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Green Gold Manga Bamboo (*Dendrocalamus stocksii*) for Commandable Profit from Cultivable Wasteland

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Abstract

Konkan farmers have traditionally cultivated manga bamboo in their farmlands for commercial purpose. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli has provided technical support that has enabled mass scale cultivation of this species in this region. The university has standardized the culm cutting vegetative propagation technology in Manga bamboo and has proactively installed nurseries in the farmers' fields and it has helped in increasing the area under manga bamboo. The university has standardized the spacing for manga bamboo along with harvesting, agroforestry system and has analyzed the diversity of this species along the Western Ghats. This species has been recommended for plantation as live fence, on bunds of Nagli and as block plantation. A biannual harvesting cycle for this species fetches 18-24 sticks per clump and each stick fetches ₹ 40 to 60. Thus, cultivation of manga bamboo is a promising avenue for doubling farmers' income.

Keywords: DFI, Manga bamboo, *Dendrocalamus stocksii*, Konkan

Introduction

Bamboo is a climate resilient crop as it has less effect on growth especially the climatic aberrations like erratic rain showers occurring in winter which affect fruit yield of horticultural crops in Konkan (Patil *et al*. 2016). After 90 years, the bamboo has legally ceased to be a tree with the government, amending the Indian Forest Act by classifying it as grass through Indian Forest (Amendment) Ordinance, 2017. This will promote cultivation of bamboo in non-forest areas by achieving "twin objectives" of increasing the income of farmers and also increasing the green cover of the country. The current demand of bamboo in India is estimated at 28 million tonnes. At global scale, although the country has 19 per cent share of the world's area under bamboo cultivation, its market share in the sector is only 6 per cent. There is wide scope to encourage bamboo cultivation in non forest areas especially through Agroforestry, involving it as a bund intercrop, boundary fence, as individuals in a homegarden and as block plantations. The planning commission of India has identified 18 commercially important bamboo species for plantation in farmers' fields across the country in the First phase of the National Bamboo Mission, with major contribution from the North East India and to some extent in the rest of the country (Planning Commission 2003). Manga bamboo (*Dendrocalamus stocksii*) is one amongst those prioritized bamboo species.

According to the Forest Survey of India, bamboo-bearing area in Maharashtra is 11,465 km^2 and Vidarbha produces over 90 percent of the total bamboo yield (FSI 2011). The prominent bamboo species of Maharashtra are Manvel (*Dendrocalamus strictus*), Katang or thorny bamboo (*Bambusa bambos*), Manga (*Dendrocalamus stocksii*) and Chivari (*Munrochloa ritchiei*). The Western Ghats part of Maharashtra provides ecological and climatic suitability for natural abundance and cultivation of bamboo. Amongst the various species, manga bamboo is the species of commerce ain Konkan region. This species is endemic along the Central

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Western Ghats of India (12° to 17.5° North latitudes).

Also being an extremely manageable bamboo species with multipurpose uses, it is used as stakes in horticulture, for making farm implements, as scaffolding, making furniture and handicrafts (Singhal and Gangopadhyay 1999). Culms of this species are thornless with non-prominent nodes with better cw:cd (culm wall thickness to culm diameter) ratio, making it the most suitable species for furniture and construction industry in the lower diameter (<5 cm) category and it attains a height of 7 to 12 m.

The diversity of manga bamboo along the region of its distribution has been documented and considerable variation was found in the culm diameter and height of this species. The height of solidness varied from 0.5 m to complete solidness, while the cw:cd ratio ranged between 0.3 to 0.5. These features are indicative that this species produces solid, stiff culms and has a multiple utility capacity under the < 5 cm category (Rane *et al*. 2013).

Truly being a domesticated species, it is incorporated in field bunds/farm boundaries and homestead component of Western Ghats (Viswanath *et al*. 2013, Rane *et al*. 2014). It is also recognized as a major traditional agroforestry system (TAFS) (Viswanath *et al*. 2018). In Konkan this species is predominantly present in Sindhudurg district and to a relatively lesser extent in Ratnagiri, Raigad, Thane and Palghar districts. It is also present on the leeward side of the Western Ghats especially in the tehsils of Satara, Pune and Kolhapur districts of Maharashtra.

According to experts (Bose 2017), Sindhudurg district presently produces around 5,000 truckloads of Manga bamboo every year. Each truckload consists of 1,200 to 1,400 poles. Each pole fetches between ₹ 50 and ₹ 80, meaning the bamboo farmers have a minimum annual turnover of ₹ 40 crore in SIndhudurg district. The total bamboo economy of the district could be around ₹ 50 crore (Bose 2017). Convincingly, this species can provide additonal farm income if it is incorporated in various upland landuse systems present in Konkan. A productive clump can fetch an annual income varying from ₹ 300 to 600 year^{-1} without any major agronomic interventions.

A peculiar feature of this species is that it does not produce viable seeds for regeneration (Beena *et al*. 2007) and is traditionally propagated through offset propagation technique. This offset technique has limitations in context with quantum, planting skill, cost and availability. The non-availability of planting material has hindered the mass-scale plantation programme

Table 1. Evaluation of bamboo species for cultivation in Konkan condition.

Sr. No	Bamboo species	Total no of culms clump^{-1}	Total no of new culms clump^{-1}	Diameter at 5th internode (mm)	Culm height (m)	Length of 5th internode (cm)
1	*Bambusa nutans*	8.13	2.33	42.13	5.15	32.67
2	*Bambusa tulda*	6.75	1.00	36.23	6.65	34.25
3	*Dendrocalamus strictus*	16.00	2.00	34.30	4.94	24.16
4	*Bambusa arundinacea*	15.14	3.53	59.00	7.88	26.44
5	*Bambusa polymorpha*	14.25	2.33	33.10	4.37	21.72
6	*Bambusa burmanica*	14.92	3.17	31.90	5.51	34.25
7	*Bambusa vulgaris*	4.00	1.50	32.20	5.32	25.20
8	*Dendrocalamus longispathus*	11.40	1.25	36.00	5.30	27.83
9	*Dendrocalamus stocksii*	20.82	3.88	37.87	5.39	26.46
10	*Yushania wightiana*	14.47	2.36	22.13	4.92	29.15
	SE +	2.80	0.68	12.00	0.48	1.78
	CD at 5%	8.31	NS	36.00	1.45	5.29

Table 2. Effect of planting density on production in Manga bamboo (pooled mean of 4 years)

Spacing	Number of bamboo sticks ha^{-1}	Height (m)	DBH (cm)	Gross returns ₹ ha^{-1}•yr^{-1}
3x3 m	22855	7.14	3.96	38092
4x4 m	14157	6.96	4.92	23595
5x5 m	9930	6.74	4.04	16550
6x6 m	7650	6.80	4.32	12750
SE±	256.81	0.17	0.26	
CD at 5%	791.40	NS	NS	

Table 3. Effect of shade, potting media, growth regulators and nursery practice on macro-propagation properties of Manga bamboo.

Shade (%)	Potting media soil:sand:fym	Growth regulator	Period in raised bed (months)	Sprouting (%)	No. of days required for sprouting	No. of nodes sprouted per three-nodal cutting	No. of shoots per node
75	1:2:1	Control	3	67.21	24	2.3	3.4
75	1:2:1	Control	6	67.21	24	2.3	6.9
75	1:2:1	IBA 1000 ppm	3	71.25	29	2.5	2.6
75	1:2:1	IBA 1000 ppm	6	71.25	29	2.5	8.1
75	1:2:2	Control	3	75.56	23	2.7	2.5
75	1:2:2	Control	6	75.56	23	2.7	7.3
75	1:2:2	IBA 1000 ppm	3	71.87	25	2.4	3.2
75	1:2:2	IBA 1000 ppm	6	71.87	25	2.4	5.3
50	1:2:1	Control	3	70.45	26	2.2	4.6
50	1:2:1	Control	6	70.45	26	2.2	6.2
50	1:2:1	IBA 1000 ppm	3	65.67	23	2.6	3.5
50	1:2:1	IBA 1000 ppm	6	65.67	23	2.6	6.7
50	1:2:2	Control	3	73.21	23	2.6	3.9
50	1:2:2	Control	6	73.21	23	2.5	7.6
50	1:2:2	IBA 1000 ppm	3	71.72	20	2.3	2.7
50	1:2:2	IBA 1000 ppm	6	71.72	20	2.3	8.1
			SE	3.5	1.9	ns	0.35
			CD	6.6	4.3		0.95

Table 4. Annual production of bamboo clumps grown under different agricultural crop combinations.

Treatments	Total number of culms clump^{-1}					
	Initial	1st year	2nd year	3rd year	4th year	5th year
T1 (Bamboo Sole@10x10m)	1	4	8	16	22	29
T2 (Bamboo@10x10m+Fingermillet)	1	3	24	44	60	77
T3 (Bamboo@10x10m + Sweet potato)	1	3	18	30	43	56
T4 (Bamboo Sole@12x10m)	1	1	7	14	21	28
T5 (Bamboo@12x10m + Fingermillet)	1	2	18	33	49	66
T6 (Bamboo@12x10m + Sweetpotato)	1	2	14	24	36	48
SEM	-	0.30	3.00	5.00	7.0	8.0

of Manga bamboo in the region. The development of intensive, farmer-friendly cultivation technology was necessary for the cultivation of this species.

Technological Interventions of DBSKKV

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli has provided several technological services for promoting cultivation of this species in the Konkan region.

Initially, a set of 10 bamboo species was evaluated for their potential for cultivation in Konkan conditions. It was concluded that Manga bamboo produced more number of culms clump^{-1} and had better annual culm production (Table 1). The Net Present Value (NPV) of 10 years old plantation was estimated to be ₹ 3,71,000 producing the highest B:C ratio of 2.99 among all species (Maharashtra SAUs 2014).

A subsequent experiment was initiated to understand the spacing and fertilizer requirements of this species when grown as a sole crop. It was reported that maximum returns for manga bamboo were attained when this species was planted at a spacing of 3 x 3 m (Table 2). Interestingly, height and diameter of the culms did not show any reduction due to high density. A fertilizer dose of 100 gUrea, 100 g SSP and 50 g MOP was recommended per clump along wih application of 5-10 kg FYM (Maharashtra SAUs 2006).

The propagation technique of this species was standardized after detailed evaluation of culm cutting method using different combinations of raised bed residence time, age of parent culm, number of nodes and growth regulators. The results of successful three-nodal cutting are shown in Table 3. It was recommended that Manga Bamboo be commercially macro-propagated using three-nodal culm cuttings of 6 month old stick under

Fig. 1. Culm cutting technology in Manga Bamboo

50 per cent shade in a raised bed (sand:soil:FYM::1:2:2) in December-January followed by transferring the proliferated individual shoots in polybags (Figure 1) after 6 months under Konkan conditions (Maharashtra SAUs, 2011).

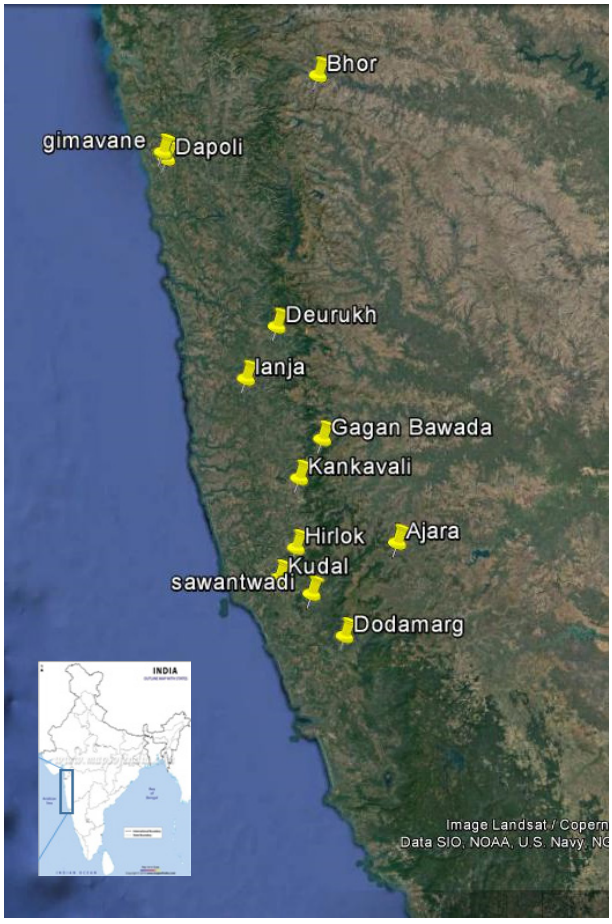

Fig. 2. RKVY Manga bamboo nurseries in Konkan region of Maharsthra.

Fig. 3. Milind Patil, a nursery owner who earned around ₹1.5 lakh per year by the

Simultaneously, manga bamboo based agroforestry experiments were initiated in 2007 at two spacings for bamboo (10 x 10 m and 12 x 10 m) with nagli i.e. fingermillet and sweet potato as intercrops. Among these systems, bamboo at a spacing of 10 x 10 m and intercropped with fingermillet produced early and better yield of bamboo (Table 4). Similarly, the yield of fingermillet was not altered significantly when intercropped within the bamboo clumps. The improved soil nutrient pools under the bamboo-fingermillet system indicated the sustenance of the system (Maharashtra SAUs, 2013). This technological intervention asserted that this species can be intercropped with seasonal agronomic crops especially in uplands.

A trial was initiated at Central Experimental Station, Wakavali in 2007 to understand the growth pattern of Manga bamboo. The annual emergence of culms was observed to range from 8 to 12 culms and the harvest potential ranged from 18 to 24 sticks per clump at alternate years (Shirke 2015). The harvesting age for this species was observed to be 2 years as there was no significant improvement in mechanical and physical properties thereafter (Ghanawat 2013). A study conducted to understand the supply chain of this species revealed that the farm gate price for a single stick in Sindhudurg district ranged from ₹ 40 to 60 (Bhuwad 2016). He also reported that this species had a marketable surplus of 83.90 percent and these sticks were supplied to Rajasthan, Gujarat, Andhra Pradesh

Fig. 4. A manga clump on farmer's field propagated through culm cutting technology.

and Karnataka.

The recently concluded developmental project supported by the Rashtriya Krishi Vikas Yojana (RKVY) resulted in training and on-field demonstration of manga bamboo propagation and cultivation technology at College of Forestry, Dapoli. Through this project more than 300 farmers have been trained in bamboo cultivation and 12 decentralized manga bamboo nurseries (Figure 2) were established along the Konkan with an annual production capacity of 3000 to 5000 saplings each by using the recommended manga bamboo culm cutting technology. Shri. Milind Patil is a post-graduate in forestry and was convinced with the economics of Manga bamboo and has established a manga bamboo nursery at Pinguli, Kudal, Dist. Sindhudurg under this project; in the first year of its inception, he has earned ₹ 1.5 lakhs and he may improve further (Figure 3). The saplings produced from these nurseries are helping farmers to cultivate this species on mass scale (Figure 4). The economic benefit of this species are encouraging and farmers are adopting this species on a large scale. Shri Rane Guriji from Kasal, Sindhudurg is one among the various beneficiaries of this project, who has cultivated manga bamboo in his farm as a sole species (Figure 5).

Way Forward

The farmers have reported that this species undergoes an unpredictable sporadic flowering and it usually results in mortality of the entire clump. This species requires a protocol to postpone flowering through rejuvenation technology. The present culm cutting technology is farmer friendly and is used for mass propagation in various parts of this region. Further, varietal improvement is also required for attaining quality and optimal yield in this species, the mass scale cloning of the identified accession is required through tissue culture technology.

Fig. 5. A beneficiary who planted 500 manga bamboo saplings produced through the culm cutting technology.

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References

Beena V. B., Seethalakshmi K. K. and Raveendran V. P. 2007. Flowering and Reproductive Biology of two endemic bamboo species of Western Ghats, *Dendrocalamus stocksii and P. ritcheyi*. J. Bamboo and Rattan, 6:11-19.

Bhuwad V. V. 2016. Marketing of Manga (*Dendrocalamus stockii*) in Sindhudurg district of Maharashtra. M. Sc. Forestry Thesis. Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli p. 60

Bose B. 2017. Konkan farms reap the bounty of bamboo. Village Square. (https://www.villagesquare.in/2017/12/18/konkan-farms-reap-bounty-bamboo/)

FSI 2011. Bamboo resources of the Country. In: India State of Forest Report - 2011. Forest Survey of India, Dehradun, pp 57-66.

Ghanawat A. M. 2013. Morphological, physiological and strength properties of *Dendrocalamus stocksii* at different Culm Ages : Implications for deciding maturity indices for the culms. M. Sc. Forestry Thesis. Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli p. 56.

Maharashtra SAUs. 2006. Spacing trial for cultivation of manga bamboo in Konkan. Recommendation of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli In: Proceedings of the Joint AGRESCO Meeting 2006.

Maharashtra SAUs. 2011. Culm cutting technology for propagation of Manga Bamboo. Recommendations of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli In: Proceedings of the Joint AGRESCO Meeting 2006.

Maharashtra SAUs. 2014. Evaluation of bamboo species under lateritic conditions. Recommendations of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli In: Proceedings of the Joint AGRESCO Meeting 2006.

Patil M. D., Indulkar S. R., Patil V. K and Rane A. D. 2016. Bamboo especially *Dendrocalamus stocksii* as a potential climate change mitigation resource in Konkan region of Maharashtra. In Kinhal A. G., Dharni A. K., Upadhyay A. P., Dugaya D. (Eds.) Climate Change Combating Through Science and

Technology. Bishen Singh Mahendra Pal Singh, Dehradun. 141-153.

Planning Commission 2003. Report of the Working Group on Horticulture and Plantation Crops. In XIIth Five Year Plan. Government of India. pp 1-264.

Rane A. D. Swomya C. and Viswanath S. 2014. Culm Emergence and Soil Properties in *Dendroclamus stocksii* under different landuse systems in Central Western Ghats. J. Tree Sci. 33: 48-52.

Rane A. D., Sowmya C. and Viswanath S. 2013. Diversity of the solid bamboo *Dendroclamus stocksii* along the Central Western Ghats of India. Proceedings of Int. Conf. Biodiversity. International Centre for Research and Development, Malabe, Srilankha. 20-27.

Shirke A. R. 2015. Variation in Clonal growth and Biomass Characteristics of Dendrocalamus stocksii in Konkan Conditions. M. Sc. Forestry Thesis. Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli p. 56.

Singhal, R. M. and Gangopadhyay G. B. 1999. Bamboos in India and database, Publication Division, ICFRE, Dehradun, 147 p.

Viswanath S., Joshi G., Somashekar P. V., Rane A. D., Sowmya C. and Joshi S. C. 2013. *Dendrocalamus stocksii* (Munro.): A potential multipurpose bamboo species for Peninsular India. IWST Technical Bulletin No.11.IWST publication, Bangalore.p. 20.

Viswanath, S., Lubina, P. A. Subbanna, S. and Sandhya M. C. 2018. Traditional agroforestry systems and practices: a review. Adv. Agri. Res. Tech. J. 2:18-29.