Cultivation, production and management techniques of broom grass (Thysanolaena maxima Roxb.) in hilly areas of Bangladesh

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This paper presents the results on appropriate cultivation, plantation, production and management techniques of Thysanolaena maxima for domestication at age 1–4 yr (grown 2007–2011). Rhizome cuttings were planted in research experimental plots at spacings of T1 = 1.0 m × 1.0 m, T2 = 1.5 m × 1.5 m, and T3 = 2.0 m × 2.0 m in a randomized complete block design with six replications and three treatments. The results showed that the number of panicles produced was 1048, 41,237, 78,737 and 105,094 in year 1 to year 4, respectively. The average total green weight (kg/plot) was 10.26, 287.65, 216.93 and 241.60 in year 1 to year 4, respectively. Composite soil samples were collected and the soil pH values of the surface soil from the different treatments varied from 5.1 to 5.2. There was no significant difference among the treatments in the available P and S. The available Ca, Mg and K were higher in the T3 treatment compared with the other treatments. Planting rhizome cuttings at 2.0 m × 2.0 m spacing gave the maximum broom/panicle production.

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Introduction

Bangladesh is situated in the northeastern part of South Asia between 20° 34' N and 26° 38' N and 88° 10' E and 92° 41' E. It has an area of 1,47,570 km² and a population of 152.25 million (Bangladesh Bureau of Statistics, 2014). Forest makes up 16.7% of the country (Bureau of Statistics, 2014). The forests of Bangladesh are generally uneven aged and multistoried. Based on tree height, the floristic composition is divided into both a top and a middle canopy and storey and the species growing on the forest floor as undergrowth. Ecologically the forest of Bangladesh is classified into four major forest types: tropical wet-evergreen, tropical semi-evergreen, tropical moist-deciduous and tidal (Das, 1990) Broom grass (Thysanolaena maxima (Roxb.) O. Ktze) of the family Poaceae is a tall, tufted, reed-like perennial grass which grows well along hill sides (Bor, 1960; Clayton and Revoize, 1986). Its inflorescence is made into brooms, hence its common name and it is also known as Chorondhora, Arjunphool and Mio in the Chittagong Hill Tracts and as Phool jhado in general (Alam, 2007). It grows naturally in temperate and sub-tropical parts of India, Bhutan, Myanmar, China, East Asia, Nepal, New Guinea and Malaysia up to 2000 m elevation (Watson and Dallwitz, 1992). It flowers during June–July and bears inflorescence on the shoot apex at the end of vegetative growth. It is an important non-timber forest resource and is widely used for cleaning floors, lime washing of building walls, it leaves and tender culms make good forage and its woody culms are used for fuel and...
as mulch material (Mohiuddin and Alam, 1987). It also has medicinal value, with a decoction of the roots used as a mouthwash during fever and the dried paste of fresh roots is applied on the skin to check boils (Rai and Sharma, 1994). Its tender twigs are good cattle feed for improving milk production and also elephants feed on the whole plant and there are also reports that its fruits have antifertility properties (Mudgal and Pal, 1980).

The plant has a significant role in the conservation of soils of the denuded hilly areas (Khisa et al., 1999) and has been identified as an important non-timber economic forest product for integrating hill farming and agroforestry systems (Alam, 1995, 1998). Its fibrous root mat effectively protects the top soil and nutrients from erosion on hill slopes, in landslides affected areas and in agricultural fields as the water run-off and soil loss are reduced by up to 88% compared with bare areas (Bluchar, 2001; Sharma et al., 2001).

In Chittagong and the Chittagong Hill Tracts of Bangladesh, broom grass is collected by the tribal ethnic community and local people during November–March from its natural habitat. It is also traded at a high price at home and abroad and is exported to the Middle East, Pakistan and Japan as a non-traditional product (Alam et al., 2013). However, scarce information is available on its cultivation, management and production system (Barik et al., 1996).

Considering the increasing demand for this produce, it is necessary to determine its cultivation and management techniques on the fallow and marginal lands in the forest in hilly areas of Bangladesh. The present study aimed to develop appropriate cultivation, plantation, production and management techniques for T. maxima.

Materials and methods

Description of the research site

The experiment was carried out during 2007–2011 at the Keochia Silvicultural Research Station, Satkania, Bangladesh Forest Research Institute, Chittagong, Bangladesh. It is situated at 22°11’N and 92°13’E and is 45 km south of Chittagong city. It lies on both sides of the Bandarban Road at 3 km east from the Chittagong-Cox’s Bazar Road transect and parts of Keochia, Sharseria, Mahalia and Sodaha Mouzas of Satkania Upazilla are located within the station boundary.

The topography of the experimental site is hilly to flat having an altitude of 15 m above mean sea level with medium to gentle slopes. The annual rainfall ranges from 3000 mm to 3200 mm with a minimum annual temperature of 21.4 °C and a maximum of 33.4 °C. The soil is brown with stones and small gravel pieces and is shallow to deep with good drainage conditions; the soil texture is a sandy loam to sandy clay loam (Hossain et al., 1989; Hassan et al., 1992).

Preparation of propagules

In total, 950 rhizomes of T. maxima were collected from the Bandarban hill district. The culms were cut to obtain stem lengths of 15–20 cm with roots. These were cut into pieces of length 5–10 cm each weighing 40–60 g and having one or two dormant buds. Then, 700 rhizome cuttings were sorted for setting in nursery beds for sprouting new shoots. After 2 mth, 648 rhizome cuttings were selected for planting in the experimental area.

Experimental design and treatments

The planting site was cleared and made free from weeds through jungle cutting and weeding. A total of 648 rhizome cuttings was required for the 0.1628 ha experimental plot. Three spacings—T1 = 1.0 m × 1.0 m, T2 = 1.5 m × 1.5 m and T3 = 2.0 m × 2.0 m—were laid out in six replications using a randomized complete block design. The pit size was 25 cm × 25 cm × 20 cm with 36 rhizomes per plot. Emerging and established plantations were protected from cattle browsing and grazing and from uprooting by wild boars.

Data collection

Data were collected from the experimental plot at three times (September, December and March) annually. Data on the survival percentage, number of culms produced, culm length, culm diameter, leaves produced per tussock, leaf length and broom length were collected. Biomass production as green weight and sun dried weight was also measured. Brooms were harvested depending on maturity during January–March when the inflorescence became tough and had changed color to light green/red. Harvesting of mature brooms was done very carefully. Every year, broom panicles were collected in January–February and dried for up for 30 d in full sunshine. The culms were harvested by cutting with a pair of sharp scissors 35–40 cm above the ground. The panicle was collected by hand pulling and properly sun dried for 25–30 d.

Soil sample collection and analysis

Soil samples were collected from the selected site. Each sample was a composite sample of three subsamples. The soil samples were put into polythene bags for transporting to the laboratory. Soil samples were air dried, ground, sieved (to less than 2 mm) and preserved in plastic bottles.

Soil pH (soil to water ratio of 1:2.5), organic matter (Walkley and Black, 1934), total N content (micro Kjeldahl distillation method) and available soil P (Bray and Kurtz, 1945) were determined using the ascorbic acid blue color method (Murphy and Riley, 1962) and available soil S (Fox et al., 1964) was determined using the turbidimetric method (Hunt, 1980). Available Ca and Mg in the soil were extracted using 1 N neutral ammonium acetate solution followed by atomic absorption spectrophotometry and K in the soil was extracted using the same method with a flame photometer.

Statistical analysis

Analysis of variance (ANOVA) for the randomized complete block design was performed using the SPSS software package (SPSS Inc.; Chicago, IL, USA). Duncan’s Multiple Range Test at p < 0.05 and p < 0.01 was used when an ANOVA table indicated that there were significant treatment effects (Steel et al., 1997).

Results and discussion

Spacing of the rhizomes significantly influenced the mean growth production parameters of above ground vegetation of broom grass at different ages (Table 1 and Fig. 1). Initially (year 1) the maximum number of culms produced (35) was observed in T1, maximum culm length (73.31 cm) in T2, maximum culm diameter (5.8 cm) in T3, maximum number of leaves per tussock (13) in T3, maximum leaf length (15.51 cm) in T3 and the maximum broom length (12.24 cm) was attained in T3. Similar trends were also observed in the second year. At age 4 yr, it was observed that the maximum number of culms (3235), maximum culm length
The widest spacing (T3) followed by T1 and T2 treatments for age 2 yr and 3 yr with values of 632.15 kg and 241.6 kg, respectively. At age 4.7 yr, the maximum number of harvested broom panicles per year (2840, 2840, respectively) and dry weight (216.93 and 241.6 kg, respectively) were recorded at the widest spacing (T3) and these were significant, but the green weight maximum among treatments was recorded in the T2 treatment for age 2 yr and 3 yr with values of 632.15 kg and 423.34 kg, respectively. At age 4.7 yr, the maximum number of harvested broom panicles was found growing in soil having the maximum depth (168.8 cm) and maximum number of leaves per tussock (29) were observed in T1 followed by T1 and T2, respectively, which were different at the 1% level of significance.

A similar trend was also found in yield and biomass production (Table 2). Initially (year 1) the maximum number of broom panicles per year (32) and green weight (10.26 kg) were found at the closest spacing (T1) followed by T2 (26 and 7.5 kg, respectively) and T3 (22 and 6.7 kg, respectively). However, the maximum dry weight of broom (9.88 kg) was found at the widest spacing (T1) followed by T3 (7.5 kg) and T2 (2.28 kg). At age 3 yr and 4 yr, the maximum number of harvested broom panicles per year (2149 and 2840, respectively) and dry weight (216.93 and 241.6 kg, respectively) were recorded at the widest spacing (T3) and these were significant, but the green weight maximum among treatments was recorded in the T2 treatment for age 2 yr and 3 yr with values of 632.15 kg and 423.34 kg, respectively.

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fourth year after planting and then declined. The maximum biomass production from the rhizome-propagated culms was in year 3 and declined thereafter (Bhuchar, 2001). In the current experiment, the yield of broom grass (number of panicles/ha) was 41,237, 78,737 and 105,094 in years 2, 3 and 4, respectively. Consequently, harvesting of broom grass started from year 2 (Fig. 2).

The soil pH values of the surface soil from the different treatments varied from 5.1 to 5.2. The organic matter content of the surface soil was higher in the T3 treatment and lower in the T2 treatment. The total N content was higher in the T1 treatment followed by the T3 and T2 treatments, respectively. There was no significant difference among the treatments for the available P and S. The available Ca, Mg and K were higher in the T3 treatment compared to the other treatments (Table 3). Naturally, broom grass grows well on the steep slopes and undisturbed fallow areas of Chittagong and the Chittagong Hill Tracts where no management is required (Khisa et al., 1999). However, the experiment was set on a gentle hill slope and it needed care and maintenance to be economically viable. In an artificial plantation, 2–3 weeding sessions during the first 2 yr are essential and commercial cultivation needs protection from grazing animals and wild boar as well as from fire during the dry season (Khisa et al., 1999). Consequently, broom grass production may vary from area to area both in natural and artificial plantations. Regardless, the growth and yield of broom grass mainly depends upon the quality of the planting material, type of land and cultural practices (Bisht and Ahalwat, 1998).

In summary, the experiment revealed that 2.0 × 2.0 m spacing produced the maximum number of brooms/panicle in strongly acid soils. Though broom grass is naturally grown in the steep hilly areas of Chittagong and the Chittagong Hill Tracts, Bangladesh, it is possible and there is a need to grow it in artificial plantations due to the increasing population resulting in increased local and export demands. Not only abroad, but also in Bangladesh it is a profitable cash crop and development of a cottage based industry in the Chittagong Hill Tracts. This paper provides guidelines for the scientific cultivation, production and proper management of T. maxima in the hilly areas of Bangladesh.

Conflict of interest

None.

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References


Fig. 2. Cumulative broom grass production.