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Research Article

Regeneration Study of *Oxytenanthera abyssinica* in Mandura District, Northwest Ethiopia

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Abstract

Lowland bamboo vegetation is threatened by cutting, decay of new shoots, mass flowering, agricultural expansion, over grazing, fire and cutting style of which fire is the most leading threat reported. The lowland bamboo forest in the Woreda was flowered in 1998 E.C. The Woreda has patchily distributed vegetation features characterized by *Combrutum molle* and *Entada abyssinica* growing in association with *Oxytenanthera abyssinica,* commonly known as lowland bamboo. The present study is about germination and regenration issues of the multipurpose lowland bamboo inManduraWoreda. Seed germination of the species was found to take on average three to four times faster in Petri-dish than in soils. Two years stored seeds showed less viability, about65% and 2 days slower rates of germination. Mixed soils found to increase seed viability from 37.5% to 68.78%. Number of culms per clump is highest in protected forests and least in wild forests. The percentage natural expansion (reproduction) was highest in cultivated and wild forest habitats. The ability of clumps to produce new offshoots is directly proportional with the clump circumference.

INTRODUCTION

Background of the study

The pure natural bamboo forest in Ethiopia is the largest in Africa, over about 1 million hectare, and 85% of this area is covered by lowland bamboo (*Oxytenanthera abyssinica)* [1]. *O. abyssinica* is an indigenous bamboo to Ethiopia and endemic to tropical Africa. It belongs to the family Poaceae and subfamily Bambusoideae [2].

Bamboo naturally propagates both sexually from seeds and asexually by rhizomes. Artificial propagation by vegetative methods includes planting of off-sets, culm cuttings, layering, and grafting of rhizome [3]. Some bamboo species are successfully regenerated using culm cuttings [4]. On the other hand, although the gregarious flowering cycle of the species is about 20 years [5], it also produces seeds from sporadic out-of-phase flowering in the intervening period [6]. This is not the case with most bamboo species, they flower only once in their life time gregariously and die. New bamboo growth may then emerge again on the site from germinating seeds if the land is left undisturbed and seed predation is not detrimental. For these reasons *O.abyssinica* is being established now, and will probably also in the future depend on seed rather than vegetative propagules. Knowledge of factors that influence seedling emergence, survival and growth is thus vital for successful establishment and expansion of the species [6].

Bamboo forest is a material source for furniture, building, pulp, particleboard, bio-energy, food, forage and medicine. It plays a vital role in environmental amelioration, bio-diversity preservation soil and water conservation and has waste purification potential [1,7]. Given its fast growth, high soil conservation potential, multiple use and adaptability to low quality sites, bamboo has the capacity to redress most of the deforestation- related problems.

In the past, lowland bamboo forests were located in the more inaccessible areas, which protected them from destruction. Lowland bamboo forests at Assosa, Metekel, and Mandura, in western Ethiopia are examples. These forests are now decreasing rapidly as result of demand for construction and new roads that are being constructed (personal observation). The rate of clearance is accelerating as more forests are cleared due to agricultural expansion or burning to increase grazing land and due to natural mass flowering of the plant [6].

Objectives

General objectives: This researchattempts to explore thegermination factors and regeneration potential of lowland bamboo forest in Mandura Woreda.

Specific objectives: The specific objectives were to

1. Investigate seed viability, soil type and depth related factors that affect bamboo seedling emergence;
2. Compare vegetative regeneration (expansion) potential of bamboo in different habitats (wild, cultivated and protected forests).

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MATERIALS AND METHODS

Description of the study area

Location: The Benishangul Gumuz Regional State (BGRS) was established in 1994 as one of the nine regional states of Ethiopia. The BGRS borders the Republic of Sudan in the west, Amhara region in the North, Oromiya in the South east and Gambella region in the South. Administratively, it is divided in to 3 zones (Metekele, Assosa, and Kemashi) that are divided in to 19 Woredas, and one special Woreda. Metekel zone is divided into 7 Woredas out of which ManduraWoreda, the study areais located North 10^0 55'-11^0 90' latitude North and 30^0 12'-30^0 36' longitude east (Figure 1) comprising 17 rural Kebeles and 3 town Kebeles. Gilgel Belese is the centere of Mandura Woredas and also the Zonal town. The Woredas has large topographic drops from east to west.

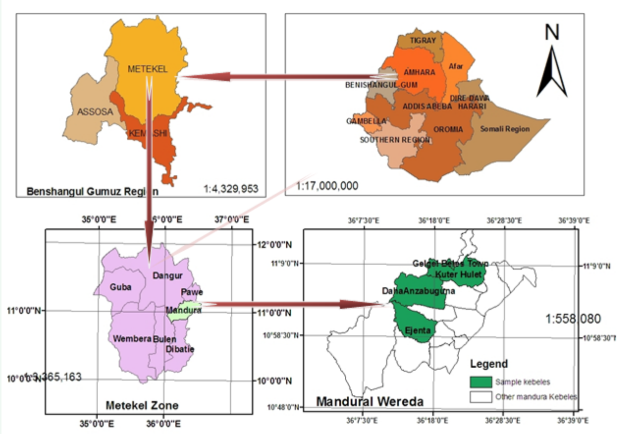

Figure 1 The location of study Kebeles in Mandura Woreda Metkel Zone, Ethiopia.

Sampling methods

Site selection: Five Kebeles (villages) were selected based on (1) availability of bamboo resources, (2) utilization potentials and significance to the surrounding community, (3) convenience to capturing as much socio-economic information as possible, and (4) the manufacturing and consumption of bamboo products.

Vegetation data: To describe the vegetation the stratified sampling method were used and vegetation data werecollected from 10×10 m quadrats lied in homogeneous vegetation units. A total of 8 quadrats were considered. Two quadrates (6 and 7) were from cultivated bamboo forest, other two quadrats (5 and 8) were in protected bamboo forest, and the rest four quadrats (1-4) were laidin wild forest of bamboo (2 from Duanzbaguna and 2 from Ajenta Villages). Community similarity among quadrats was quantified using Sørensen similarity coefficient. This coefficient of similarity (*Ss*) was defined using the formula:

$$Ss = \frac{2a}{(2a+b+c)}$$

Where Ss = Sørensen similarity coefficient

a = number of species common to both quadrat

b = number of species in quadrat 1

c = number of species in quadrat 2

Association among *O. Abyssinica* and other woody trees was calculated using Jaccard's index. The Jaccard index of species association (*IA*) is based on species presence (*p*) (Figure 2):

Index of association for presence *(IAP)* = [a/(*a* + *b* + *c*)] x 100.

Where,

IAP= Jaccard index

a = number of quadrat in which the two species under comparison occur together

b = number of quadrat in which one of the two species occur alone

c = the number of quadrat in which the other species is found alone [8].

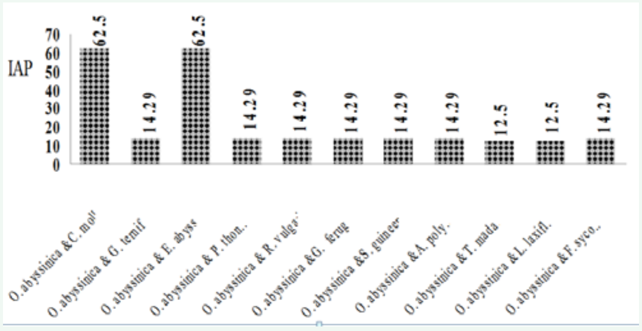

Figure 2 Graph showing IAP value of different plants associated with *O. abyssinica*.

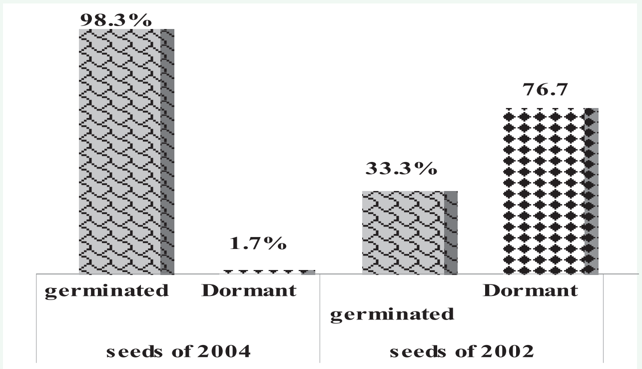

Figure 3 Comparisons of seed viability between seeds collected in 2004 and 2002 E.C.

Seed viability test

Seed viability of *O. abyssinica* was evaluated by germinating seed under predetermined conditions. Sixty seeds from each sample were divided in to 3 replicates of 20 seeds each. Seeds collected in 2002 and 2004 E.C. were germinated on Petri-dishes with filter paper in the laboratory. The substrate used for germination test was free of moulds or other micro-organisms and provided with adequate aeration and moisture [9]. This was done in 2004 E.C.

Seed viability and length of time was compared between seeds collected in 2002 and 2004 E.C. by using student's t-test to check how time length of seed storage affects effectiveness and duration of germination.

Impact of sowing depth and soil type on germination

Seeds for sowing depth test and soil type were collected from an extensively flowered and heavily seeded lowland bamboo forest in Assossa Zone, Southwest Ethiopia (11º14´ N and 36º16´ E) by Pawie Agricultural Research Centre (PARC). The experiment on sowing depth was conducted using plastic polyethene 0.5 l volume, 16 plastic polyethene bags were filled with a mixture of sand and peat soil (ratio 1 sand: 1 peat) and 16 plastic polyethene bags were filled with pure natural peat soil (unmixed) of the area. A randomised complete block design was used in the experiment. In the experiment, each block consisted of 4 polyethene bags. Four seeds were sown at random and in embryo end up orientation in each of the various depth categories. The depths were: 0 mm (surface), 5 mm, 10 mm and 15 mm and replicated four times, i.e., 4 seeds × 4 treatments × 2 blocks (i.e., a total of 32 sample units). During the experiment, seedling emergencewas recorded on a daily basis for four consecutive weeks starting from the first germination. Data was analysed by using version 19 SPSS statistical software. Block means of the different treatments were applied for one-way ANOVA calculations to investigate the impact of sowing depth and soil type on germination.

Vegetative expansion potential

To study reproductive potential and population of lowland bamboo, ten bamboo clumps were taken from quadrants of the 3 habitat categories: Category P (protected habitat), Category C (cultivated habitat) and Category W (wild habitat). Population size was counted based on number of culms in all of the clump observation, whereas reproductive ability of *O. Abyssinica* was examined by counting number of newly developing culms in three different categories of habitats (P,C and W) and circumference classes. This was done by taking ten clumps of *O. abyssinica* from quadrants of the three habitats (protected, cultivated and wild habitat) randomly and the total number of newly emerged culms in the study year, number of cut culms, and number of decayed suckers was counted from each clumps. Then the total newly emerging culms were compared using ANOVA and the relationship between circumference and newly emerging culms was made using Pearson's correlation by using the formula (Table 2).

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2]\,[n(\sum y^2) - (\sum y)^2]}}$$

For this part, data collection was carried out in September by counting newly emerging shoots from sample clumpes, when the young culms developed from bud (youngest rhizomes); they were distinguishable from those sprawtingoutofmature culms. Thus it helped to compare vegetative reproduction potential of *O. abyssinica* in different habitats and different clump sizes.

RESULT AND DISCUSSION

Analysis of vegetation feature

Vegetation feature of Mandura Woredas is made up of different patchy distribution of forests that contain plants like *Combrutum molle, Entada abyssinica, Lonchocarpus laxiflorus* and clumps of *O. abyssinica* associated among themselves. According to the Sørensen coefficient, highest similarity of forest vegetation was found between quadrats 6 and 7 that were taken from cultivated forest. And the lowest similarity of vegetation was between quadrats 3 and 6, and quadrats 3 and 7. Although both of the quadrats were classified as low land bamboo forest, however vegetation in quadrat 6 and 7 was influenced by cultivation activity of humans and the other plants except *O. abyssinica* are removed as wild. The second highest similarity of forest vegetation was found between quadrats 4 and 8. Some valuable vegetation such as *Combrutum molle*, *Entada abyssinica* and *Lonchocarpus laxiflorus* were found in common.

The lowest similarity of vegetation between quadrats was found among quadrats 3 and 6, and quadrats 3 and 7. Although both of the quadrats were classified as lowland bamboo forest, however vegetation in quadrat 6 and 7 was influenced by cultivation activity of humans and the other plants are removed as wild.

In Mandura Woreda, *O. Abyssinica* grows mixed with different trees species. In the quadrats surveyed, it was clear that *Combrutum molle* and *Entada abyssinica* have high association with *O. abyssinica* (IAP= 62.5 %). These plants range from shrub to small trees in their habit, so that their existences do not affect *O. abyssinica* forming canopy shad. Some species such as *Trilepisium madagascariense,* and *Lonchocarpus laxiflorus* have less association with *O. Abyssinica* (IAP = 12.5 %). These plants are tall trees that can form canopy so that *O. abyssinica* is less associated with these species.

Seed viability test

The seedling emergence speed of lowland bamboo seeds were generally fast, less than 5 days on Petri dish but 9-12 days in soil. The percentage of viability is more (98%) on Petri dish and less (65.8%) in soil. This is deu to good moisture on petridish than in soil.

According to Kassahun E [10], lowland bamboo seeds are found most successful and practical propagation materials. The duration of seed storage causes variation on efficiency and speed of viability, in this experiment two years difference in storage duration decreases seed viability by 65%. Viability of seeds collected in 2004 E.C. is 98.3% and germinat in 2 days, but viability is 33.3% and germinates in 4 days for seeds collected in 2002 E.C. (Figure 3). This lies in agreement with Rao IV [11], that reported lose of bamboo seed viability about 2-3 months after harvest. The fast and high seedling emergence percent of *O. abyssinica* agree with the result reported by Prasad P et al. [12], for *Bauhinia retusa*.

Seed germination

Percentage of seedling emergence varied with the type of soil condition and sowing depth. Students t-test (at sig=0.05) showed that seedling emergence was significantly different (higher in mixed soil than the unmixed soil). Time taken for seedling emergence was not significantly different in the two soil condition.

Seed germination of any plant is affected by different factors like temperature, moisture, soil type and sometimes light. In this experiment seed germination of *O. abyssinica* is mainly affected by soil type and moisture. Seeds in Petri dish germinated in less than 5 days where as seeds sown in soil took 9-12 days for germination, this is a fast seedling emergence speed. This in lines with the result reported by Kassahun E et al. [6], in which seeds of *O. abyssinica* germinate in two weeks time after sowing. Seedlings that are germinated in the Petri dish survive effectively when transplanted to soil.

Seedling emergence (viability) is 98% in Petri dish and 65.8% in soil. This is a very high value in the germination efficiency with respect to short viability and low germination rate of bamboo seeds reported by other researchers [4,13]. The variation in speed of germination and percentage of viability could be due to the difference in moisture in the two conditions. In Petri dish, seeds get sufficient moisture and the loss of moisture by evaporation is controlled by laboratory condition. Whereas,in the soil the moisture is lost due to evaporation, down ward percolation of water and fixation of water molecules between soil particles, so that moisture is inadequate for seed germination.

More than half of seeds in mixed soil emerged as seedling with in 12 days. Regarding sowing depth, cumulative emergence (percentage) was highest in 10 mm depth (100%) and lowest at surface (0 mm) and 15 mm. In unmixed (pure peat) soil less than half of seeds emerged as seedling. In unmixed soil the cumulative emergence percentage was equal in the four depths.

Soil type is another factor for seed germination; seeds sown in unmixed soil (pure forest soil) have less percentage of seed viability (37.5%) than mixed soil (68.78%). Student's t-test show significant difference in seed viability between two types of soils (sig=0.05). But difference in duration of germination is insignificant in the two types of soil and sowing depth (Table 1). In contrast to this; Kassahun E, Iji PA, Yorinori NA, [10,14,15], reported that better seedling emergence speed and cumulative seedling emergence at and near the surface is in conformity with the general trend of increasing seedling emergence with decreasing sowing depth.

The variation in viability percentage in the two types of soil condition could be due to that there is good porosity, drainage and aeration in mixed soil, so that moisture and air circulates sufficiently to seeds to germinate, but in the unmixed soil these conditions are low, so that the viability of seeds decreases.

Another factor that affected seed germination in *O. abyssinica* is sowing depth. Seedling emergence is highest in 10mm depth (100%) and lowest at surface (0 mm) in mixed soil. In unmixed soil half of seeds germinated at sowing depth of 5mm, 10mm and 15mm but no any seedling germination is observed on the surface (Table 1,2).

Table 1: Time length and Percentage of seed germination of *O. abyssinica.*

Depth	Mixed soil		Unmixed soil	
	% of seed germination	$\bar{X}$ days for germination	% of seed germination	$\bar{X}$ of days for germination
0 mm	50	10.5	0	-
5 mm	75	10	50	10.5
10 mm	100	9.5	50	9.5
15 mm	50	11	50	10.5
Total average	275 68.75	11 10.25	150 37.5	10.5 10.17

Table 2: ANOVA of difference in seedling immergence in different sowing depth.

	df	Mean Square	F	Sig.
Between Groups	3	1.338	.922	.478
Within Groups	7	1.452		
Total	10			

Population and expansion ability

Population size: The number of culms of *O. abyssinica* varied in different habitats. As shown in (Table 3) the mean number of culms per clump varied significantly (P=0.016) between protected forest, wild forest and cultivated forest. The number of culms is smallest in the wild forest (47 per clump) and highest in the protected forest (86 per clump). But according to the INBAR [16], the average number of culms per clump is 72.3. According to Jodha NS [17], most of the non timber forest products (NTFPs) are harvested from common property resources in situations where access appears to be neither restricted nor regulated so that resources are depleted. In cultivated lowland bamboo forest, the number of culms per clump was high (85). This agrees with the finding of Arnold JE [18] in which, privatization or transfer of control of vegetation forests to a few individuals can lead to a situation where a use of forests is denied access to informal users of forest products, so that the forests can be well managed.

The reason for less number of culms per clumps in the wild forest could be due to uncontrolled harvesting by the community, animal disturbance and fire. In the wild forest in addition to uncontrolled harvesting of bamboo culms, the way of cutting was not properly. During the field observation the researcher observed that culms were cut near the earths' surface. On the other side, the elders in the community claimed that when culms of lowland bamboo are cut near the earth's surface, the ability of clump to produce new shoot decreases. So uncontrolled and unwise harvesting of lowland bamboo culms in the wild forest contributed to the decrease in number of culms per clumps.

On the other side, cultivated and protected forests of *O. abyssinica* in Mandura Woreda, has high number of calms per clump. The reason for large number of culms could be due to controlled system of harvesting culms, proper management and wise way of cutting and being protected from over disturbance by domestic animals.

Vegetative expansion ability: During this study the vegetative reproduction of *O. Abyssinica* is observed with a production of new shoot. The percentage of expansion ability of new culms varied in different habitats (protected, cultivated and wild forests habitats.

Human impact on certain habitat such as tropical forest is responsible for the spread of bamboo that is able to strive under disturbed conditions [7,19]. The percentage reproductive ability is high in cultivated (33.08 average new shoots per clump) and wild forests (16.83 average new shoot per clump) of lowland bamboo (38.77% and 36% respectively) and lowest in protected forests (Table 4). Similar survey in Bambassi Woreda of Benishangul Gumuz Regional State by INBAR [16], showed the average number of new shoots per clump per year to be 22.

The success in the cultivated and wild forests of low land bamboo accounts for high percentage of new shoot production due to the presence of disturbance in the forests. When there is moderate disturbance in any vegetation, the vegetation expansion and vegetation diversity increases. In the cultivated forests the owners collect mature calms for different uses properly and this moderate disturbance activates the clumps to produce many new shoots. In the same manner, in the wild forest of lowland bamboo there is severe disturbance by human beings, domestic animals, wild animals and fire. Even though this all factors do have their own negative effects on the reproductive ability of the plant, they activate the clump to produce more new shoots.

In this study the productive ability of new shoot in each clump is positively correlated with circumphrance of clumps with corrolation value of r=0.66. This shows that there is strong correlation between new shoot production and circumference of clumps that is significant at 0.01 confidence level (2- tailed).

Further more the new culm production difference in the three habitats was tested by Tukys' honesty test (p<0.05). The new culms production was significantly different among the protected and cultivated (group P and group C) and among cultivated and wild forest of lowland bamboo (group C and group W). But the potential of production of new culms of lowland bamboo is not significantly different between protected and wild forest (group P and group W) [20].

CONCLUSION AND RECOMENDATION

Conclusion

Mandura Woreda has different patchily distributed vegetation features containing plants like *Combrutum molle*, *Entada abyssinica*, *Lonchocarpus laxiflorus* and *O. abyssinica*. In the study Woreda *O.abyssinica* grows mixed with different tree species. *Combrutum molle* and *Entada abyssinica* grows more associated with *O. abyssinica*.

Seed germination of *O. abyssinica* is fast which took average 3 days on Petri dish and 9-12 days in soil. Duration of storage of seeds before germination has its own effect on speed and effectiveness of seed germination. So, seeds stored for two years loss their viability by 65% and speed of germination slows by 2 days on Petri dish test. Using mixed soil with sand in the ratio of 1:1 increases seed viability from 37.5% to 68.78%. Although different authors reported the effect of depth of sowing on germination speed and efficiency, in this research the effect of depth is not significant on speed of germination.

Number of culms per clump of *O. abyssinica* varied in different habitats (Table 5). The mean number of culms per clump is highest in protected forests and least in wild forests due to uncontrolled harvesting of the community, animal and fire disturbance and wrong cutting style.

Vegetative expansion of *O. abyssinica* is means of regeneration in which new shoots emerge from the rhizoid every rainy season. The percentage expansion (reproduction) is different in wild, protected and cultivated habitats. It is highest in cultivated and wild forest habitats (38.77% and 36%) per year respectively,

Table 3: Summary table for ANOVA to determine the significant difference of number of culms in the three types of habitats of lowland bamboo.

Source of variation	(SS)	(df)	Mean Square (MS)	F	Sig.
Between Groups	12118.722	2	6059.361	4.664	0.016
Within Groups	42874.917	33	1299.240		
Total	54993.639	35			

Significance level at P<0.05

Table 4: Percentage of new culms production in the three habitats of low land bamboo.

Group	Average of total culm	Average of new culm	% of new culm
P	86	17.83	20.73
C	85.33	33.08	38.77
W	46.75	16.83	36

Table 5: Tukey HSD test to determine the significant difference of number of new culms in the three types of habitats of lowland bamboo.

Group(I)	Group(J)	Mean Difference (I-J)	Std. Error	Sig.
P	C	-15.25000*	3.40992	.000
C	W	16.25000*	3.40992	.000

* The mean difference is significant at the 0.05 level.

but least in protected forest (20.73%). The ability of clumps to produce new shoots is directly proportional with the circumference of the clump.

Recommendation

Since the seeds of *O. abyssinica* require good moisture and good soil aeration and porocity to germinate effectively. So the seeds should be sown in highly humid environment and well aireted.

REFERENCES

1. Kassahun E. The indigenous bamboo forests of Ethiopia: an overview. Ambio. 2000; 29: 518-521.
2. Ohrnberger D. The Bamboos of the World. Amsterdam. 1st Edn. New York: Elsevier. 1999.
3. Uchimura E. Bamboo cultivation. In: Lessard G, Chouinard A, Editors. IDRC, Ottawa Canada. 1980; 151-160.
4. Liese W. Bamboos: Biology, Silvics, Properties and Utilisation [1985]. 1985.
5. Fanshawe DB. Bamboo *Oxytenanthera abyssinica*. Its ecology, silviculture and utilisation. Kirkia. 1972; 8: 157-166.
6. Kassahun E, Christersson L, Ledin S, Weih M. Bamboo as bioresource in Ethiopia: management strategy to improve seedling performance (*Oxytenanthera abyssinica*). Bioresource Technol. 2003; 88: 3-39.
7. Wold Michael Kalecha. The Bamboo Potential of Ethiopia. Addis Ababa. 1980.
8. Mueller-Dombois D, Ellenberg H. Aims and Methods of Vegetation Ecology. 1st Edn. New York: John Willey & Sons. 1974.
9. Beniwal BS, Dhawan VK, Joshi SR. Standardisation of nursery techniques of *Meloccana bacifera* (syn. M. bambusoides). Van Vigyan. 1996; 34: 81-83.
10. Kassahun E. Study on Ecological aspects and resource management of bamboo forests in Ethiopia. Acta Universitatis Agriculture Sueciae Silvestria. 2003; 273: 1-25.
11. Rao IV. Delivery systems for planting materials: requirements and approaches. In: constraints to production of Bamboo and Rattan. INBAR, IDRC Technical Report No.5. 1994.
12. Prasad P, Nautiyal AR. Influence of seed orientation on seedling emergence in Bauhinia retusa Ham. ex Roxb. Seed Sci Technol. 1995; 23: 861-864.
13. Banik RL. Techniques of bamboo propagation with special reference to pre-rooted and pre-rhizomed branch cuttings and tissue culture. 1985; 160-169.
14. Iji PA, Tarawali G, Baba M. The influence of stage of development and sowing depth on seed quality and seedling emergence of *Gliricidia sepium*. Seed Sci Technol. 1993; 21: 197-202.
15. Yorinori NA, Sada SY, Pissaia A. The effect of depth of sowing and early ageing of popcorn (*Zea Mays*) seed upon the percentage of plant emergence. Revista do Sector de Ciencia Agraias. 1996; 2: 173-178.
16. INBAR. International Network for Bamboo and Rattan. Study on Utilization of Lowland Bamboo in Benishangul Gumuz Region, Ethiopia. 2010.
17. Jodha NS. A Framework for Integrated Mountain Development. MFS Discussion Paper No 1. 1990.
18. Arnold JE. Socio-economic benefits and issues in non-wood forest products use. 1995; 89-123.
19. Numata M. The relationship of limiting factors to the distribution and growth of bamboo. In: Numata M, Editor. Ecology of Grasslands and Bamboo-lands in the World. The Hague. Dr. W. Junk Publishers. 1979; 258-275.
20. Widmer Y. Life history of some Chusquea species in old-growth oak forest in Costa Rica. In: Chapman GP, Editor. The Bamboo, Linean Society Symposium Series. San Diego: Academic Press. 1997.

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