

EVALUATION AND COMPARISON OF SURVIVAL RATE AND GROWTH PERFORMANCE OF SELECTED INDIGENOUS TREE SPECIES UNDER DIFFERENT POLYTHENE TUBE SIZE

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ABSTRACT

In arid and semi-arid areas land rehabilitation was potentially affecting from poor survival rate due to moisture stress and short rainfall duration. The objective of the study was to evaluate and compare survival rate and growth performance of selected indigenous tree species (*Ziziphus spina-christi*, *Fadherbia albida*, *Tamarinadus indica* and *Acacia amara*) at different pot size (8 cm, 10 cm, 12cm and 16 cm diameter size of polythen tube). The produced seedlings were transplanted to abergelle agricultural research station which found at gereb-giba. The sapling monitored for one year through recording their survival rate and height at every three month. The difference in polythen tube size doesn't show significant different for all saplings. However, without considering the polythen tube size *Tamarinadus indica* and *Acacia amara* indicates better survival rate in the site. The plant height also doesn't show significant difference for the diameter size across all transplanted species. This result suggests there could be a holistic study from seed collection to post plantation management activities.

KEYWORDS: Land rehabilitation, Plantation, Polythene tube size, Survival rate, Transplanting.

1. INTRODUCTION

Ethiopia is one of the most environmentally troubled countries in the Sahel belt. The principal environmental problem in Ethiopia is land degradation, in the form of soil erosion, gully formation, soil fertility loss and severe soil moisture stress (Hagos, 1999, Yirdaw *et al.*, 2017). Forests are seen as being intricately linked with many of the world's most pressing global environmental and social concerns, such as climate change, loss of biodiversity, water issues and rural poverty. Trees are central to our lives as they are source of food, paper, wooden tools, shelter and medicinal value (Jaenicke, 1999). The problem of environmental degradation, affecting the livelihoods of 1.5 billion people worldwide of which one sixth or 250 million people reside in drylands, is most intense in arid and semi-arid areas (Geist and Lambin, 2004 ; Liu, 2003; Jha *et al.*, 2013; Yirdaw *et al.*, 2017), which together cover nearly 30% of the Earth's surface and comprise half the surface area of the world's developing countries (UNDP, 2004).

Tigray contains many of the areas of greatest land degradation concern in Ethiopia's highlands. But Tigray is known not only for the severity of land degradation, but also for construction of stone terraces and soil bunds, area enclosure and afforestation (Hagos, 1999). Reforestation programme using nursery-produced

seedlings can be an effective means of ensuring successful establishment and rapid growth after out planting (Pinto *et al.* 2011). In Ethiopia plantation has history of decades and the number of seed lings planted each year is increasing from time to time to fulfill the demand of fuel wood and to get other goods and services of forests. But there is low survival rate of seedlings in moisture stress areas of the country especially Tigray (Gebremeskel, 2018). Plant survival is a key factor in forest dynamics and survival probabilities often vary across life stages and using planting containers techniques enhance for restoration of biodiversity (Anton *et al.*, 2015; Moustakas & Evans, 2015; Repáč, 2011). With this regard the survival rate of indigenous tree seedlings is very low but the use of these trees for their forest and non-forest product is getting increased through time so to sustain the demand of the people increasing survival rate of these tree seedling are crucial. The objective of this study was to evaluate and compare survival rate and growth performance of selected indigenous tree species using different polythene tube size diameter.

2. MATERIALS AND METHODS

Description of the study Area

This experiment was undertaken at Abergelle agricultural research center research site station. The

research station is found in Tanqua abergelle wereda, central zone of Tigray. It is located about 120 kilo meter away from the capital city of Tigray regional state, Mekelle, to the west direction. The rain fall pattern of the district is monomodal with a wet season of about two months occurring in July to August. It is located 13° 14' 06'' N latitude and 38° 58' 50'' E longitudes. It is agro

ecologically characterized as hot warm sub- moist low land (SM1- 4b) below 1500 m.a.s.l. the mean annual rain fall and temperature are 350 – 700mm and 24- 41 °c respectively. It has diverse soil type such as sandy loam (63.73%), clay loam (30.47%) and silt loam (5.8%) with low organic matter content (unpublished data of OoARD of the wereda, 2008).

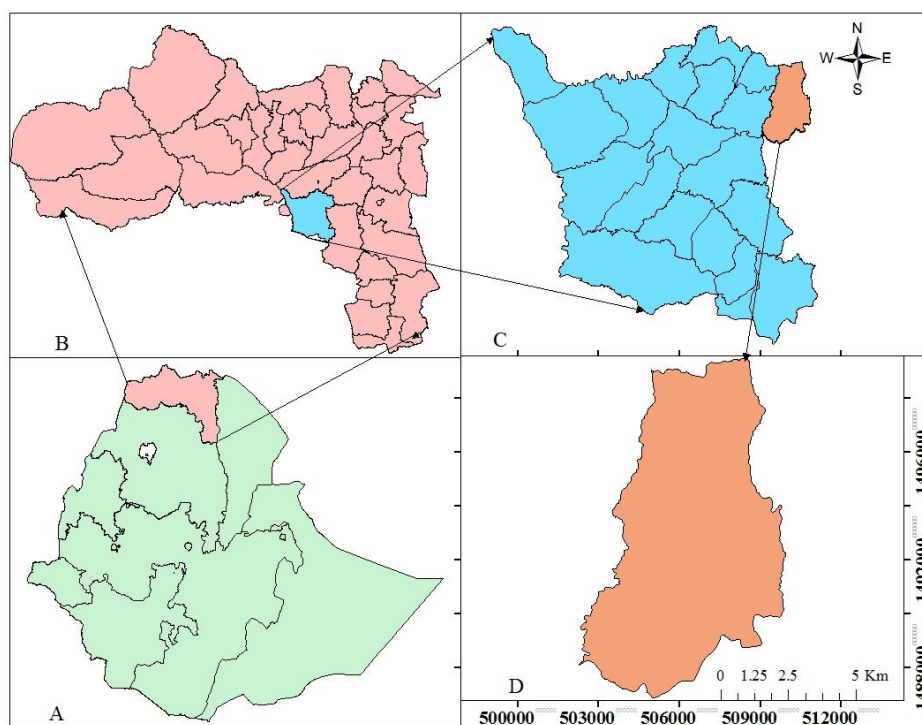


Figure 1: Map the study area.

Experimental design and treatments

Four indigenous tree species (*Ziziphus spina-christi*, *Fadherbia albida*, *Tamarinadus indica* and *Acacia amara*) were selected for evaluation and comparison of their survival rate and growth performance at the established experimental plots. The experimental plots were laid out in randomized complete block design with three replications. The space between species within the plot was 2m x 2m. The space between plots within a block and between block were 3 and 5m respectively. The treatments were 8 cm, 10 cm, 12cm and 16 cm diameter size of polythene tube. The seedling were raised and produced at governmental nurseries with soil ratio of 3:2:1(local soil: forest soil: sand) and transplanted to research station.

Data collection and analysis

The planted seedling monitored for one year and at every three month their survival rate and growth rate were measured. Pre and post silvicultural management activities were equally applied for all species. SPSS V-20 software was used for statistical analysis. A survival analysis was done for each species using one-way ANOVA.

3. RESULT AND DISCUSSION

Survival Rate: Survival rate of transplanted seedling of *Ziziphus spina-christi* after 12 month was 6.5%, 3.3%, 6.5% and 11.5 for 8cm, 10cm, 12cm and 16cm diameter size of polythene tube respectively (Figure 2). The survival rate of the seedling was very low for all different polythene tube diameter size. The trend line shows there was a decreasing in survival rate at all quarterly inventory. In the dry season *Ziziphus spina-christi* was critically challenged from moisture stress as the rain season were off at late September. The time bound between December to February was clearly identified for its highly reduced survival rate (Figure 2). The size of polythene tube for survival *Ziziphus spina-christi* couldn't signify the problem of moisture stress and soil fertility in the research station. The statistical analysis of effect of different polythene tube diameter size for survival of *Ziziphus spina-christi* do not significantly ($P < 0.5$) affected. The study of Scianna *et al.*, 2016 reported there was no significance in survival rate of specie at different container size. Birhan 2017 indicate that slow rehabilitation process was the main factor at enclosure as it is highly exploited and severely degraded. Plants in forest restoration projects managed by community groups experienced similar mortality as those managed by local government (Anton *et al.*, 2015).

Asmelash *et al.*, 2019 reported that arbuscular mycorrhizal fungi (AMF) have a role forest restoration for tree species selection and seedlings in Ethiopia.

Survival rate of planted seedling of *Tamarindus indica* after 12 month was 56.6%, 60%, 65% and 68% for 8cm, 10cm, 12cm and 16cm diameter size of polythene tube respectively (Figure 2). This tree shows better survival rate as compared with *Ziziphus spina-christi* and the larger polythen tube size indicates relatively higher survival rate. In this study *Tamarindus indica* shows good survival rate. The survival trend line in *Tamarindus indica* show relatively uniform reduction at all quarterly inventory. The diameter size of 12 and 16 cm shows better performing than diameter size of 8 and 10 cm. *Tamarindus indica* shows a promising survival at higher polythene tube size. Comparison for *Tamarindus indica* under different polythen tube size doesn't show significant ($P < 0.05$) difference on its survival rate. Shows Broad-leaved trees, shrubs, and herbaceous plants need a larger container diameter so that irrigation water applied from above can penetrate the dense foliage and reach the medium. Survival rate of species was determined with physiology and adaptation to the environment (Birkinshaw *et al.*, 2009).

Survival rate of planted seedling of *Acacia amara* after 12 month was 66.9%, 65%, 65% and 70 for 8cm, 10cm, 12cm and 16cm diameter size of polythen tube respectively (Figure 2). The survival rate *Acacia amara* was best as compared with remaining tree seedling. In average this tree shows good response for plantation but

the different in pot doesn't show much significant. The pot size had no significant important for survival at plantation area. The survival trend line for *Acacia amara* indicates the reduction was small in number as compared with other tree seedlings. The different diameter size of polythen tube doesn't show recognized different survival rate at all diameter size. Comparison for *Acacia amara* under different polythen tube size doesn't show significant ($P < 0.05$) difference on its survival rate.

Survival rate of planted seedling of *Faidherbia albida* after 12 month was 1.6%, 3.3%, 6.6% and 1.6% for 8cm, 10cm, 12cm and 16cm diameter size of polythene tube respectively (Figure 2). This result shows poor survival rate of *Faidherbia albida* across all polythen tube size size. *Faidherbia albida* doesn't show much difference on the survival rate using different polythen tube size diameter for plantation program. *Faidherbia albida* survival trend lines indicate decreased the whole year without difference across all diameter size of polythen tube. In this study *Faidherbia albida* doesn't respond its survival for different diameter size. Comparison for *Faidherbia albida* under 8cm, 10cm, 12cm and 16cm polythen tube diameter size doesn't show significant ($P < 0.05$) difference of survival rate. Tsakaldimi *et al.*, 2012 reported that all initial characteristics were not good predictors for survival at field condition. The study of Moustakas1 & Evans1, 2015 reports most tree species of UK hardwood mortality was constant between years and size dependent at early life stages and size independent at later life stages.

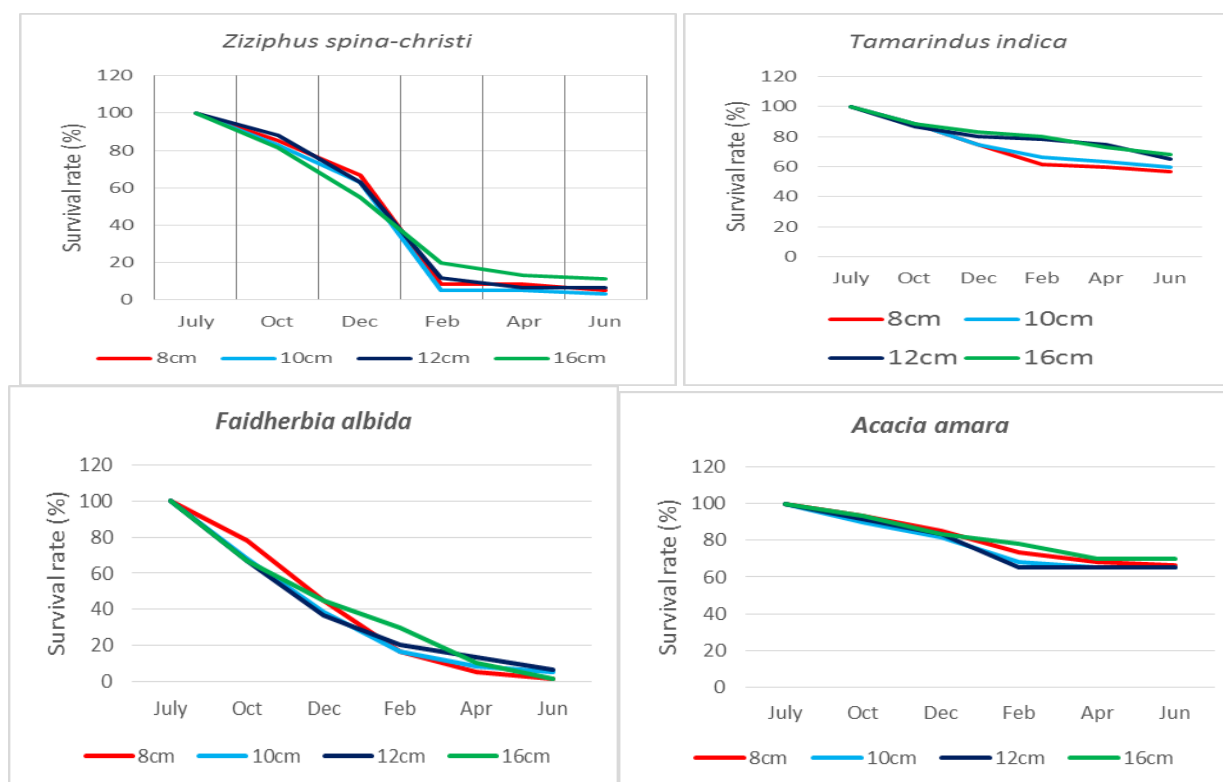


Figure 2: Effect of polythen tube size on survival rate of *Ziziphus spina-christi*, *Tamarindus indica*, *Acacia amara*, *Faidherbia albida*.

Comparison for the survival rate of the seedling doesn't show a significant difference with the polythene tubes size. The attributes of species survival to the polythene size was the low moisture content, shallow root depth, low soil nutrient and long dry season. In dry areas of Tigray, moisture stress continued as a constraint of land rehabilitation activities. Moisture deficiency results in

poor germination, establishment and survival of plants (Birhane, 2017). The story of UNEP 2019, reports the challenges with tree planting has been seedling survival, which depends on outside human control like drought or natural disasters, overgrazing by animals, which can require fencing, and poor soil fertility.

Table 1: One-way ANOVA analysis of effect of polythene tube diameter size on survival rate and growth performance with standard errors in parenthesis.

Treatments	<i>Ziziphus spina-christi</i>		<i>Tamarindus indica</i>		<i>Acacia amara</i>		<i>Faidherbia albida</i>	
	Survival rate	Plant height	Survival rate	Plant height	Survival rate	Plant height	Survival rate	Plant height
8cm	5±2.8	40.5±1.6	56.6±4.4	42.6±2.9	66.6±8.8	39.8±2.7	1.6±1.6	36.2±0.03
10cm	3.3±3.33	35.3±4.1	60±5.7	41.7±2.7	65±7.6	34.8±1.8	5±2.8	36.2±0.42
12cm	6.6±4.41	37.8±1.8	65±5.7	45.4±2.2	65±5	42.9±0.9	6.6±1.6	40.7±1.7
16cm	11.6±1.66	38.8±2.6	68.3±2.7	40.8±1.5	70±2.8	38.1±2.8	1.6±1.6	39.2±2.3
F-value	1.24	0.63	0.62	0.69	0.13	2.3	1.5	2.3
p-value (sig)	0.35	0.61	0.61	0.58	.93	0.15	0.28	0.14

Height: The plant height of the transplanted seedling has no significant difference at the different diameter size for all species (Table1). The growth performance in height was influenced due to moisture stress and, poor soil fertility and long dry season. However Scianna *et al.*, 2016 stated that large container diameter size shows significantly higher in height. The study of Birkinshaw *et al.*, 2009 revealed that there was no significant difference of survival rate between relatively short seedlings and tall seedlings. Seed size, soil ratio and mycorrhiza was related with root collar diameter, survival rate and height increment for rehabilitation or pinus tree which is needed to consider during seedling preparation (Missanjo and Thole, 2014; Macera *et al.*, 2017; Mao *et al.*, 2019).

4. CONCLUSION

Tamarindus indica and *Acacia amara* had better survival rate at species level however *Ziziphus spina-christi* and *Faidherbia albida* records poor survival rate. The survival trend line of all species similarly influenced from all factors as their survival rate is similar at all diameter size per species. The tree seedlings tested for different polythene tube diameter size do not show any significant difference in survival rate and height. This indicates the growth performance and survival rate of the species is not influenced or supported from having different diameter polythene tube size. In general in addition to polythene tube size watering the whole year and supplementing additional organic fertilizer can contribute for the higher survival rate and growth performance. This also indicates that plantation of tree seedlings should depend on previous success stories of that specific area, seed source, post management not just by blind generalization of saying it's a low land tree.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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