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The potential of reed bamboo (*Ochlandra travancorica*) for revegetating degrading lateritic soils: a case study in Kerala, India

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Abstract—Considering the importance of reed bamboo (*Ochlandra travancorica*) in cottage and paper industries, along with its ecofriendly and fast growing nature, this study was conducted to evaluate the potential of this species for revegetating the degrading lateritic soils in Kerala, India. The heavy rainfall prevalent in the region removes the bases through leaching and causes the formation of lateritic soils rich in iron and aluminium. To find out the survival and growth of reed bamboo on degraded soil, both seedlings and rhizomes were planted in the degraded area at Palappilly in Chalakkudy Forest Division of the State and the observations on survival and growth performance were recorded. Results revealed that reed plants raised from rhizomes could establish themselves better in the degrading lateritic soils than the seedlings and if seedlings are preferred for planting on degrading lateritic soils, then they should be at least 15 months old with well-developed rhizomes. After the establishment phase the plants grew vigorously, irrespective of the nature of the planting material and they attained an average height of 226 cm height and produced 13 culms within three years. Reed bamboo (*O. travancorica*) can, thus, be recommended as a very suitable species for revegetating the degrading lateritic soils.

Key words: Reed bamboo; revegetating; degraded lateritic soil.

INTRODUCTION

The soils of Kerala, especially in the upland regions, are under severe threat of erosion caused mainly by deforestation followed by heavy rainfall. Most of the topsoil once under forest cover has been eroded down to reservoirs and rivers, leaving barren hills in the high ranges. The loss of organic rich top-soil through erosion not only leads to fertility decline, but also exposes the underlying subsoil to the direct actions of adverse climatic factors such as intense sun and rain, finally

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resulting in the physical, chemical and biological deterioration of the soil. Since laterisation is the major soil-forming process in Kerala, most of these soils are in various stages of laterisation. Laterisation is mainly characterized by the removal of bases through leaching and accumulation of secondary oxides of iron or aluminium or both. Laterite is either hard or capable of hardening on exposure or wetting and drying. Even though the formation of laterite is a boon to keep the soil mass intact without being completely lost through erosion, its management from the point of view of biomass production is a great task. Prevention of hardening of laterite that is still soft is reported to be a feasible and perhaps the most promising technique of laterite management and maintenance of moist conditions and actively growing vegetation appears to be associated with the softening process [1]. This points out that the immediate strategy for protecting and improving the health of denuding lateritic soils is by revegetating with some fast growing, economically viable and eco-friendly plant species. The available reports indicate the suitability of plant species tolerant to Al, Fe and Mn toxicities for laterite management [2]. Further, monocots rank first in revegetating the degraded lands than dicots [3]. In view of the above facts, this study was formulated to find out the feasibility of reed bamboo for revegetating the degrading lateritic soils of Kerala. Reed bamboo is an important species of bamboo in the state serving the raw materials for both cottage and paper industries. It is also used for controlling soil erosion in steep slopes. Even though few studies on the importance of different species bamboo in the afforestation programme [4–8] are available, the subject of rehabilitation of degraded lateritic soils with bamboo, especially reed bamboo has not previously been studied.

STUDY AREA AND METHOD

Reed bamboo grows naturally as undergrowth in evergreen and semi-evergreen forests of the Western Ghat region of Kerala, especially along the sides of rivers and streams sticking to wet soil conditions. When the upper canopy was removed due to deforestation, this species started to grow rapidly and occupied the whole area forming extensive reed patches. In this part of the study an attempt was made to evaluate the feasibility of establishing this plant on a degraded lateritic area, where the edaphic (soil related) conditions are quite different compared to its natural habitat mentioned above.

Establishment of nursery

Under natural conditions, reed bamboo occasionally flowers and propagates through seeds. Since the availability of seeds is uncertain, rhizomes of 5-year-old reed clumps were collected from Athirappilly Range of Chalakkudy Forest Division during February 1997. While collecting the rhizomes, care was taken to excise a portion of the mother rhizome along with daughter rhizome without disturbing it.

They were planted in polythene bags and kept in the nursery of the Field Research Centre of KFRI at Palappilly, situated in Chalakudy Forest Division of the State and they were watered regularly twice a day.

Seeds of reed bamboo also could be collected from Ranni Forest Division of the State during April 1997 and they were sown in nursery beds at KFRI Peechi campus. Seeds germinated within 3–4 days and 2-week-old seedlings were transferred to polythene bags containing potting mixture and they were watered regularly.

Establishment of field plots

The site for planting reed bamboo in a degraded area was selected at Field Research Centre, Palappilly situated in the lower reaches of southern Western Ghats of India receiving an average annual rainfall of about 4320 mm. The area selected for planting was a moderately sloping land with southern aspect, medium erosion and dominated by lateritic gravel with low content of organic carbon and available N, P and K. The vegetation comprised of some residual coppice growth of an earlier teak germplasm collection and natural growth of *Cynadon dactylon, Chromolaena odorata*, etc. After conducting necessary weeding operations, six plots of 40×40 m size were aligned in the field. Variation in soil characteristics due to change in slope gradient was minimised by taking two plots lying side by side at the top (no. 3 and 6), middle (no. 2 and 5) and lower (no. 1 and 4) parts of the slope. Planting was done in $30 \times 30 \times 30$ cm pits during south west monsoon showers, by adopting the quincuncial method of planting. In the quincuncial method of planting, each plant in a row is in the centre of two plants of the adjacent row, so that the loss of soil through run off will be minimised. Planting in the 1st, 2nd and 3rd plot was carried out with a spacing of 5×5 m (77 plants/plot), and in the 4th, 5th and 6th plot the spacing adopted was 3×3 m (196 plants/plot). The planting stocks raised from seeds and rhizomes were used for field planting mainly because of the following problems usually encountered. Reed bamboo flowers only occasionally and hence raising of seedlings in the nursery is not certain always. On the other hand, the planting stocks raised from rhizomes are bulky and hence difficult to transport to the field. Since the aim of the present study was only to evaluate the survival and growth of reed bamboo on degraded area, the comparison of planting materials was not taken into account. The planting stocks from rhizomes were planted only in the first and sixth plot and also as buffer plants along the boundaries of all plots due to problems in transportation. In all other plots, 3-month-old seedlings were used for planting. The plots 2 and 3 contained 53 seedlings and 24 rhizomes while the plots 4 and 5 contained 156 seedlings and 40 rhizomes. Temporary fencing for both the whole plot and individual plants was provided. Necessary weeding and fire line works were also carried out. Gap filling was done in next year during south west monsoon with 15-month-old seedlings retained in the nursery. All the plants were fed with 500 g cow dung and 25 g neem cake (organic pesticide containing nitrogen) in order to boost growth.

RESULTS AND DISCUSSION

Survival

Seedlings of reed planted in the field were browsed by animals especially the spotted deer residing nearby the area. Fencing was provided around each plant with locally available materials, but they were still attacked by termites and the termite started to feed on the young roots of reed and, hence, they were removed. Fencing with split bamboo culms, the bottom dipped in tar was found somewhat better in this regard. However, in some cases they were broken down by grazing deer.

A general scrutiny of the survival percentage of the plants after a period of 1 year (Table 1) indicated that most of the plants failed to get through. This was mainly because 60–65% of the seedlings were grazed by animals which prevented further growth of the plant. The underground rhizome of the seedlings was very immature to produce shoots further. Survival percentage in these plots would have been higher if the plots were free from grazing and termite attack. A comparatively higher survival percentage was recorded in plots no. 1 and 6. The planting materials used in these plots were raised from rhizomes and the underground rhizomes were not adversely affected by the biotic pressure and hence they were able to produce more number of shoots. It was also noted that the survival percentage of the seedlings was higher in the second year than the first year. This is because all the plants which could not survive in the first year were replanted with the seedlings retained in the nursery for 15 months and these seedlings with more developed rhizomes could establish better than a few-weeks-old seedlings in the first year. Moreover, the application of cow dung and neem cake (an organic pesticide containing nitrogen) might have increased the vigour of the seedlings.

Growth performance

Data on various growth parameters given in Tables 2–5 show that reed performed remarkably well in the planted site. It could attain a maximum mean height of 78 cm within 1 year, 158 cm within 2 years and 311 cm within 3 years on degraded soil. Also it could produce a maximum mean number of 4, 8 and 15 culms within

Table 1.
Survival percentage of reed bamboo after 1st and 2nd year of planting

Plot No.	1st year			2st year		
	Total no. of plants	No. of plants surviving	Survival percentage	Total no. of plants	No. of plants surviving	Survival percentage
1	77	50	64.9	77	61	79.2
2	77	26	33.8	77	46	58.7
3	77	28	36.4	77	43	55.8
4	196	68	34.7	196	104	53.1
5	196	59	30.1	196	114	58.1
6	196	107	54.6	196	134	68.4

Table 2.
Growth parameters of reed bamboo at the time of planting

Plot No.	Height (cm)		No. of culms/clump		Girth at collar region (cm)		Circumference of the clump (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	53	7.3	3.3	1.0	1.4	0.6	13.4	3.4
2	48	9.4	3.1	0.2	1.1	0.4	10.2	2.6
3	55	8.1	2.9	0.2	0.8	0.4	10.9	2.4
4	53	10.4	2.8	0.6	0.8	0.2	11.0	2.9
5	52	9.6	3.0	0.3	1.1	0.2	9.2	1.8
6	55	10.2	2.9	1.2	1.1	0.4	11.5	2.0

Table 3.
Growth parameters of reed bamboo 12 months after planting

Plot No.	Height (cm)		No. of culms/clump		Girth at collar region (cm)		Circumference of the clump (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	78.4	10.3	3.2	0.8	1.6	0.2	44	5.4
2	73.3	29.5	3.2	1.9	1.3	0.8	31	11.4
3	69.0	33.4	3.9	2.2	1.2	1.4	34	13.5
4	67.9	26.6	3.4	1.6	1.4	1.0	37	13.2
5	67.2	25.2	3.2	2.0	2.0	1.4	39	11.8
6	69.2	12.4	3.2	0.6	1.9	0.2	46	6.2

Table 4.
Growth parameters of reed bamboo 24 months after planting

Plot No.	Height (cm)		No. of culms/clump		Girth at collar region (cm)		Circumference of the clump (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	129	72.6	6.0	1.9	2.6	1.3	59	20.8
2	117	70.2	6.0	1.8	1.2	0.8	65	26.9
3	98	65.9	8.0	5.4	1.6	1.2	86	28.4
4	98	68.0	7.0	2.9	1.2	1.2	59	18.4
5	158	76.3	8.0	5.0	1.9	0.8	68	22.0
6	135	65.9	7.0	3.5	1.3	0.6	67	16.8

1, 2 and 3 years, respectively. The wide variation between the maximum and minimum values is due to the plants grazed by animals as well as the difference in the age of seedlings due to replanting. Data in Tables 2–5 also show that mean values of height had a tremendous hike from the time of planting to 36 months after planting. Similarly, the number of culms per clump, girth at collar region and circumference of the clump had considerable increase within three years irrespective of the age of seedlings. Application of cow dung and neem cake also might have helped in boosting the growth. Seethalakshmi [9] studied the growth performance of

Table 5.
Growth parameters of reed bamboo 36 months after planting

Plot No.	Height (cm)		No. of culms/clump		Girth at collar region (cm)		Circumference of the clump (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	268	42.8	12	4.9	5.8	2.0	94	28.4
2	181	50.4	10	6.2	5.1	3.6	79	31.0
3	152	62.9	15	6.8	5.1	2.5	122	34.6
4	182	48.5	13	4.0	4.6	2.8	93	26.4
5	311	60.7	15	5.7	6.0	3.6	118	34.0
6	265	68.9	14	5.6	5.8	1.9	105	30.6

O. travancorica in its natural habitat at Vazhachal. According to them, the seedlings and cuttings could attain a mean height of 93.0 and 111.9 cm, respectively, after 2 years of planting. In their study, seedlings produced 5.2 sprouts and the cuttings produced 7.9 sprouts within two years. In the present study, reed was grown in the most adverse conditions and still its growth performance was as good as in natural habitat. Results of the study also imply that after the establishment phase, the plants grow vigorously irrespective of the nature of the planting material. Application of cow dung and neem cake might have played a significant role in increasing the growth of reed bamboo on degraded area.

CONCLUSIONS

The study reveals that the planting stocks raised from both seeds and rhizome can be used for revegetating the degraded lateritic soils with reed bamboo. Since the few-month-old seedlings are very sensitive to biotic pressures like grazing and termite attack, seedlings of about 15 months old with well-developed rhizomes or those raised from rhizomes are suggested for easy establishment. After the establishment phase plants grow vigorously irrespective of the type of planting material. Growth of reed bamboo on degrading soil can be boosted by the application of cow dung and neem cake. Based on the growth performance it is concluded that reed bamboo (*Ochlandra travancorica)* can be recommended as a very suitable species for revegetating the degrading lateritic soils of the Western Ghats in Kerala.

REFERENCES

1. A. I. Jose, P. A. Korah and V. K. Venugopal, Constraints for crop production in red and lateritic soils of Kerala, in: *Managing Red and Lateritic Soils for Sustainable Agriculture, Vol. II*, J. Seghal, W. E. Blum and K. S. Gajbhiye (Eds), 447–453 (1998).
2. H. Marschner, *Mineral Nutrition of Higher Plants*, 478 pp. Academic Press, Harcourt Brace Jovanorich, London (1986).
3. N. G. Totey, A. K. A. Prasad, Bhowmik and P. K. Khatri, Cation exchange capacity of forest tree species, *Journal of the Indian Society for Soil Science* **41** (1), 158–160 (1993).

4. G. S. Neginhal, Introduction of bamboos through afforestation measures, *Indian Forester* **75** (11), 457–458 (1949).
5. K. Singh, B. Kumar and N. Singh, Impact of intensive afforestation programme on the rehabilitation of Punjab Shivaliks, *Indian Forester* **121** (2), 115–121 (1995).
6. S. S. Grewal, M. L. Juneja, K. Singh and S. Singh, A comparison of two agroforestry systems for soil, water and nutrient conservation on degraded land, *Soil Technology* **7** (2), 145–153 (1994).
7. R. K. Maikhuri, R. L. Senwal, K. S. Rao and K. G. Saxena, Rehabilitation of degraded community lands for sustainable development in Himalaya: a case study in Garhwal Himalaya, India, *International Journal of Sustainable Development and World Ecology* **4** (3), 192–203 (1997).
8. I. S. Ming and L. H. Shou, Agroecosystem models to prevent land degradation and improve land productivity along the Jian River Watershed, China, *Journal of the Asian Farming Systems Association* **1** (4), 479–493 (1993).
9. K. K. Seethalakshmi, T. Surendran and C. K. Somen, Vegetative propagation of *Ochlandra travancorica* and *Ochlandra scriptoria* by culm cuttings, in: *Bamboos Current Research*, I. V. R. Rao, R. Gnanaharan and C. B. Sastry (Eds), pp. 136–143. Kerala Forest Research Institute, Peechi and International Development Research Centre, Ottawa (1990).