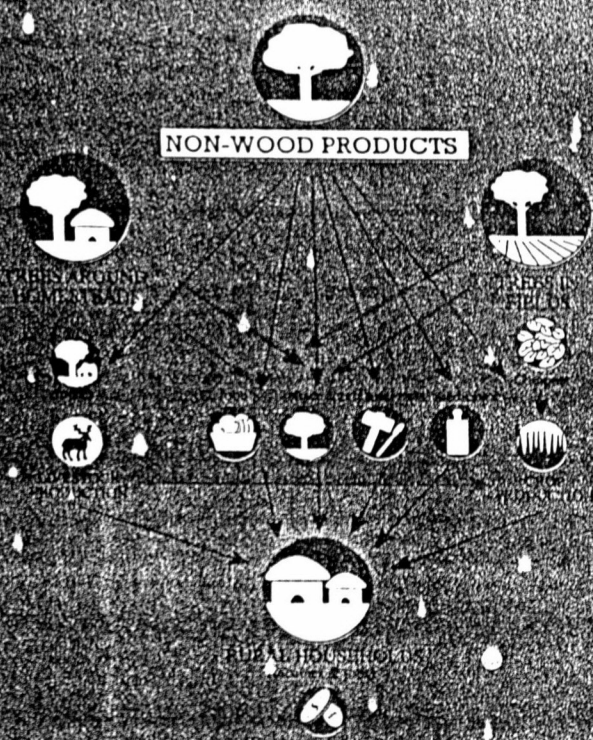


MANAGEMENT OF MINOR FOREST PRODUCE FOR SUSTAINABILITY

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Plantation Technique and Management, and Growth Features of *Thysanolaena maxima*, a Minor Forest Produce Species of North-east India

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INTRODUCTION

Thysanolaena maxima (Roxb.) O. Ktze, commonly known as broom grass is grown as a minor forest produce plant in hilly regions of North-east India. It also grows wild in the hills of North-east and in Darjeeling (Patel 1992) and Sikkim Himalayas (Tewari 1992). The inflorescence of the plant is used in making brooms which are quite popular and fetches good price. These brooms have a ready market in North-east India and they are also exported to other parts of the country in good quantity.

Besides using the inflorescence of the plant as broom for cleaning and sweeping the floor, the leaves of the plant which is a good fodder, are fed to the cattle after the broom grass is harvested. Since the leaves remain green during winter, they also serve as a fodder for stray grazers. The sticks (grass stems) are used as a raw material in the paper industries. However, full utility potential of the sticks in industries is yet to be explored. In addition, the species has high potential for binding soil with its fibrous root system and therefore, it helps in reducing soil erosion. After the harvest, the culm sticks of the plant can also be used as barrier against soil erosion by keeping them across the hill slopes. These sticks subsequently get rotten and add nutrients to the soil. The leaf litter of the plant is also readily decomposable and adds considerable amount of nutrients to the soil system, thereby ameliorating the soils of the plantation plots. This indicates the high potential of the species for its use in eco-restoration of the degraded sites.

In view of the above multiple uses of the broom grass, its large scale plantation may be helpful in uplifting the economic condition of rural poor. However, there is a conspicuous lack of literature on the economic importance, agro-climatic and edaphic requirements, and planting technique and management of the broom grass plantations. No scientific study has so far been

conducted on the species describing its phenology, soil ameliorating potential, growth and productivity.

The present paper describes some of these aspects for wider disseminations of information so that the species could be introduced in other parts of the country having similar elevation, soil and climatic conditions.

EDAPHIC AND CLIMATIC REQUIREMENTS

The species grows on a wide range of soil types ranging from sandy to sandy loam. It can even grow in crevices of broken rocks. Field observation indicates its preference for acidic soils (pH 5.0 - 6.0). However, its success on soils having higher pH value has not been investigated. Though the species can grow on nutrient deficient/infertile soil, the yield on such soils is rather low.

The plant grows well up to an elevation of 1800 m, beyond which the climatic conditions are believed to adversely affect the produce quality, i.e., inflorescence. The frost at higher altitudes does not allow the flowers to bloom fully and thus, it may reduce the yield considerably. Broom grass grows under the climatic conditions ranging from tropical to sub-tropical.

PHENOLOGY

Seedings are of infrequent occurrence, and the plants arising from seeds show poor growth. In nature the plant mostly multiplies through underground rhizomes.

Broom grass is usually planted during April and May, and peak vegetative growth takes place during June-July. The vegetative growth continues till the plant bears inflorescence. In most areas, flowering starts during October. The inflorescence becomes ready for harvest by December-January and the harvest continues till March.

PLANTING TECHNIQUE

The species is planted through rhizomes, which are generally collected from the natural populations. As the plants grow scattered on the hills, collection of rhizome is highly labour-intensive. Broom grass is grown either in monoculture or as an intercrop with *Atrocarpus integrifolia*, *Citrus* spp., *Ananas comosus*, *Psidium guajava*, *Cinnamomum tamala*, and *Michelia champaca*. The spacing maintained in these plantations varies from 3 × 3 m to 5 × 5 m depending upon the associated crop. In monocultures, the spacing is usually 2 × 2 m. The sites are cleaned properly during February/March and planting is done thereafter in pits. The size of the pits depends on the size of rhizome(s). In case the planting

is to be done on the poor sites, cow dung manure is put in the pits before planting in order to obtain better results. Three to four rhizomes of average size are usually planted in a single pit. This helps in getting more shoots per pit. New shoots come up within three to four weeks after planting.

PLANTATION MANAGEMENT

Though the plant grows wild along the hill slopes, the commercial cultivation needs considerable amount of care during post-planting period. In fact, the economic yield of the crop largely depends on the proper management of the plantation. Weed infestation poses the most serious problem and causes considerable reduction in the yield. Therefore, weeding should be done 4-5 times in a year. During the first two years of growth weeding is absolutely essential. As the leaves have good fodder value, the plant is prone to grazing by cattle and thus the plantations get damaged, if grazing is severe. Therefore, a cattle proof fencing is required to be provided. Adequate fire prevention measures need to be taken during dry and winter months. After a crop cycle of five years, the plantation is generally burnt in order to get better shoots from the underground rhizomes.

YIELD AND ECONOMICS

The yield of inflorescence varies depending on the site conditions and the size of rhizomes planted. Maintenance of the plantation has also an important bearing on the yield. On an average, inflorescence yield (on fresh weight basis) per hectare during the 1st year of cropping is about 70 kg, and during the 2nd year it increases to about 180 kg. The yield increases till 4th year, after which it declines. Average inflorescence yield during the 3rd year of cropping is ca. 220 kg and during the 4th year it is ca. 350 kg.

In order to document the spatial variation in yield due to planting technique used, soil conditions, associated crops and variation in selling price of the produce, a study was conducted during May, 1993 at various locations in Meghalaya (Table-1). In view of good economic return from broom grass, the plant is not being cultivated as a cash crop in many parts of Meghalaya both with and without subsidy from the government. The species is also being planted under the Minor Forest Produce Scheme of the government of India implemented through the state forest department, Meghalaya.

The expenditure incurred during first three years of cropping for raising one hectare of *Thysanolaena maxima* plantation in Meghalaya worked out to be Rs 1700/- only (Table-2).

Table-1: Plantation sites, associated crops and economic yield of *Thyrsanolaena maxima* in East Khasi Hills and Ri-Bhoi districts of Meghalaya

Plantation site	Population	Area (ha.)	Soil texture	Associate crop	Spacing (m)	Cumulative yield during first 3 years per ha. (ton)	Selling price per ton (Rs)
Nongpoh	10,000	145	Sandy loam	monoculture or mixed with <i>Artocarpus integrifolia</i>	2.5 × 2.5 4 × 4	0.9	8000
Jirang	5,000	130	Sandy loam	<i>Piper longum</i> , <i>Artocarpus integrifolia</i> & <i>Cinnamomum tamala</i>	2.5 × 2.5	0.75	8000
Mawky- nrew	2,500	100	Sandy loam	<i>Monoculture</i> or <i>Psidium guajava</i>	2 × 2	-	-
Cherra- punjee	42,000	165	Sandy loam	<i>Cinnamomum tamala</i> & <i>Artocarpus integrifolia</i>	2.5 × 2.5 4 × 4	0.9	-
Shang- pung	25,000		Red loam	Monoculture	3 × 3	1.2	-
Khliehriat	40,000	150	Red loam	<i>Cinnamomum tamala</i>	3 × 3	0.9	3000-4000
Pynursla	34,000	240	Sandy loam	Monoculture	2.5 × 2.5 4 × 4	0.8	-
Byrnihat		100	Sandy loam	Monoculture	3.5 × 3.5	4.0	6000
Shillong	1,500	23	Sandy loam	Monoculture	2 × 2 4 × 4	2.8	6000
Kyrdemk- ulai		125	Sandy loam	<i>Zingiber officinale</i> , <i>Michelia champaca</i> & <i>Artocarpus integrifolia</i>	2 × 2.5	1.2	6000

* indicates data not available

Table-2: Expenditure incurred during first three years to raise one hectare of *Thysanolaena maxima* plantation in Meghalaya

Components of expenditure	Amount (Rs.)
Survey and land demarcation	50
Clearing of land	450
Cost of planting	300
Weeding (three times per year)	
1st year	450
IInd year	450
Total	1700

Average net income from one hectare of *Thysanolaena maxima* plantation during a five year cropping period in Meghalaya works out to Rs. 5,320. The year-wise statement of income and expenditure is presented in Table-3.

Table-3: Average income and expenditure from one hectare of *Thysanolaena maxima* plantation during a five year cropping period in Meghalaya

Year of cropping	Income (Rs)	Expenditure (Rs)	Net Income (Rs)
I	420	1250	-830
II	1080	450	630
III	1320	-	1320
IV	2100	-	2100
V	2100	-	2100
Total	7020	1700	5320

GROWTH FEATURES

The growth pattern of *Thysanolaena maxima* in plantations of different ages was studied at selected sites as mentioned in Table-1. The plant grows in tussocks. The culms arise centrifugally during the peak growing season. The appearance and growth of culms in a tussock depict a characteristic order, which probably controls the position and extent of growth of culms, size, number and also length of leaves, and the overall shape of the crown of the tussock.

It was found that the maximum height of tussock increased upto 3 years while basal girth continued to increase even after that and at a considerably faster rate. The average number of culms constituting a tussock and basal area of each culm also increased at a faster rate after the 2nd year of plant growth (Table-4).

Table-4: General growth pattern of *Thysanolaena maxima* in the plantations of different ages in Meghalaya

Growth parameters	Age (Year)			
	I	II	III	IV
Height of tussock (cm)	75.0	100.0	180.0	178.0
Basal girth of tussock (cm)	48.0	83.0	108.0	170.0
No. of culms/tussock	24.0	67.0	312.0	428.0
Basal area/culm (cm ²)	1.3	1.9	2.8	3.5

CROWN STRUCTURE

The internode length and area per leaf increased steadily with the age of tussock but leaf number per culm remained almost constant. A substantial increase in average leaf area per tussock was observed during the 3rd year of growth. The maximum area of crown cross-section, however, increased at a much faster rate during the second year of growth. The leaf area index (LAI) was minimum during the second year and maximum during the 3rd year of growth. The growth analysis of crown indicates a very high level of integration of different components forming the crown of the tussock. The central cavity of tussock was devoid of any culm. The culms came up only at the periphery of the system. The vegetative growth attained a peak during the 2nd to 3rd year of growth. As the growth continued, the basal perimeter of the tussock increased and the top surface of the crown became more elliptical and more sparse paving the way for greater exposure of the crown to light. Such a crown structure caused a decrease in LAI. The LAI peaked during 3rd year of growth. After 4th year the tussocks gradually showed the sign of withering and disintegration. During this period, the area of cavity (open central empty space devoid of culms) within the perimeter of the tussock increased at a higher rate. The culms at the periphery of the cavity, help to retain the dead leaf biomass within the cavity, thus conserving the leaf nutrients significantly in the close vicinity of the newly arising culms. This strategy is merely a function of growth pattern of the species, which probably helps the species in terms of nutrient conservation in the close vicinity of parent plant especially at degraded sites (Table-5).

BIOMASS AND PRODUCTIVITY

The dry weight of stem or leaves per culm did not increase significantly with the age of tussock and the overall ratio of leaf to stem weight per tussock during first and second year of growth was around one. The ratio, however, increased slightly during 3rd year and significantly during 4th year. A low proportion (6.2%) of shoot biomass was found allocated to the inflorescence which is the

Table-5: Dynamics of crown structure of *Thysanolaena maxima* in the plantations of different ages in Meghalaya

Structural attributes of crown	Age (Year)			
	I	II	III	IV
Leaf no./culm	6.2	7.0	8.0	8.2
Internode length (cm)	7.5	13.6	25.8	26.9
Leaf area/culm (cm ²)	445.7	520.7	956.6	1102.2
Leaf no./tussock	148.8	470.4	2496.0	2424.0
Leaf area/tussock (cm ²)	11055.9	34997.7	298521.6	472512.0
Area of canopy cross section (cm ²)	4415.6	20096.0	42983.5	96162.5
LAI	2.5	1.7	6.9	4.9
Cavity area (cm ²)	22.8	84.9	162.8	314.0

most valuable product arising at the cost of stem biomass. Total biomass per tussock increased from about 1 kg at the end of first year of growth to about 14 kg at the end of 4th year. The average productivity increased upto 3rd year and was very high at this age. It decreased drastically beyond 3rd year. The net yield was maximum during 4th year of its growth. Thus the growth features and productivity pattern of the species indicate its production potential in degraded environment even in the face of paucity of soil (Table-6). The trends of biomass accumulation and productivity of the species during different years of cropping justifies the on going practice of burning the crop after every five years in order to get better yield.

Table-6: Distribution of above ground biomass (g/plant) in different plant parts of *Thysanolaena maxima* in the plantations of different ages in Meghalaya

Plant components	Age (Year)			
	I	II	III	IV
Stem wt./culm (g)	17.0	18.8	30.0	20.5
Leaf wt./culm (g)	6.0	7.0	8.2	8.0
Total wt./culm (g)	23.0	25.8	38.2	28.5
Stem wt./tussock (g)	408.0 (49.9%)	1263.0 (49.4%)	6240.0 (47.6%)	3424.0 (25.0%)
Leaf wt./tussock (g)	409.0 (50.1%)	1293.0 (50.6%)	6864.0 (52.4%)	9416.0 (68.8%)
Inflorescence wt./tussock (g)	-	-	-	856.0 (6.2%)
Total dry wt./tussock (g)	817.0	2557.0	13104.0	13696.0
Average productivity (g/tussock/yr)	-	1740.0	10547.0	592.0

Broom grass plantation is gradually becoming popular among the villagers, particularly, the marginal farmers in Meghalaya. The state forest departments of Meghalaya and Sikkim have also introduced this plant in social forestry plantations. It has emerged as a good cash crop and has potentials to augment

the income of the poor farmers. The produce from the plant starts coming within a year of plantation because the gestation period is usually about six months only. In view of its attractive economic return, less management cost and nominal input to raise the plantation, and the availability of large areas of uncultivable wastelands which account for more than 20% of the total land mass in the hills of North-eastern India, broom grass could be planted on a large scale and can become an effective instrument for rural development. The growth features of the species as presented in this paper, are suggestive of its potential as one of the compatible components of certain agroforestry systems in North-east India. However, such agroforestry models prescribing the crop combinations are yet to be worked out.

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REFERENCES

- Patel, S. (1992). Integrated wastelands development project in Mechi Watershed, Darjeeling, W.B. In : *Models for Regeneration of Degraded Forests Through Participatory Management* (Eds. B.K. Tiwari, R.P. Kapoor, S.K. Barik and R.S. Tripathi) Regional Centre, National Afforestation and Eco-development Board, North-Eastern Hill University, Shillong. pp. 30-39.
- Tewari, B.K. (1992). Integrated wastelands development project in Rangphuchu watershed in West Sikkim. In : *Models for Regeneration of Degraded Forests Through Participatory Management* (Eds. B.K. Tiwari, R.P. Kapoor, S.K. Barik and R.S. Tripathi) Regional Centre, National Afforestation and Eco-development Board, North-Eastern Hill University, Shillong. pp. 42-46.