# BAMBOO FOR PAN INDIA PLANTATION PROGRAMMES – PRELIMINARY OBSERVATIONS FROM RECENT TRIALS

K. HARIDASAN* AND SALIL TEWARI**

## Introduction

Based on India's rich bamboo diversity and rich culture of bamboo utilization (Tiwari, 1994; Seethalakshmi and Kumar, 1998; Biswas, 1989) with greater potentials has triggered programmes nation wide for economic and industrial development through the use of bamboo in a most environmental friendly way. Large targets for plantation across the country have been fixed. The National Bamboo Mission (NBM) envisages covering over 1.7 lakh hectares. This will need over 70 million plants. There are also other department programmes and private initiatives. This has warranted prioritization of quality planting material. Obviously it is not enough to rely on seedlings of seed origin as these are available only for a few species like *Dendrocalamus hamiltonii, Bambusa bambos* and *Dendrocalamus strictus*. Though these are in the priority list there is limited application due to site specific issues, extraction difficulties and local preferences. Thus different institutes and organizations have started propagating bamboo by effective vegetative propagation methods with remarkable success. The products need to be tested for performance in different eco-geographic zones. Their performance and application for specific end uses also need to be evaluated. New techniques and machinery for industrial production has emerged that warrants specific bamboos on mass scale. Thankfully new propagation techniques that cover both micro- and macro-techniques in vegetative propagation are currently available and tested for different eco-regions that could be supportive in massive plantation efforts. There have been multilocation trials using a few important bamboos thus produced in different designated centres. The early results indicate the applicability of some species for pan-India cultivation while a few others are good for regional plantations. This paper looks at some of the issues related to bamboo propagation and plantation in the national and regional level. The opinions expressed are based on personal observations and interaction with experts and need not necessarily be the final word, particularly when the inferences made are based on personal observations.

## Prioritized species

National agencies involved in promoting bamboo in the country have prioritized species to be promoted based on their industrial and commercial application values. There are over 19 species so identified (Table 1). Most of them are clump-forming types suitable to grow in tropical and sub-tropical areas. Species

* National Mission on Bamboo Application, New Delhi. e-mail: haridasank@hotmail.com
** GB Pant Univ. of Agri. & Tech., Pantnagar (Uttarakhand). e-mail: saliltewari@yahoo.com.

**Table 1**

*List of NMBA prioritized bamboo species*

| Sl. No. | Species | Local Name |
|---|---|---|
| 1 | *Bambusa balcooa* | Bhaluka, Boro bans, Wamna, Beru, Barak, Leewa |
| 2 | *Bambusa bambos* | Kotoha, Illi mula, Kanta bans, Seneibo, Mungil, Mullu vedaru, Bongu vedaru |
| 3 | *Bambusa nutans* | Mokal, Malla, Makla, Kali, Badia bans, Uttang, Rungazumi |
| 4 | *Bambusa pallida* | Bijuli, Bakhal, Barwal, Tesero, Watoi, Pushee Loto |
| 5 | *Bambusa polymorpha* | Betwa, Bari, Narangi bans, Jama betwa |
| 6 | *Bambusa tulda* | Jati, Kiranti, Wati, Makar, Mirtinga, Rowthing, Paoshiding, Ying, Deobans |
| 7 | *Bambusa vulgaris* | Basini bans, Bakal, Lam sameibi, Vairua, Sundrogai, Ketuna, |
| 8 | *Dendrocalamus brandisii* | Bulka, Wanan, |
| 9 | *Dendrocalamus giganteus* | Maipo, Bhalo bans, Mari bol, Sadiya kako |
| 10 | *Dendrocalamus hamiltonii* | Kako, Fonay, Pecha, Taqma, Unep, Wanoke, Pao, Phulrua, Maggar |
| 11 | *Dendrocalamus strictus* | Lathi bans, Kanka kara, Sandapa veduru, Karal, Nakur bans, Kallan mula, Kurathi mula, Narvel, Salia, Kal mungil |
| 12 | *Melocanna baccifera* ( = *M. bambusoides*) | Mautak, Tarai, Arten, Muli, Watrai, Moubi, Turiah |
| 13 | *Ochlandra travancorica* | Eera, Eatta, Oda, Odai, |
| 14 | *Pseudoxytenanthera stocksii* = *Oxytenanthera stocksii* = *Dendrocalamus stocksii* | Konda, Oor-shema, Uyi, Chivari, Mes |
| 15 | *Schizostachyum dullooa* | Dolo, Tolluwa, Rawthla |
| 16 | *Thyrsostachys oliveri* | Kanakaich, Kerakwa |
| 17 | *Dendrocalamus asper* | Asper |
| 18 | *Guadua angustifolia* | Guadua |
| 19 | *Phyllostachys pubescens* | Moso |

of *Phyllostachys* and *Melocanna* are non-clump forming ones. Three or four species like *P. pubescens, Guadua angustifolia* and *D. asper* are exotics with great potential in the country.

## Plantations and trials

There have already been many plantation ventures that have come up in the country in different regions and

locations. Much of these nationally supported projects have been raised through seeds available from commercial sources particularly those located in Dehra Dun. For some species like *Bambusa bambos* and *D. strictus* the seeds are also locally collected according to their distribution. *B. tulda* was reported to have been flowered a couple of years back while in some pockets *D. giganteus* and *Arundinaria maling* and a few others flowered during 2006-07 (Taj, 2006; Sharma, 2006; Naithani *et al.,* 2007a, b). *Melocanna baccifera* on the other hand has been flowering for the last three years in North-East region as predicted. However, there has not been any large scale plantation of these species with seeds that are thus available. The traditional practice of rhizome/sucker plantation is usually practiced for raising homestead plantations. However for two species viz. the Apatani bamboo in Arunachal Pradesh and for *Thyrsostachys oliveri* in Tripura this traditional practice using rhizome/ sucker is the only method of planting. With the support from National Mission on Bamboo Application (NMBA), in different organizations there are a few Vegetative Propagation Centres (VPC) (Table 2) that have come up based on the techniques of culm cutting and branch cutting propagations for selected species. However there is not much effort to screen and select the clumps for superiority for use in large scale propagation though in few centres these have been practiced. It appears because of the seed availability species like *B. bambos* and *D. strictus* are tried in most regions even if the bamboos are not occurring in their area. Due to the efforts of different Tissue Culture laboratories in the country like the Grow More Biotech Ltd., TERI, Sheel Biotech, Aryave Biotech Pvt. Ltd. etc., more and more Tissue Cultured plants are popular in plantation ventures. The Tissue Culture plants are more common in case of *B. balcooa, D. asper, B. nutans, B. tulda* and *D. hamiltonii*.

A nationally coordinated location trial for a few commercially important bamboo species is in progress covering different regions of the country which is coordinated by the G.B. Pant University of Agriculture & Technology, Pantnagar (Uttarakhand). The centres involved in the bamboo location trials are detailed in Table 3. The species tried in each centre is given in Table 4.

**Observations**

Though the experiments are of recent origin and plantations that have come up are also not so old, a conclusive recommendation cannot be derived about the suitability and performance. However early indications suggest some trends that are as given in Table 5. It is not possible to clearly recommend the species for the entire nation due to the prevailing agro-climatic variations. Therefore regional plant suitability had to be taken care of which will be a more realistic approach. An attempt has been made in this direction here. Thus we can see a few species that can be grown in most regions while others are only to be tried in specific regions. The list in Table 5 is thus divided into two that is species suitable to grow across the country and those that can be tried in separate regions only which also include those that are suitable to grow only in high altitudes.

**Discussion**

Plantation trials have been initiated

**Table 2**

*NMBA-supported existing Vegetative Propagation Centres (VPC) network in India*

| Sl. No. | Location | Implementing Agency |
|---|---|---|
| 1 | Bangalore (Karnataka) | Tree improvement & Propagation Division, Institute of Wood Scince & Technology, 18th Cross, Malleswaram, Bangalore - 560003 |
| 2 | Chessa, Papum Pare Distt. (Arunachal Pradesh) | State Forest Research Institute, Van Vihar, P.B.No 159, Itanagar - 791111. |
| 3 | Palampur (Himachal Pradesh) | Institute of Himalayan Bioresource Technology, Post Box 6, Palampur - 176061 |
| 4 | Pantnagar (Uttarakhand) | Bamboo Coordination Centre, G B Pant University of Agriculture & Technology, Pantnagar - 263145. |
| 5 | Basishta, Guwahati (Assam) | State Silviculturist, Forest Complex, Basishta, Guwahati - 781029 |
| 6 | Karigaon, Kokrajhar, BTC, Assam | Divisional Forest Officer, Haltugaon, Bodoland Territorial Council, Kokrajhar - 783370 |
| 7 | Lathao, Lohit District (Arunachal Pradesh) | Divisional Forest Officer, Namsai Forest Division, Lohit District. |
| 8 | Zunheboto (Nagaland) | Nagaland Bamboo Development Agency, Red Cross Building, P.R. Hills, Kohima. |
| 9 | Hatipara, Agartala (Tripura) | Tripura Bamboo Mission, (Deptt. of Industries and Commerce) ITI Road, Indranagar, Agartala, West Tripura |
| 10 | Kalyani, Nadia Distt. (West Bengal) | B.C. Krishi Viswavidyalaya (BCKV) Kalyani - 741235, Distt. Nadia. |
| 11 | Thanjavur (Tamil Nadu) | Bamboo Extension and Enterprise Development Programme (BEED), Forestry Extension Centre, (Opp. RTO), Pillaiyarpatty (PO), Thanjavur - 613403 |

in different centres of the country using most of the species listed in Table 5. Since the plots have not come to harvestable size in many cases, it will be difficult to predict the performance conclusively. However the early indications are such that definite trends are visible. Data recorded in nine centres for the top seven species are tabulated in Table 6. However it should be kept in mind that this is only

**Table 3**

*Bamboo Location Trial Project (BLT) – Nodal Centres*

| Sl. No. | Name of the Centre | Agro-ecological Zone |
|---|---|---|
| 1 | Allahabad Agriculture Institute (Deemed University), Naini, Allahabad (Uttar Pradesh). | East Zone |
| 2 | Bidhan Chandra Krishi Vishwavidyalaya, Nadia (West Bengal). | East Zone |
| 3 | GB Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). | North-West plains Zone/Western Himalayan zone |
| 4 | Uttarbanga Krishi Vishvavidhyalya, Pundi Bari (West Bengal). | East zone |
| 5 | Institute of Forest Genetics and Tree Breeding, Coimbatore (Tamil Nadu). | Southern plateau |
| 6 | Kerala Forest Research Institute, Peechi, Trichur (Kerala) | Southern plateau: |
| 7 | Institute of Himalayan Bioresource Technology, Palampur (Himachal Pradesh) | Western Himalayan Zone |
| 8 | Institute of Wood Science and Technology, Bangalore (Karnataka) | Southern plateau |
| 9 | Arid Forest Research Institute (AFRI), Jodhpur (Rajasthan) | Western Zone |

preliminary observations based on 2 years and the trend may change as the bamboos mature. The ocular observations makes it clear that though *B. tulda* and *D. asper* are having more culms in field they are comparatively slender. *D asper* is dwarf too.

The observations based on visual estimate are discussed below for each species.

*Bambusa bambos* is thriving nearly uniformly well in all areas. *B. bambos* has large culms, but its profuse thorny branches make it difficult to extract unless properly pruned and managed from the beginning. This species yields seeds frequently which will enable macroproliferation of the seedlings produced out of these seeds, that is an added advantage. Due to its thorny and thick nature this is a preferred species for the perimeter fencing.

Similarly, *Bambusa balcooa* grows very well in all the trial areas indicating their suitability for country wide plantation. They are also comparatively easy to propagate (Ahlawat and Singh, 2000). The next species that could be tried across the country are *B. tulda* and *B. nutans*. However they are best seen growing in more humid locations.

*Dendrocalamus asper* on the other hand shows a trend that it may not be suitable for drier regions. This difficulty can be over come by adequate supply of irrigation water. *D. giganteus* too falls in this category.

*Dendrocalamus strictus* on the other hand can be better grown in drier areas.

**Table 4**

*Bamboo Species tried in Bamboo Location Trials*

| Sl. No. | Name of the Centre | Bamboo species selected |
|---|---|---|
| 1 | Allahabad Agriculture Institute (Deemed University), Naini, Allahabad (Uttar Pradesh). | *CS+, Bambusa vulgaris, Dendrocalamus giganteus* |
| 2 | Bidhan Chandra Krishi Vishwa Vidyalaya, Nadia (West Bengal). | *CS+ Bambusa vulgaris, Thyrosostachys oliveri* |
| 3 | GB Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). | *CS+, Bambusa vulgaris, D strictus* |
| 4 | Institute of Forest Genetics and Tree Breeding, Coimbatore, Koveilpetty (Tamil Nadu) | *CS+ Bambusa vulgaris, Dendrocalamus giganteus* |
| 5 | Kerala Forest Research Institute, Peechi (Kerala) | *CS+, Guadua angustifolia, Ochlandra travancorica* |
| 6 | Institute of Himalayan Bioresource Technology, Palampur (Himachal Pradesh) | *CS+ Arundinaria falcata , Phyllostachyus pubescens* |
| 7 | Uttarbanga Krishi Vishvavidhyalya, Pundi Bari (West Bengal). | *CS+, Bambusa vulgaris* |
| 8 | Arid Forest Research Institute, Jodhpur (Rajasthan). | *CS+ Bambusa vulgaris, Dendrocalamus giganteus,* |
| 9 | Institute of Wood Science and Technology, (Main campus) Bangalore (Karnataka). | *CS+ Dendrocalamus giganteus, Dendrocalamus stocksii (Pseudoxytenanthera stocksii, Oxytenanthera stocksii)* |
| 10 | Institute of Wood Science and Technology, Bangalore (Karnataka) (Forest Research Center, Hyderabad, A.P.) | *CS+, Dendrocalamus stocksii, Guadua angustifolia* |

CS = *Bambusa bambos, Bambusa tulda, Bambusa nutans, Bambusa balcooa, Dendrocalamus hamiltonii, Dendrocalamus asper* (as common to all species)

In more wet North-East India the performance of this species is poor. The availability of seeds regularly and adaptation to drier regions make this a favourite species for planting on larger areas. But due to its congested and curved culm growth certain industries may not find it ideal for them.

*Bambusa vulgaris* (green) is a species that is again emerging as a choice for cross country plantations. The growth is comparable to *B. balcooa* and has tall shining large culms. However in drier regions the culms tend to be comparatively smaller and thicker. The easy nature of its vegetative propagation make it favoured by nurserymen and in the subsequent plantation, survival rate is higher.

*Dendrocalamus hamiltonii* is also found more adapted to a wider range of

**Table 5**

*Species performance at national and regional level.*

| Sl. No. | Species | Local name | Locations tried | Remarks |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| A. Species that have country-wide planting prospects : | | | | |
| 1 | *Bambusa bambos* | Kanta bans | Throughout the country | Thriving well in all locations. Can tolerate even dry areas. |
| 2 | *Bambusa balcooa* | Bhaluka | Throughout the country | Doing well in all trials |
| 3 | *B. nutans* | Mokal | Kerala, Tamil Nadu, Karnataka, Delhi, NE Region, Himachal Pradesh, Uttarakhand | Growing well in all areas where tried |
| 4 | *B. tulda* | Jati | Kerala, Tamil Nadu, Karnataka, West Bengal, NE India, Himachal Pradesh, Uttarakhand. | Grows well in most parts of the country. Best growth in Western Ghats and North-East. |
| 5 | *B. vulgaris* | | Kerala, Tamil Nadu, Uttar Pradesh, West Bengal, Uttarakhand, Rajasthan | Grows well in all the locations. |
| 6 | *Dendrocalamus hamiltonii* | Kako | Kerala, Tamil Nadu, Karnataka, West Bengal, North-East India, Himachal Pradesh, Uttarakhand | Grows well all over but better growth in Western Ghats, West Bengal, North-East and Himachal Pradesh. |
| 7 | *D. giganteus* | Giant bamboo | Kerala, Karnataka, North-East India, Uttarakhand | Best growth in NE India and Western Ghats. However it can be grown with care in other areas like Delhi too. |
| B. Species that have regional planting prospects : | | | | |
| 8 | *D. asper* | Asper | Kerala, Tamil Nadu, Karnataka, West Bengal, NE India, Himachal Pradesh, Uttarakhand | Best in Kerala, North-East and Uttarakhand. Needs more water and manure. |
| 9 | *D. strictus* | Male bamboo | All over India | Poor growth in high rainfall areas as in NE India. |

*Contd...*

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 10 | *Guadua angustifolia* | Guadua | Kerala, Karnataka, Arunachal Pradesh | Reportedly growing better in coastal area of Kerala |
| 11 | *Pseudoxytenanthera stocksii* | | Kerala, Karnataka, Maharashtra | Best in North Karnataka, Maharashtra |
| 12 | *Phyllostachys pubescens* | Moso | Arunachal Pradesh, Assam, Himachal Pradesh | Best in sub-temperate zones in Arunachal Pradesh |
| 13 | *Melocanna baccifera* | Muli | Tripura and other NE States, Kerala, Maharashtra, Uttarakhand. | Doing well in Kerala and Maharashtra outside NE. |
| 14 | *Thyrsostachys oliveri* | Kanakaich | West Bengal, Kerala, | Growth is very good. Even in other locations like Delhi, Arunachal Preadesh etc. |
| 15 | *Ochalandra travancorica* | Oda | Kerala | Recent trials in NE India in Assam and Arunachal Pradesh are doing extremely well. |

**Table 6**

*Performance of the top 7 species across 9 centres covering Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Rajasthan, Uttarakhand, Uttar Pradesh and Himachal Pradesh after two years of planting.*

| Sl. No. | Species | Av. Survival (% ) | Av. Height (cm) | Av. Culm production (nos.) |
|---|---|---|---|---|
| 1 | *Bambusa tulda* | 90.30 | 129.17 | 17.50 |
| 2 | *Bambusa balcooa* | 91.08 | 245.88 | 7.14 |
| 3 | *Bambusa nutans* | 88.14 | 209.30 | 8.10 |
| 4 | *Bambusa vulgaris* | 97.40 | 214.58 | 5.50 |
| 5 | *Bambusa bambos* | 77.41 | 124.80 | 10.30 |
| 6 | *Dendrocalamus hamiltonii* | 70.00 | 190.56 | 7.39 |
| 7 | *Dendrocalamus asper* | 65.79 | 86.97 | 14.89 |

conditions. However they are at their best in more humid regions. There is another issue with *D. hamiltonii* that is regarding their identity of different provenance. The bamboos of Western Himalayan region (as in Himachal Pradesh) which are referred as *D. hamiltonii* are recognized as *Dendrocalamus somdevai* (Naithani and Pal, 2001). The issue is yet to be conclusively resolved. The Western Himalayan ones are more thick and durable compared to the North-eastern counterparts. Morphological differences can also be seen.

*Phyllostachs pubescens* is currently

introduced into the country through the IHBT Palampur (Himachal Pradesh) which has mastered their nursery production. However the best growth of this species is seen in hills between an altitude range of 1,000 m to 2000 m amsl. Rhizome segment separation and sucker planting are the possible options now with its limited population. The seedling stock can be macroproliferated. In Arunachal Pradesh at Yachuli, Lower Subansiri District the species has well adapted and reached sizes of 34 cm girth and vigourous growth is observed.

*Guadua angustifolia* on the other hand is not found encouraging in hills and dry regions. They are seen better for riparian locations in more wet and warm regions. Their growth near coastal areas are also said to be very good. (Syam V., Pers. Comm.). Thus this may perhaps be good for Western Ghats region and North-East India, particularly Assam and adjoining foothills. Further trial are required for recommending this species.

*Thyrsostachis oliveri*, which is grown in Tripura for its near solid culms are tried in most part of the country. The propagation is mainly through suckers. They are doing well even in Delhi conditions. Recent trials in West Bengal as yielded very good results. The plantation of this species is tried at closer spacing as practiced in the State of Tripura traditionally. In Kerala Forest Research Institute, Peechi the growth is excellent.

*Pseudoxytenanthera stocksii* is another near solid species that are currently tried in North Karnataka and Maharashtra. This species tried in Kerala is also doing well there. Perhaps it should do well in the North-East as well.

Recent trials of the Muli bamboo (*Melocanna baccifera*) which has produced huge quantities of seeds in Tripura, Mizoram and other NE States have been tried in Maharashtra and is said to be doing extremely well. Similar good growth is also observed at Uravu, Wyandu, Kerala.

The above discussion has given an indication to the performance of the cited species for planting in different parts of the country. Another important factor that needs to be considered while selecting the propagation material is their genetic superiority. Not much work is available till recently. The works in bamboo improvement in the State of Arunachal Pradesh (Beniwal and Singh, 1988; Haridasan *et al.,* 1987) and the works from FRI, KFRI, etc are of pioneering nature in selecting best gemplasm for different species. The GBPUAT at Pantnagar has started a massive programme for selecting superior clones. Using these selected material for propagation and plantation is bound to produce perceptible improvement in the productivity of or bamboo farms.

**Conclusion**

In India massive plantation programmes for bamboo have been started. A few species from the large bamboo diversity have been identified for promotion. Since the country has a wide ranging agroclimate and distribution of bamboo is not uniform in nature, an effort should be made to know which are the bamboos that can be cultivated across the country and the ones that has limitation to the region only. Seven species which include *Bambusa balcooa, B. bambos, B. nutans,* etc are identified as possible candidates for pan India

cultivation and eight species which include *Dendrocalamus asper, Phyllostachys pubescens, Guadua angustifolia*, etc are listed as probable for regional plantation ventures. Vegetative propagation is the ideal option to meet the large demand of quality planting material. For the production of Quality Planting Material (QPM), a network of vegetative propagation centres has been established in India. If these centres produce plants from superior clones and plantations are raised following the findings of the multilocation trials, the effort is going to yield valuable results and ensure higher productivity.

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## SUMMARY

**National Bamboo Mission envisages bamboo plantations over more than 1.7 ha which will need more than 7 crore plants. It is not enough to rely upon seedlings alone to meet this requirement and several organizations have started experimenting propagation by vegetative methods. These experiments have not finally concluded, but trends noticed in them can be predicted to some extent. Besides new techniques and machinery have also to be evaluated. Basing on these trends of bamboo have also to the evaluated. Basing on these trends seven bamboo species which include *Bambusa balcooa, B. bambos, B. nutans* etc. have been identified for pan Indian large scale plantations while 8 other species which include *Dendrocalamus asper, Phylostachys pubescens, Guadua angustifolia* etc. can be tried for regional plantation.**

अखिल भारतीय रोपवन कार्यक्रमों के लिए बांस–विगत में किए परीक्षणों पर कुछ प्रारम्भिक पर्यवेक्षण

के० हरिदासन व सलिल तिवाड़ी

**सारांश**

राष्ट्रीय बांस मिशन ने अनुमान लगाया है कि 1.7 हेक्टे० से अधिक क्षेत्र में बांस रोपवन लगाने होंगे जिनके लिए 7 करोड़ से ज्यादा पौधों की जरूरत पड़ेगी। इतनी अधिक पौध के लिए केवल बीज पौधों पर निर्भर करना पर्याप्त नहीं है और अनेक संगठनों ने वर्धी उपायों द्वारा पौधे उगाना संपरीक्षित करना आरम्भ कर दिया है। इन संपरीक्षणों के अन्तिम निष्कर्ष तो अभी नहीं मिले परन्तु कुछ सीमातक इनकी प्रवृतियां अवश्य बताई जा सकती हैं। इनके अतिरिक्त नई प्रावधियों और मशीनरी आदि का मूल्यांकन भी किया जाना शेष है। इनकी प्रवृतियों के आधार पर बांसों की सात जातियां जिनमें *बैम्बूसा बाल्कुआ, बै० बैम्बोस, बै० न्यूटंस* आदि सम्मिलित है अखिल भारतीय बड़े–बड़े रोपवन लगाने के लिए पहचानी गई है जबकि 8 अन्य जातियां जिनमें *डेण्ड्रोकैलेमस एस्पर, फायलोस्टैकिस प्युबिसेंस, गुआडुआ एंगस्टिफोलिया* आदि आती है, ऐसी है जिन्हें क्षेत्र विशेष में ऐसे रोपवन लगाने को उपयोग में लाया जा सकता है।

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