

Assessment of Growth Performance of *Acacia catechu*

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Abstract: Growth performance of any tree species is a major parameter to determine the felling rotation of that species. In Nepal, the growth performance of the *Acacia catechu* has not been assessed so far. Thus, this study was objectively carried out to assess the mean annual volume growth according to blocks and provenances. The Breeding Seed Orchard of Siraha district was selected for the study site. Both primary and secondary data were collected. The diameters and heights were measured using Diameter tape, Abney's level and linear tape. Total enumeration was done to collect the data so altogether 2520 plants were measured. The collected data were analyzed using descriptive and inferential statistics. The average volume in 2018 was found to be highest in Block D with 0.0186m^3 and lowest in Block A with 0.0130m^3 . The mean annual volume increment was found to be highest in Block D i.e. 0.0031m^3 in 2018 and lowest in Block A i.e. 0.0022m^3 . Here, the mean annual volume increment was found to be higher in 2018 as compared to 2016. The average volume of *A. catechu* was the highest around 0.0072m^3 in 2016 of Dhanusha (Dharapani) while it was the highest around 0.0191m^3 in 2018 of Dhading (Benighat) provenance. It was the highest mean annual volume increment 0.0018m^3 of Dhanusha (Dharapani) provenance in 2016 while it was the highest mean annual increment about 0.0032 in Sunsari (Parkashpur) prominence in 2018. The growth performance of this species will be useful to determine the rotation.

Keywords: Breeding Seed Orchard, Provenance, Mean Annual Increment

1. BACKGROUND

Forests are the valuable natural resources in Nepal. The forest cover in Nepal was around 45.5% which was reduced to 39.6% in 1994 (DFRS, 1999). With active participation of various organizations and nature conversationalist, forest covers have once again increased to 44.74% (DFRS/FRA, 2014). According to forest resource assessment (FRA, 2014), there is an increase of forest area by 5% between 20 years period from 1990s. The MoEST (2008) has estimated that over 28% of the lands in Nepal are in degraded condition. It would be wise to select a native or naturalized species for the rehabilitation of degraded sites in mid-hills (Jha et al., 2013).

Acacia catechu is one of the very few species which grows well in the degraded lands and could be very useful for the community plantations in Nepal. It is a useful multi-purpose tree producing fuel wood, small timber and fodder which is very popular among the local people in Terai region (Thapa, 2004). The most important commercial products from *Acacia catechu* are Kathha and Cutch. Katha is mainly used for chewing with betal nut and pan, and also have medicinal and pharmacological use whereas the bi-product cutch used in tanning and dyeing ships (Jackson 1994).

Growth performance of any tree species is a major parameter to determine the felling rotation of that species (Thapa and Gautam, 2005, Onefeli and Adesoye, 2014). At the same time, the species wise growth performance varies according to its inherent quality obtained by its parent as well as the site quality and microclimate. *Acacia catechu* is planted in the Breeding Seed Orchards (BSOs) of Mirchaiya, Siraha Nepal (TISC, 2011 and 2012).

2. MATERIALS AND METHODS

2.1. Study Area

After discussion with Forest Silviculture Division staffs and analysis of different Breeding Seed Orchards (BSOs) records available at FSD (2015), BSO was selected from Siraha district for study. The BSO at Siraha district, Nepal was selected because it is one of the important site which was

established with Randomized Block Design (RBD). The BSO was established in 2012 A.D. After the establishment of BSO, different silvicultural operations like weeding, cleaning, thinning, pruning were carried out. The first thinning was done after four years of establishment i.e.2016 A.D.

The information about the selected BSO is shown in following table 1 and figure 1:

Table1. The Information about Selected BSO

BSO/Spp	Area ha	Total provenance	Seedling	No. of Blocks	Total Seedling Planted	Spacing	Est. Date
<i>Acacia catechu</i>	1	30	21	4	2520	1.5 m X 1.5m	2012AD

Plants were marked before measurement and also tied with red ribbon. As the plants were measured the ribbon was removed to avoid the repetition.

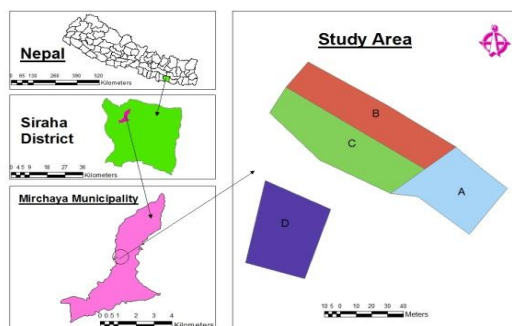


Figure1. Map of Study Area

2.2. Data Collection

Both primary and secondary data were collected. The primary data was collected from the field measurement. Total enumeration was done to collect the data so diameter and height of total 2520 plants were measured using D tape, Abney's level and simple tape (Chaturbedi and Khanna, 1982). The secondary information was gathered from the available records from department of forest. The secondary information included the plantation time, seed sources and previous measurements. In addition, the literature review, various publications of Ministry of Forest and Soil Conservation, Department of Forests, Department of Research and Survey and other related literature (published and unpublished) were consulted during this study.

2.3. Data Analysis

The data collected from different sources were processed, tabulated and analyzed qualitatively as well as quantitatively. Quantitative data was analyzed using descriptive statistics such as percentage, mean, frequency distribution, table, graphics etc. whereas qualitative data was analyzed in descriptive manner.

The Volume and mean annual volume increment were calculated using the measured records of diameter and height. The following formulae were used for the quantitative analysis.

Volume Calculation

$$Volume (V) = \left(\frac{\pi d^2}{4} * Height * form factor\right) / 10000$$

Where, V = Volume in m³, d = diameter in cm

Mean Volume (MV) and Mean Annual Volume Increment (MAVI) = MV/Age of tree

3. RESULTS AND DISCUSSION

3.1. Mean Volume Growth of *Acacia Catechu* in Different Blocks

The table shows that, the average volume of *Acacia catechu* before thinning was found to be highest in Block D i.e. 0.0061 m³ and lowest in Block B i.e. 0.0045 m³. Similarly, the average volume in 2018 was found to be highest in Block D i.e. 0.0186 m³ and lowest in Block A i.e. 0.0130 m³. The difference in the average volume was found highest in block D i.e. 0.0125 m³ and the lowest in block A i.e. 0.0081 m³.

Likewise, the mean annual volume increment (MAVI) before thinning was found to be highest in Block D i.e. 0.0015m³ and lowest in Block B i.e. 0.0011 m³. The mean annual volume increment in 2018 was found to be highest in Block D i.e. 0.0031 m³ and lowest in Block A i.e. 0.0022m³. Here, the mean annual volume increment was found to be higher in 2018 as compared to 2016 (Table 2).

Table2. Mean Volume Growth of *Acacia Catechu* in Different Blocks

Block	Avg.vol. (m ³) in 2016	Avg.vol.(m ³)in 2018	Difference	Difference %	MAVI(m ³) in 2016	MAVI(m ³) in 2018
A	0.0050	0.0130	0.0081	161.1405	0.0012	0.0022
B	0.0045	0.0144	0.0099	218.3764	0.0011	0.0024
C	0.0050	0.0160	0.0110	219.2695	0.0013	0.0027
D	0.0061	0.0186	0.0125	204.5835	0.0015	0.0031

One way ANOVA Test for comparing carbon growth in *Acacia catechu* in Different blocks and Tukey's B Post hoc test shows that there is no significant difference in volume growth of *Acacia catechu* of different provenances y at 95% confidence level.

3.2. Mean Volume Growth of *Acacia Catechu* According to Provenances (Different Sites)

The average volume of *A. catechu* was the highest around 0.0072 m³ in 2016 of Dhanusha (Dharapani) while it was the highest around 0.0191 m³ in 2018 of Dhading (Benighat) provenance. It was the highest mean annual volume increment 0.0018 m³ in 2016 of Dhanusha (Dharapani) provenance while it was the highest mean annual increment about 0.0032 Sunsari (Parkashpur) provenances (Table 3).

Table3. Growth of *Acacia Catechu* of Different Provenance

District/Place (Provenance)	Avg. vol. (m ³) in 2016	Avg.vol. (m ³) in 2018	Difference	Difference %	MAVI (m ³) in 2016	MAVI (m ³) in 2018
Jhapa (Suranga)	0.0057	0.0176	0.0119	208.772	0.0014	0.0029
Ilam (Danabari)	0.0049	0.0115	0.0066	134.694	0.0012	0.0019
Sunsari (Parkashpur)	0.0056	0.0136	0.008	142.857	0.0014	0.0023
Saptari (Mahuliya)	0.0052	0.0192	0.014	269.231	0.0013	0.0032
Siraha (Bandipur)	0.0051	0.016	0.0109	213.726	0.0013	0.0027
Siraha (Mirchaiya)	0.0043	0.0147	0.0104	241.861	0.0011	0.0025
Siraha (Phulbariya)	0.0057	0.0132	0.0075	131.579	0.0014	0.0022
Siraha (Chaurahwa)	0.0045	0.0133	0.0088	195.556	0.0011	0.0022
Dhanusha (Dhanushadham)	0.0054	0.0162	0.0108	200.00	0.0014	0.0027
Dhanusha (Godara)	0.0041	0.0135	0.0094	229.268	0.001	0.0023
Dhanusha (Umaprempur)	0.0055	0.0162	0.0107	194.546	0.0014	0.0027
Dhanusha (Dharapani)	0.0072	0.0161	0.0089	123.611	0.0018	0.0027
Mahottari (Bardibas)	0.0048	0.0164	0.0116	241.667	0.0012	0.0027
Sarlahi (Hariwan)	0.0058	0.0177	0.0119	205.172	0.0015	0.003
Rautahat (Chandranigahpur)	0.0061	0.014	0.0079	129.508	0.0015	0.0023
Rautahat (Gaidatar)	0.006	0.0152	0.0092	153.333	0.0015	0.0025
Bara (Ratanpur)	0.0049	0.0168	0.0119	242.857	0.0012	0.0028
Dhading (Salyantar)	0.0054	0.0138	0.0084	155.556	0.0014	0.0023
Dhading (Gajuri)	0.0039	0.0164	0.0125	320.513	0.001	0.0027
Dhading (Galaudi)	0.0059	0.0139	0.008	135.593	0.0015	0.0023
Dhading (Kumpur)	0.0056	0.0152	0.0096	171.429	0.0014	0.0025
Dhading (Benighat)	0.0049	0.0191	0.0142	289.796	0.0012	0.0032
Dhading (Salangaghat)	0.0048	0.0146	0.0098	204.167	0.0012	0.0024
Nawalparasi (Bardaghat)	0.0066	0.0173	0.0107	162.121	0.0017	0.0029
Nawalparasi (Triveni)	0.0058	0.0177	0.0119	205.172	0.0015	0.003
Rupandehi (Tamnagar)	0.0045	0.0166	0.0121	268.889	0.0011	0.0028
Rupandehi (Ranibagiya)	0.0035	0.0145	0.011	314.286	0.0009	0.0024
Rupandehi (Murgiya)	0.0044	0.0153	0.0109	247.727	0.0011	0.0026
Kapilbastu (Chandrauta)	0.0046	0.0184	0.0138	300	0.0012	0.0031
Kanchanpur (Chadanidodhara)	0.0056	0.0133	0.0077	137.5	0.0014	0.0022

Note: Avg. Vol. Indicates Average Volume in Table

Volume growth depends up on the growth of height and diameter of the plants. In 72 months period, the volume growth of *Acacia catechu* of 30 different provinces was recorded 0.001 to 0.003 m³. The site quality, damage, light condition (open, shade, hinder), local operations, diseases effects are main causes of variation of growth performance of plants (Karlen et al., 1997, Goel and Singh 2008, Deve and Parthiban, 2014). In addition, the moist condition also affects the growth of the plants (Hunter, 2000, Moni et al., 2014). The study Growth Performance of Native Tropical Tree Species on a Coal Mine Spoil on Singrauli Coalfields, India done by Singh et al. (2009), resulted that, 'the height, diameter and volume of 2-years and 9 months-old tree species ranged between 1.59 to 4.25 m, 4.41 to 9.29 cm and 3503 to 36238 cm³, respectively.

4. CONCLUSION AND RECOMMENDATION

The mean annual volume increment (MAVI) before thinning was found to be highest in Block D and lowest in Block B. The average volume of *A. catechu* was the highest around in 2016 of Dhanusha (Dharapani) but it was highest in 2018 of Dhading (Benighat) provenance. Similarly, the highest mean annual volume increment was in 2016 of Dhanusha (Dharapani) provenance while it was the highest mean annual increment about Sunsari (Parkashpur) prominence. Therefore, these provenances are very appropriate for seed production of *A. catechu*.

Such types of research showing the growth performance should be continued to find growth performance upto maturity.

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