizome planting are the most common methods applied in bamboos in the absence of seed (Seethalakshmi *et al*., 2008) and called as the traditional method for bamboo propagation. When compared to the conventional one, rhizomes with four and six nodes had significantly higher mean shoot diameters in *Yushania alpina* (Kebede *et al*., 2017). Study by Kebede *et al*. (2017) also proved that using rhizomes with four and six nodes was a superior method of propagating *Y. alpina* than the conventional methods.

Culm cuttings

Culm cuttings are segments of the culm (stem) usually with one to three nodes with buds or branches. The method is suitable for clump-forming species rather than non-clump-forming species. Generally, the culm selected for the cuttings should be not more than two years old and buds should be healthy. Treatment with growth regulating substances (GRS) like Naphthyl acetic acid (NAA) and Indole butyric acid (IBA) enhanced rooting response in bamboo (Seethalakshmi, 2015). Generally, 50-100 ml of GRS is used for bamboos like *Bambusa balcooa, B. bambos, Dendrocalamus brandisii*, *etc.* For large diameter bamboos like *D. giganteus* about 250 to 500 ml of the solution is required (Seethalakshmi *et al.,* 2008). The selection of the cuttings based on position of node and application of proper concentration of growth regulating can be resorted to ensure efficient rooting and cost-effective planting stock production (Jijeesh and Seethalakshmi, 2010; Raveendran *et al*., 2010 ab).

Rooting response of cuttings depends on species, type of cutting, season of collection, growth regulator and its concentration etc (Hartman *et al*., 2002). The environmental conditions during collection like light, temperature, humidity, rainfall plays a significant role in root induction of cuttings (Hofferman, 1979). This may be related to endogenous plant growth regulator levels or carbohydrates (Day and Loveys, 1998). The seasonal influence was prominent during root induction in bamboos (Raveendran *et al*., 2010 ab). Surendran and Seethalakshmi (1985) reported that the application of the growth regulating substances such as, IAA, IBA, NAA, Coumarin or Boric Acid enhanced the rooting and sprouting and the responses varied with species and collection time. The study conducted by Raveendran *et al.* (2010a) on adventitious root induction of culm cuttings in giant bamboo *Dendrocalamus giganteus* indicated that the maximum rooting can be obtained during summer season (February to May) only. Similar results were obtained in rooting of *Dendrocalamus brandisii* cuttings also (Raveendran *et al.,* 2010b). For instance, in Nepal, good success rate (60-80%) has been achieved from single node culm cuttings in *B. balcooa, B. nutans, D. hamiltonii, D. hookeni* and *Oxytenanthera nigrociliata* (Das, 1988). Propagation studies in Sri Lanka showed that two-node culm cuttings of some major bamboo species are more satisfactory than split culm-cuttings (Vivekanandan, 1987). Reddy and Yekanthappa (1989) reported that, two node cuttings obtained from one year old culm exhibited 90 per cent rooting in eight months’ period in *Oxytenanthera stocksii.* The position of cuttings also played an important role in the propagation through culm cuttings (Raveendran *et al*., 2010ab). There was difference in rooting efficacy of cuttings collected from basal, middle and top portion of the bamboos. In most cases, basal portions of the culm responded better than the top and middle ones (Chinte, 1965). In the propagation of *Thyrsostachys oliveri* using culm cuttings, especially cuttings from basal third of culms performed better than the other parts and the growth

promoter NAA stimulated rooting responses quickly than IBA (Seethalakshmi, 1998). It was observed that horizontal planting of culm cuttings was significantly better over planting in slanting as well as vertical irrespective of size. Similarly, 'planting of one or two noded cuttings' horizontally was the best method over others. More than one noded culm cutting should be planted horizontally, because the vertical or slanting position methods not only reduce quality of plant but also number of rooted plants (Bhol and Nayak, 2012).

Treatment with growth regulating substances like naphthyl acetic acid and IBA enhances rooting response in bamboo. Since NAA is cheaper than IBA, generally NAA is preferred. For bamboos with hollow internode (e.g. *Bambusa bambos*), GRS solution is poured into the cavity and for solid bamboos (*e.g. Dendrocalamus strictus*), dip method of treatment (the basal part is dipped in GRS solution overnight) is preferred (Seethalakshmi *et al*., 2008). Uchimura (1977) found that, among the three growth regulators (IAA, IBA and NAA), cuttings treated with 100 ppm of IBA for 24 hours gave better rooting percentage and formation of longer roots in *B. vulgaris*. In a similar study with *B. blumeana* using different concentrations of IAA, IBA and NAA, Bumarlong (1977) observed the highest dry weight and mean length of roots for cuttings treated with 600 mg/l of NAA while maximum number of roots per cutting was obtained with 200 mg/l of NAA. However, normal concentrations of growth regulators have no effect on rooting of branch cuttings (White, 1947; Delgado 1949). Gantait *et al*. (2018) propagated untreated culm cuttings of *B. balcooa* directly in different substrate in West Bengal and reported earliest emergence of axillary shoot buds within 9 days in soil and more than 2 weeks in soil plus sand/ vermiculite while survival % was highest in coarse sand (96.5%) among all substate. Shirin *et al*. (2021) studied the effect of seasons, auxins, diameter of cuttings and their interactions on rooting behavior of culm cutting of *Bambusa nutans*, *B. vulgaris* var. green, *B. tulda*, *B. bambos* and *Dendrocalamus strictus* and reported that 2-3 cm thick culm cuttings that had been treated with 200 ppm IBA showed the best rooting response in all seasons, with spring being the best followed by summer. IBA-treated cuttings produced 76.25 per cent rooting in *B. nutans*, 74.50 per cent rooting in *B. vulgaris*, 63.33 per cent rooting in *B. tulda*, 35 per cent rooting in *D. strictus* and 23.33 per cent rooting in *B. bambos* (Shirin *et al*., 2021). For excellent planting material throughout the spring and summer seasons, single nodal culm cuttings treated with 200 ppm IBA are advised. Study by Mulatu and Fetene (2014) in Addis Abada, Ethiopia reported that 'no root developed in culm cuttings and branch cuttings of *Arundinaria alpina'* while whole-culm propagation technique produced high number of shoots with reasonable size at the butt, middle and top positions. Venkatesh and Kariappa, (2021) reported higher sprouting percentage (54.50%), number of nodes (1.85) and number of shoots (1.75) when culm cuttings of *Dendrocalamus stocksii* treated with 750 ppm IBA among 0, 250, 500, 750, 1000 and s ppm IBA treatments. Ray and Ali (2016) found that coarse sand as seed bed for two-nodded culm cutting of *Bambusa balcooa* provided higher rooting percent than vermicompost and vermiculite in West Bengal conditions. Pathak *et al*. (2018) treated 3-nodded culm cuttings of *Schizostachyum dulloa* (Gamble) with various concentrations of IBA and NAA and reported highest rooting percent of 66.67%, highest % of cuttings (66.67%), highest survival % after transplanting (62.35%) in NAA-500 ppm + IBA-200 ppm treatment among all. Methods for vegetative propagation using culm cuttings by treating them with GRS were standardised for many commercially important bamboo species (Table 1) like *Bambusa balcooa, B. bamboos, B. blumeana, B. pellicio, B. tulda, B. vulgaris. Dendrocalamus hamiltonii, D. strictus. Ochlandra scriptoria, O. travancorica* and *Teinostachyumd dullooa* (Seethalakshmi *et al*., 1983; Surendran *et al*., 1983; Surendran and Seethaiakshrni, 1985; Sharma, 1987; Nath *et al*. 1986; Kumar *et al*., 1988; Jayasree, 1989; Jijeesh and Seethalakshmi, 2010; Seethalakshmi and Jijeesh, 2011).

Layering methods

Layering is the method of bringing a culm or branch in contact with soil or other rooting medium so that rooting occurs. There are four types of layering namely ground or simple layering, stump layering, air layering or marcotting and seedling layering (Ahlawat *et al.,* 2002; Pandalai *et al.,* 2002). Whole bamboo layering method has been adopted to develop rooting and sprouting at each node. Serajuddoula (1987) described the propagation of *Bambusa vulgaris* and *Melocanna baccifera* by layering method. Ground-layering and air-layering trials were conducted on *B. vulgaris* and *M. baccifera*. All the treated branches of *B. vulgaris* produced successful propagules in the air-layering experiment. The ground-layering of twelve culms of this species produced 23 rooted and rhizomed propagules. Initiation of rooting and rhizome appeared only in the branches of mid-culm zone in both of the layering experiments. *M. baccifera* did not respond to any of the layering methods. Layering is successfully employed in the propagation of *Guadua anguistifolia* (Verma *et al.* 2013).

Branch cutting

Propagation through branch cuttings is the simplest and easiest method of bamboo propagation due to the ease in handling but the success of rooting is not as high as in culm cuttings. However, considering the availability in large number and ease in handling, even 50 per cent rooting is sufficient if this method of propagation is successful. It is reported to be suitable for bamboo species with prominent primary branches from the base of the culm like *Bambusa balcooa*, *B. vulgaris*, but very difficult in species like *Dendrocalamus giganteus* and *Thyrsostachys oliveri* (Seethalakshmi *et al.,* 2008).

Banik (2015) reported that in majority of the species *viz. B. balcooa, B. bambos, B. tulda, B. vulgaris etc*. exhibit branching from base to top, more or less throughout the culm. In some bamboo species, culms of progressively larger sizes (those approaching mature statures) have a

progressively longer series of budless lower above-ground internodes. As for example, mature size culms from clumps of *B. cacharensis*, *B. polymorpha, D. asper, D. giganteus, D. hamiltonii, D. longispathus, Thyrsostachys oliveri, T. siamensis*, may lack buds and branches in the lower ½ to ²/₃ or even ¾ of their length (Banik, 2015). Branching pattern vary in different bamboo species. *Schizostachyum* and *Melocanna baccifera* branches near the top of the culm (Seethalakshmi and Kumar, 1998). Many *Ochlandra* species also produce many branches towards the top region of culms. The major limitations of propagation through branch cutting are low rooting percentage of branches, availability of branches in species branching only from top one-third of the culm, technology is not standardized for many species and synchronous flowering (Seethalakshmi, 2015). The adventitious rhizogenesis in branch cuttings can be enhanced by the treatment with GRS. The treatment enhances rooting response in branch cuttings and dip method of treatment can be successfully used (Seethalakshmi *et al*., 2008). The time taken for planting stock production is a constraint and the time taken for rooting may be about four to eight months and rhizome formation take still longer periods of about a year (Seethalakshmi *et al*., 2008). Preparing pre-rooted and pre-rhizomed branch cuttings can reduce the time taken for rooting and rhizome development in branch cuttings (Banik, 1984). Natural aerial rooting and rhizome formation is seen in some species the collection of planting material from this region ensures more rooting success. Chopping off the top part of the culm and covering the nodal buds with moist medium like moss or coir can also induce pre-rooting (Seethalakshmi, 2015).

The success of rooting in branch cuttings can be improved by the selection of pre-rooted cuttings. Banik (1984) successfully induced *in situ* rooting and rhizome at the branch bases of some thick-walled species of bamboos of Bangladesh. These "pre-rooted and pre- rhizomed branch cuttings" performed better than normal branch cuttings (Banik, 1987). The average rooting and rhizome formation of these types of cuttings were 67 per cent in *Bambusa balcooa*, 70 per cent in *B. nutans*, 93 per cent in *B. poly morpha* 90 per cent in *B. vulgaris* and 63 per cent in *D. giganteus* (Banik, 1984). Seethalakshmi *et al.* (1983) reported that NAA and mixture of coumarin and IAA gave the higher percentage of rooting when treated with *B. balcooa* lateral branch cuttings and culm cuttings. They were of the opinion that branch and culm cutting materials are more economical and convenient for large scale vegetative propagation of bamboos, than the conventionally used offset and rhizome material. About 40 per cent (with IBA 100 ppm) rooting was obtained in branch cuttings of *B. arundinaceae*. In branch cuttings planted vertically as well as horizontally only the latter developed vigorous sprouts and roots occasionally from both the nodes. In *Bambusa balcooa* About 40 per cent rooting was obtained in branch cuttings treated with IAA or coumarin (Surendran and Seethalakshmi, 1985). Venkatesh (1989) showed that lateral branch cuttings of bamboo culms can be effectively used for vegetative multiplication with the help of suitable growth regulators. Adventitious rhizogenesis was dependent on season and cutting size and IAA treatment enhanced the rooting during warm season of the year. It was found that the cuttings collected in April treated with 100 ppm IAA with

Table 1: Various macropropagation techniques of bamboos.

Method	Species	GRS*	Survival	Rooting%	Shoot emergence (days)	Source
Culm cutting	*B. balcooa*	Without treatment	96.5%	-	9	Gantait *et al.* (2018)
Culm cutting	*Bambusa nutans*	200 ppm IBA	-	76.25	-	Shirin *et al*. (2021)
Culm cutting	*B. vulgaris var. green*	200 ppm IBA	-	74.50	-	Shirin *et al*. (2021)
Culm cutting	*B. tulda*	200 ppm IBA	-	63.33	-	Shirin *et al*. (2021)
Culm Cutting	*B. bambos*	200 ppm IBA	-	23.3	-	Shirin *et al*. (2021)
Culm cutting	*Dendrocalamus strictus*	200 ppm IBA	-	35.0	-	Shirin *et al*. (2021)
Culm cuttimg	*Dendrocalamus stocksii*	750 ppm IBA	Sprouting percentage (54.50%)	-	-	Venkatesh and Kariappa, (2021)
Three nodded culm	*Schizostachyum dulloa* [Gamble]	NAA-500 ppm + IBA-200 ppm	62.35% after transplanting	66.67%	20.73	Pathak *et al*. (2018)
Branch cuttings	*b. vulgaris*	20% coconut water +80% NAA (500 ppm) for 36 hrs. of soaking	-	-	2.02	Setiawati *et al.* (2018)
Branch cuttings	*D. asper*	Without any treatment	Satisfactory	Satisfactory	Moderate	Hossain *et al.* (2018)
Branch cuttings	*D. asper*	0.8% IBA	Good	Good	Good	Hossain *et al.* (2018)
Branch cuttings	*B. tulda*	200 ppm IBA for 24 hrs.	-	73.60	-	Kumar *et al*. (2021)
Branch cuttings	*B. nutans*	200 ppm NAA for 24 hrs.	-	69.02	-	Kumar *et al.* (2021)

*Growth regulating substance.

double/triple nodes (59.6%) and those in February treated with 100 ppm IAA with double nodal cuttings (30.3%) gave the better rooting performance in *B. vulgaris* and *D. strictus*, respectively (Agnihotri and Ansari, 2000). Singh *et al.* (2002) treated culm and culm-branch cuttings of *Bambusa nutans* with auxins for adventitious rooting and observed that in both types of cuttings, adventitious rhizogenes was higher during April than May. However, culm cuttings exhibited markedly better adventitious root formation and growth, compared to culm-branch cuttings. Pattanaik *et al*. (2004) reported that the two noded branch cuttings of *Bambusa balcooa* Roxb. with rhizomatous swelling, treated with 200 ppm IBA gave 66.7 per cent success in rooting and rhizome formation and 100 per cent field survivals after two years of field planting. However, the culms produced were small and the intensive management practices like fertilization, irrigation and regular soil working shortened the establishment period. They opined that the possibility of combining macro-proliferation with branch cutting technique needs to be explored for fast multiplication of the species. The planting of *Gigantochloa levis* in the field showed that the polybag branch cuttings had a higher survival percentage (88.9%) than those of the bare root planting (41.7%) and the newly branch cutting planting (33.3%). Hossain *et al*. (2005) found highest rooting percentage (84%) was in IBA treated cuttings rooted in the tree shade followed by untreated cuttings under the same light regime (73.3%) and the lowest (60%) was under the deep shade. Study also indicated that the highest survival percentage was 95.2 in treated cuttings rooted in the open sun and the lowest was in case of deep shade without IBA treatment. Hossain *et al*. (2005) studied the rooting of *Bambusa vulgaris* Var. striata and the highest percentage of rooting (63.33%) was observed in the base cuttings (Rhizomatous) treated with 400 ppm IBA than in case of secondary branch cuttings. However, the highest rooting response was in samples treated with 2000 ppm IBA in *B. vulgaris*. Razvi and Nautiyal (2009) also observed maximum rooting in untreated juvenile branch cuttings of *Bambusa vulgaris* (green). However, Bakshi and Prakesh (2008) obtained best response survival (80%), rooting (75%) and sprouting (80%) was achieved in IBA 100 ppm treatment in *B. Vulgaris*, whereas control depicted 50% survival, 40% rooting and 50% sprouting. While Islam *et al.* (2011) observed highest rooting percentage in nodal leafy cuttings and the tip cuttings (56.67 and 51%, respectively) on treatment with 0.8 per cent IBA for *B. vulgaris*. The study by Kaushal *et al*. (2011) revealed that application of IBA enhanced the rooting and sprouting parameters of primary branches and those varied with species. In secondary branch cuttings, all the species except *B. vulgaris* failed to produce root. Adventitious rhizogenesis was influenced much by season in *B. nutans* and by season, nature of cuttings and IBA treatment in *B. tulda.* Culm cuttings exhibited superiority over culm-branch cuttings for rooting in both species. However, rooting of culm branch cuttings appeared to be a viable procedure for propagation in *B. nutans* (Singh *et al.*, 2011). It is recommended that single node culm and culm-branch cuttings in *B. nutans* and culm cuttings in *B. tulda* treated with 2 mM IBA during February to May can be employed for their clonal multiplication (Singh *et al.*, 2011). Razvi *et al.* (2015) reported maximum (63.33%) rooting in untreated cuttings in rainy season while minimum (21.83%) rooting were recorded in the cuttings treated with NAA 200 ppm in autumn. As regards to rooting hormones the rooting behaviour was in the order: Control>IBA500 ppm>IBA200 ppm>IBA100 ppm>IAA100 ppm>IAA500 ppm>IAA200 ppm>NAA100 ppm>NAA200 ppm>NAA500 ppm. When branch cuttings of *B. vulgaris* treated with different mixtures of NAA (500 ppm) and coconut water with various soaking duration, good growth in terms of leaf area, root and shoot length and number of roots reported for combination of 20% coconut water and 80% NAA, which is highest interaction effect with 36 hrs of soaking durations for earliest shoot emergence time of 2.02 days after planting (Setiawati *et al*., 2018). Primary and secondary branch cuttings of *D. asper* developed shoots, roots and rhizome even without any hormone treatment but application of IBA substantially increases survival %, rooting ability and shoot number (Hossain *et al*., 2018). Branch cuttings planted in the spring-summer season reported 63.39 percent and 72.68 per cent rooting ability in 2.0 cm diameter (thin) and >2.0 cm diameter (thick) *B. tulda* cuttings, respectively and 73.60 percent and 69.02 per cent rooting ability in *B. nutans* cuttings, respectively in study done by Kumar *et al*. (2021) (Table 1).

CONCLUSION

The review of literature indicated that different vegetative propagation methods can be successfully employed in bamboo propagation. Truly successful method for vegetative multiplication of bamboos has not been standardised yet. The propagation through branch cuttings in bamboos is gaining momentum and it is influenced by collection season, type of cuttings, growth regulators and their concentration. However, the literature on propagation through branch cuttings is limited. Some studies indicated that the success of rooting is not as high as in culm cuttings. Successful propagules must develop sufficient roots and rhizomes in the field so as to ensure their survival after planting. Most of the studies were limited only to the rooting ability which does not necessarily indicate the success of rooted cuttings after transplanting in the field. However, considering the availability in large numbers and ease in handling, even a moderate rooting percentage is enough as it is cost effective. As importance of bamboos is rising, this review will provide brief understanding of macropropagation techniques for mass production of planting material.

Conflict of interest

All authors decalre that they have no conflict of interest

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