Print : ISSN 0970-7662

**Journal of Tree Sciences**
*online available at www.ists.in*

Volume 33 No. 2 December, 2014

# Culm Emergence and Soil Properties in *Dendroclamus stocksii* under different landuse systems in Central Western Ghats

**A. D[1]. Rane, C Sowmya[2] and S. Viswanath[2]**

*[1]Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India; [2] Institute of Wood Science and Technology, 18th Cross, Malleshwaram, Bengaluru.*

**Keywords**:

*Dendrocalamus stocksii,* land-uses, Western Ghats.

## ABSTRACT

*Dendrocalamus stocksii* (Munro.) a potential bamboo species grows under natural condition in Central Western Ghats. In the present study an attempt has been made to explore (i) number of new culms emerged per clump and (ii) soil properties under bamboo canopy across five different land-uses in Central Western Ghats. Among the five land-use types evaluated, homestead, farm boundaries and mixed forest component exhibited production of higher new culms per clump. Available soil nitrogen and organic carbon was better among bamboo clumps present as mixed forest component. It may be concluded that this species is widely accepted by the farmers in this region and is luxuriantly present in different landuse systems.

## INTRODUCTION

Bamboo forms an important component in traditional agroforestry systems in various parts of India and is grown either in the form of grove where bamboo is grown as pure or mixed with other vegetation or as home garden component (Nath and Das 2008). Bamboos in home garden are principally managed for household purposes and in exclusive bamboo block plantation for commercial purposes. In homegardens, where coconut is the major component especially in Kerala any subcomponents or diversity of trees, plantation crops and herbaceous annuals and perennials and or/with bamboo are common (Nair and Sreedharan, 1986). Such home gardens and other landuse types also prevail in humid tropics of Central Western Ghats with bamboo as one of the perennial component.

*D. stocksii* is endemic to Central Western Ghats and is found in Karnataka, Goa, Kerala and Maharashtra where its natural distribution is mostly confined to the banks of streams as it requires well drained deep soil. *D. stocksii* is cultivated in the coastal belts of Karnataka (Seethalakshmi and Mukteshkumar 1998) and is primarily planted around the arecanut gardens and paddy fields in many parts of Northern Karnataka (Devar 2000). This species is solely domesticated in the South Konkan and Goa regions of Central Western Ghats where it forms an important component of homesteads and is scattered along farm boundaries. Prominent land use systems in South Konkan (Maharashtra) and Goa with bamboo are, *D. stocksii* as block plantations (spacing of 4x4 m), and on boundaries of rice and fingermillet fields. Along with it, this species is also present as component of mixed forest tree species on private lands and as a component of homegardens. Growth in bamboo is an annual phenomenon with increasing number of thicker and taller culms until maximum stature and productivity for the species is reached under specific local conditions of weather and soil fertility

which may range from 3-5 years (Farrelly, 1984). In the present study an attempt has been made to explore (i) number of new culms emerged per clump and (ii) soil properties under bamboo canopy across five different land-uses in Central Western Ghats.

## MATERIALS AND METHODS

The study area comprised of Goa and South Konkan (Ratnagiri and Sindhudurg districts) region of Western Ghats. The region contain lateritic soil type with an annual precipitation of >3000 mm. In this region paddy (*Oriza sativa*), fingermillet (*Eleusine coracana*) and groundnut (*Arachis hypogaea*) is cultivated in low-land farms and cashew (*Anacardium occidentale*), mango (*Mangifera indica*) orchards along with mixed forest landuse types are prominent in uplands. Culm recruitment (emergence) in *D. stocksii* usually occurs between July and September in monsoon and is harvested after 3 years.

A total of 43 matured healthy clumps (a clump devoid of dried, borer infested culms and in which both old and new culms had same diameter) of *D. stocksii* were randomly selected from different villages in Goa and South Konkan (Maharashtra) and evaluated to estimate annual recruitment of culms during January to May, 2013 (culm emergence is complete by September and new culms have attached culm sheaths). The clump diameter was measured at base by taking the average of the lowest and highest diameter, while clump height was measured using a clinometer. Total number of standing culms along with the quantity of current year emergents (Culms with sheaths) was recorded. Five random culms each from matured and new emergent categories were evaluated for culm basal diameter using digital vernier caliper. One culm each from the identified clumps was destructively sampled from the base to measure its total height and commercial height (height upto 20 mm culm diameter). Culm wall thickness and diameter was measured with a vernier caliper at a cross-cut portion of the culm in the middle. Simultaneously, culm wall thickness to diameter ratio was estimated accordingly and land-use type in which the *D. stocksii* clump was present was also recorded.

Soil properties of bamboo under the different land use types were assessed by collecting soil samples from the clump rhizosphore. Soil was sampled at a depth of 0-15 cm using a spade and collected in polybags. This soil was processed and analysed for pH as per the procedure described by Jackson (1973). Soil organic carbon was estimated by wet digestion method of Black (1965) and available nitrogen was determined by alkaline permanganate method as described by Subbaiah and Asija (1956). Available phosphorus in the soil was determined by Bray and Kurtz method as described by Jackson (1973) and available potassium was extracted by using neutral normal ammonium acetate and the content was determined by aspirating the extract into flame photometer (Jackson 1973).

All the evaluated clump parameters and soil properties of landuse types was calculated using analysis of variance (GLM procedures). As number of replications (clumps) in each landscape was unequal, DMRT (Duncans Multiple Range Test) was performed by estimating critical range for each landuse type based on their number of means. Karl Pearson's correlation was conducted on all the culm and soil parameters. The data was analyzed using SAS 9.3 statistical software and the culm count data was log transformed before statistical analysis.

## RESULTS AND DISCUSSION

The 43 clumps evaluated in South Konkan and Goa part of Western Ghats were distributed amongst five landuse systems *viz.* Homesteads, Farm boundaries, Live fence, Mixed Forest Component and Block Plantations (Table 1). Most of the clumps were scattered as homestead components in this region, implying its domestication and wide utilization potential. Preference of bamboo species in homegardens depends upon branching, architecture and utilization (Nath et al. 2001). Singhal and Gangopadhyay (1999) have earlier reported that *D. stocksii* is an extremely manageable species with great economic and ecological importance, finding large scale utilization in scaffolding, paper and pulp, crafts, construction, making baskets, umbrella handles and poles. Nair and Sreedharan (1986) have mentioned that farmer prefer bamboo

**Table 1.** Composition of landuse types comprising D. stocksii in Central Western Ghats

| Landuse type | Composition of the Landuse type | Number of clumps evaluated |
|---|---|---|
| Block Plantation | *D. stocksii* planted at a defined spacing of 4 to 5 m usually on the uplands. | 5 |
| Farm boundary | Clumps are scattered along the farms boundaries as single or multiple individuals. | 5 |
| Mixed forest component | Clumps co-dominate with local tree species of tropical moist deciduous forest type. | 5 |
| Home stead | Scattered within the homestead boundary, usually as a single clump on boundaries. | 23 |
| Live fence | Clumps are densely planted in single row as boundary around the homestead, cashew plantation and farms. | 5 |

**Table 2:** Culm and clump parameters of D. stocksii present in different land use systems in Central Western Ghats

| Landuse systems | No. of new culms per clump | Number of old culms per clump | Average clump diameter (m) | Clump height (m) | Culm height (m) | Commercial culm height (m) | Basal diameter of new culms (mm) | Basal diameter of old culms (mm) | Culm diameter to culm wall thickness ratio |
|---|---|---|---|---|---|---|---|---|---|
| Block Plantation | 8[b] | 20 | 2.14[ab] | 8.70[b] | 10.04[b] | 7.16[b] | 43.07 | 43.21 | 0.29 |
| Farm boundary | 20[a] | 37 | 2.96[ab] | 8.80[b] | 10.40[b] | 8.42[ab] | 45.01 | 46.27 | 0.30 |
| Mixed forest component | 16[a] | 36 | 3.14[a] | 10.24[ab] | 11.40[ab] | 7.95[ab] | 45.46 | 45.15 | 0.32 |
| Home stead | 18[a] | 43 | 2.62[ab] | 9.45[b] | 10.66[ab] | 7.49[b] | 44.28 | 45.76 | 0.32 |
| Live fence | 7[b] | 24 | 2.02[b] | 11.78[a] | 13.02[a] | 9.93[a] | 46.57 | 49.18 | 0.29 |
| | | N. S. | | | | | N.S. | N. S. | N.S. |

along with other tree species as perennial component in their homestead in Kerala, which has a similar kind of climatic and ecological conditions as that of Konkan belt.

Recruitment of new culms among clumps present in various landuse systems varied significantly (Table 2). Clumps present in homestead, farm boundaries and as a mixed forest component produced more number of new culms per clump (16 – 18 culms per clump). The clump diameter of *D. stocksii* present as live fence was less (2.02 m) than that of the clumps present in mixed forest landuse type (2.02 m). Clumps present as live fences had better culm height (13.02 m) followed by the bamboos present in home stead (10.66 mm) and mixed forest land use type (11.40 mm). Usually, these landuse systems offer

Table 3: Soil nutrient status of different landuse systems containing D. stocksii in Central Western Ghats

| Landuse systems | Available Nitrogen (Kg ha $^{-1}$) | Available Phosphorus (Kg ha $^{-1}$) | Available Potassium (kg ha $^{-1}$) | Organic carbon (percentage) | pH |
|---|---|---|---|---|---|
| Block Plantation | 196.52$^{ab}$ | 5.58 | 951.60 | 6.73$^{ab}$ | 4.93 |
| Farm boundary | 146.35$^{b}$ | 5.36 | 1400.40 | 6.75$^{ab}$ | 4.96 |
| Mixed forest component | 221.61$^{a}$ | 7.84 | 1774.10 | 8.43$^{a}$ | 5.18 |
| Home stead | 197.41$^{ab}$ | 7.53 | 918.80 | 5.74$^{b}$ | 4.92 |
| Live fence | 137.98$^{b}$ | 5.829 | 980.20 | 6.70$^{ab}$ | 5.02 |
| | | N. S | N. S | | N. S. |

overstorey canopy of tree species which provide beneficial microclimate facilitating growth of culms. Ried et al. (1991) observed that culms under-storey of evergreen and deciduous forest produced thicker and taller culms. However, other culm diameter parameters did not vary among various land use systems.

Among the soil nutrient properties, available nitrogen and organic carbon varied among land use systems. Soil beneath the bamboo clumps present in mixed forests contained more available nitrogen (221.60 kg ha$^{-1}$) and organic carbon (8.43 percent) (Table 3). There existed no significant correlation between soil properties and culm growth parameters. Improvement in nitrogen levels is associated with increase in organic carbon litter to the incorporation of various tree crop combinations by adding above and below ground organic matter (Jose, 2009).

It may be concluded that this species is accepted by the farmers and are incorporating it as a component with other crop types. These tree based landuse systems benefit from the growth of *D. stocksii* by facilitating the production of more number of thicker and taller bamboo culm sticks. This may be attributed to the improvement in the fertility of soil and growing conditions. Hence, it is always better to undertake plantation of this species under already existing forest canopies, without undertaking clear-felling of existing flora or land developmental activities.

**REFERENCES**

Black C. A. 1965. *Methods of Soil Analysis Part II*. America Society of Agronomy, Inc. Madison, Wisconsin, U. S. A.

Devar K.V. 2000. *Improvement studies in Bamboo*. Indian Council of Forestry Research and Education, Dehradun.

Farrelly, D. 1984. *The Book of Bamboo*. Sierra Club Books, San Francisco, USA.

Jackson, M. L. 1973. *Soil chemical analysis*. Prentice Hall of India Pvt. Ltd. New India.

Jose S. 2009. Agroforestry for ecosystem services and environmental benefits: an overview. *Agroforestry Systems*. **76**: 1-10.

Nair A. M. and Sreedharan C. 1986. Agroforestry farming systems in the homesteads of Kerala, Southern India. *Agroforestry Systems*. **4**: 339-363.

Nath A. J., Das G. and Das A. K. 2001. Phenology and culm growth of *Bambusa caharensis* R. Majumdar in Barak Valley, Asssam, Norht East India. *Bamboo Science and Culture***18**: 19-23.

Nath, A. J. and A. K. Das. 2008. Bamboo resources in the homegardens of Assam: A case

study from Barak Valley. *Journal of Tropical Agriculture* **46**: 46-49.

Reid D. G., Taylor A. H., Hu. Jinchu and Qin Zisheng. 1991. Environmental influences on bamboo *Bashania fangiana* growth and implications for Giant Panda conservations. *Journal of Applied Ecology*. **28**: 855-868.

Seethalakshmi, KK and Muktesh Kumar MS. 1998. *Bamboos of India – A Compendium.* Kerala Forest Research Institute, Peechi. p 227-228.

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

Subbiah BV and Asija GL. 1956. A rapid procedure for the determination of available nitrogen in soils. *Current Science* 25: 259-260.