



BIOMASS PRODUCTION POTENTIAL AND ASH CONTENT VARIATION IN DIFFERENT FOREST TREES SPECIES IN EASTERN REGION OF UTTAR PRADESH, INDIA

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ABSTRACT

Live tree biomass estimates are essential for carbon accounting, bioenergy feasibility studies, and other analyses. The estimation of biomass in forests is critical for carbon cycle modeling and climate change mitigation programs. To estimate the biomass production potential of different fast growing tree species in Allahabad district of U.P, total of 12 tree species was selected viz a viz *Dalbergia sissoo*, *Acacia nilotica*, *Azadirachta indica*, *Leucaena leucocephala*, *Aegle marmolos*, *Cassia*, *Fistula*, *Albizia lebbeck*, *Bauhania variegata*, *Ficus religiosa*, *Madhuca indica*, *Tectona grandis*, and *Terminalia arjuna*. This study assessed the biomass production potential and ash content variation of the tree species in the Allahabad district of Uttar Pradesh. The experimental data was subjected to statistical analysis by using ANOVA techniques and critical difference test. And treatment effect was determined by F test. Research result shows that production of biomass was obtained maximum in *Albizia Lebbeck* (9.021 ton/ tree), *Madhuca indica* (7.867 ton/ tree), *Aegle marmolos* (7.538 ton/tree), *Dalbergia sissoo* (7.37 ton/tree) minimum was recorded for *Azadirachta indica* (1.953 ton/tree). Maximum ash content was obtained for *Terminalia arjuna* (4.743%), *Ficus religiosa* (3.08%) and minimum for *Leuceana leucocephala* (1.790%).

INTRODUCTION

Reasonable methods for estimating tree biomass and carbon stocks on forest land are increasingly important given concerns of global climate change, increasing interest in bioenergy projects, and carbon sequestration protocols for the voluntary and regulated markets. After a gap in scientific research of approximately 30 years, interest in forest biomass is again growing (Zianis et al. 2004). Traditionally, the determination of above ground tree biomass has been conducted to ensure sustainable management of forest resources. Fuel wood management has motivated the calculation of biomass equations, whereas timber management has

mainly driven volume equations. Today, the accurate estimation of forest biomass is crucial for many applications, from the commercial use of wood (Morgan and Moss 1985) to the global carbon (C) cycle (Bombelli et al. 2009). Because of interest in the global Carbon cycle, estimating above ground biomass with sufficient accuracy to establish the increments or decrements of Carbon stored in forests is increasingly important. Forests form a major component of the Carbon reserves in the world's ecosystems (Houghton, 2007) and greatly influence both the lives of other organisms and human societies (Whittaker and Likens 1975).

Trees also play a key role in the global Carbon cycle. Managing forests through agroforestry, forest plantation systems is seen as an important opportunity for climate change mitigation and adaptation (IPCC, 2007), Canadell and Raupach 2008).

Biomass estimation for tropical forest has received much attention in recent years because the change of biomass regionally is associated with important components of climate change. Biomass determines potential carbon emission that could be released to the atmosphere due to deforestation or conversion of non forest land use. Therefore, accurate biomass estimation is necessary for better understanding deforestation impact on global warming and environmental.

Ash from woody biomass comes from the minerals present in the structure of trees and shrubs in addition to any soil contamination Demeyer, *et. al*, 2001 . Properties of wood ash depend on a variety of factors including type of tree or shrub, part of the tree or shrub (bark, wood, leaves), type of waste (wood, pulp, or paper residue), combination with other fuel sources, type of soil and climate and conditions of combustion. Ash from woody biomass, in general, stimulates microbial activities and mineralization in the soil by improving both the soil's physical and chemical properties Misra *et. al.*, 1993. Improved soil quality from the nutrients found in wood ash can lead to better growing conditions for vegetation. Wood ash has a high alkalinity or neutralizing capacity Misra *et. al.*, 1993.

MATERIALS AND METHOD

Study Area

The study area was located in Uttar Pradesh, India. Allahabad is located in the southern part of the state at 25°27' N latitude 81°84' E longitude. Allahabad possesses tropical to subtropical climate with extreme summer and winter. The temperature falls to as low as 5° C in winter while in summer it reaches above 45°C. Hot sizzling winds are quite common during summer and sporadic spell of frost occurs during winter.

Methods

Measurement of Diameter at breast height (DBH)

To estimate biomass from selective tree species, it is not advisable to cut them. The biomass can be measured by mathematical models by measuring diameter at breast height (DBH) directly and the girth at DBH. Girth considered is the DBH (Chavan and Rasal 2010).

Above Ground Biomass of Tree (AGB)

AGB include all living biomass above the soil. The aboveground biomass (AGB) has been calculated by multiplying volume of biomass and wood density the volume was calculated using volume equations given by forest survey of India, 2011 report.

Below Ground Biomass of Tree

The below ground biomass (BGB) include all biomass of live roots excluding fine roots having, <2 mm diameter.

Below ground biomass = Above Ground Biomass × (15/100) (ton).

Total Biomass

Total biomass is the sum of the above and below ground biomass. (Sheikh *et al.*, 2011).

Total Biomass (TB) = Above Ground Biomass + Below Ground Biomass

Calculation of ash (%)

The percentage ash of the tree species was determined by laboratory analysis. However, woody samples of all the tree species were collected for oven dry and burned to ash for ash content determination, Sample was dried at 105°C for some days until the dried weight remain constant, Using a porcelain marker, an appropriate number of crucibles are marked and place them in muffle furnace at 575± 25°C for minimum of 4 hours , crucibles was removed from the furnace directly into dessicator and allowed to cool for period of one hour minimum. Crucibles was weighed to the nearest 0.1mg and recorded, sample was taking back to the muffle furnace at 575±25°C and dried at constant weight. Weighed 0.5 to 2.0g to nearest 0.1g of a test specimen into the crucibles and the sample weight was recorded.

Ash (%) = $(W_3 - W_1)/(W_2 - W_1) \times 100$
 Where W1 is the weight of crucibles
 W2 the weight of oven dried grind samples + Crucibles
 W3 is the weight of ash + Crucibles

RESULT AND DISCUSSION

Data collected from the study area were summarized in the figures below. It reveals the summary of the data been recorded in Allahabad. The selected 12 tree species, it also indicates the average DBH in (m), the mean

above ground biomass (ABG) per tree in (ton/tree), below ground biomass (BGB) per tree in (ton/tree), the Total biomass per tree in (ton/tree). The estimated biomass has been compared, It reveals that maximum biomass (9.021 ton/tree) was obtained obtained for *Albizia lebbeck*, *Madhuca indica* (7.867 tone/tree), *Aegle marmolos* (7.538 ton/tree). However, minimum was obtained for *Azadirachta indica* with (1.953 ton /tree)

Fig.1 Diameter at the breast height of the species (m)

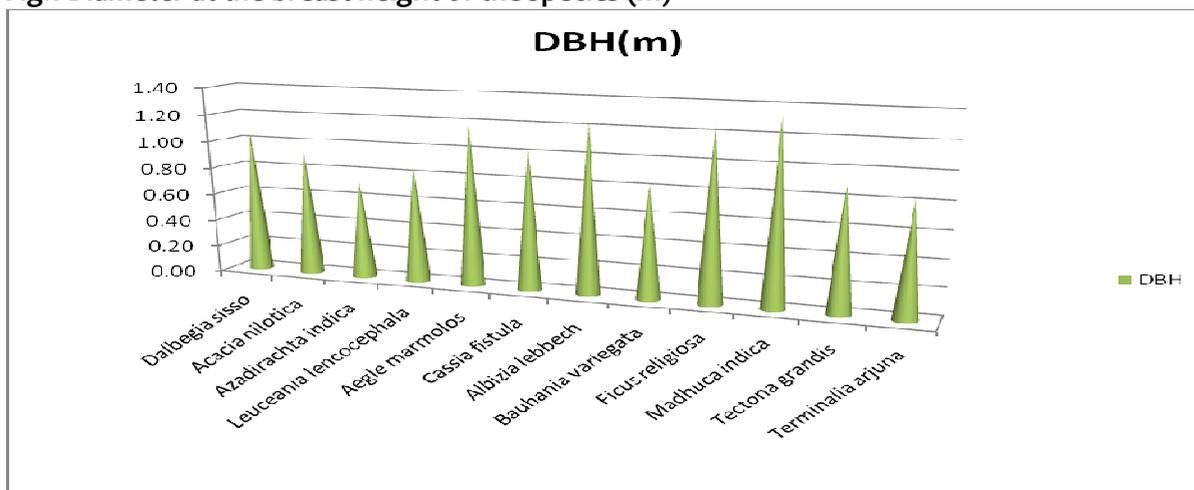


Fig:1 Diameter at breast height (1.423 m) was recorded for *Aegle marmolos* which was statistically at par with *Madhuca indica* (1.327 m), *Albizia lebbeck* (1.24m). Whereas the rest of treatments showed significant different with each other. However, the minimum was obtained for *Azadirachta indica* (0.723 m).

Fig.2 The above ground biomass of the tree species in (tone/tree)

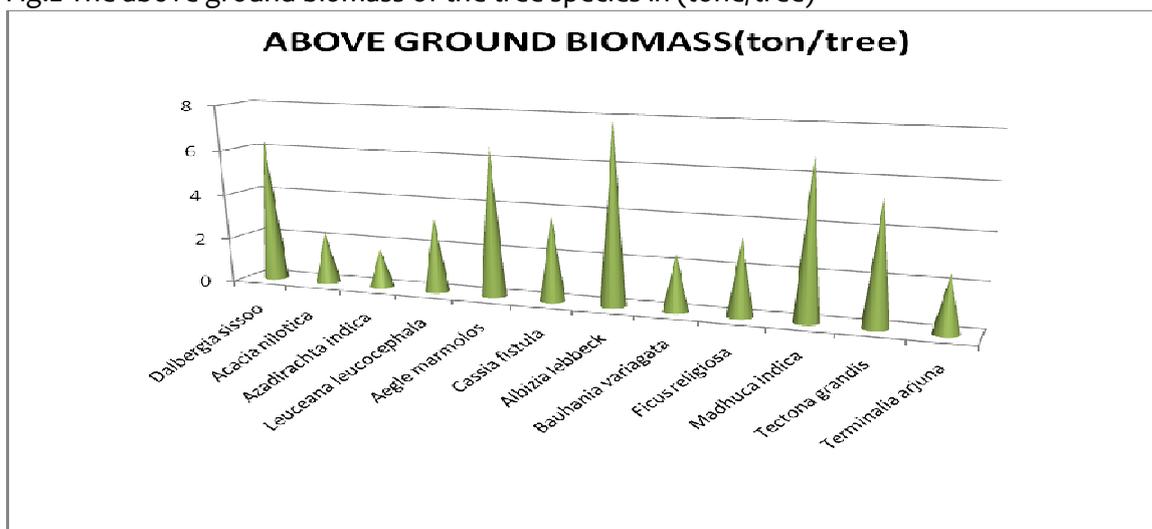


Fig : 2 revealed the maximum above ground biomass (7.845 ton/tree) was found for *Albizia lebbeck* which is statistically at par with *Madhuca indica*(6.841ton), *Aegle marmolos* (6.555 ton/tree), *Dalbergia sissoo* (6.409 ton/tree),the rest of treatments showed significant different with each other, minimum (1.698 ton/tree) was found for *Azadirachta indica*.

Fig. 3 Below ground biomass of the tree (ton/tree)

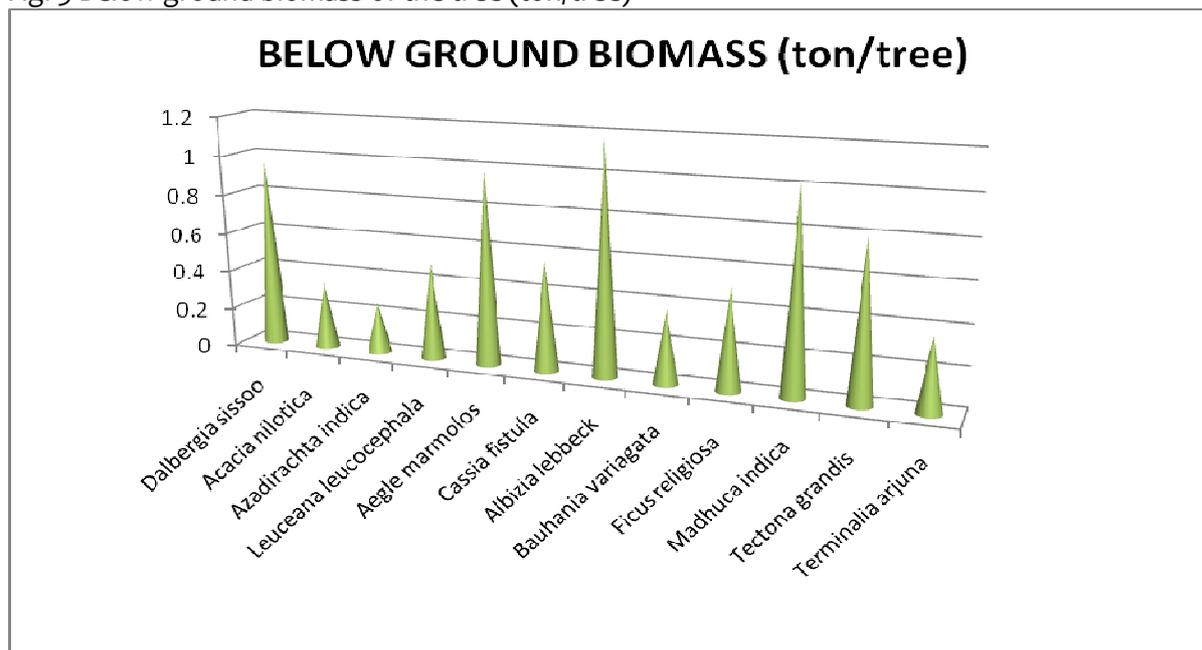


Fig: 3 revealed the maximum below ground biomass (1.177 ton/tree) was found for *Albizia lebbeck* which is statistically at par with *Madhuca indica* (1.026ton/tree), *Aegle marmolos* (0.983ton/tree), *Dalbergia sissoo* (0.961ton/tree), the rest of treatments showed significant different with each other, minimum (0.255 ton/tree) was found for *Azadirachta indica*.

Fig 4 Total biomass of the tree species (ton/tree)

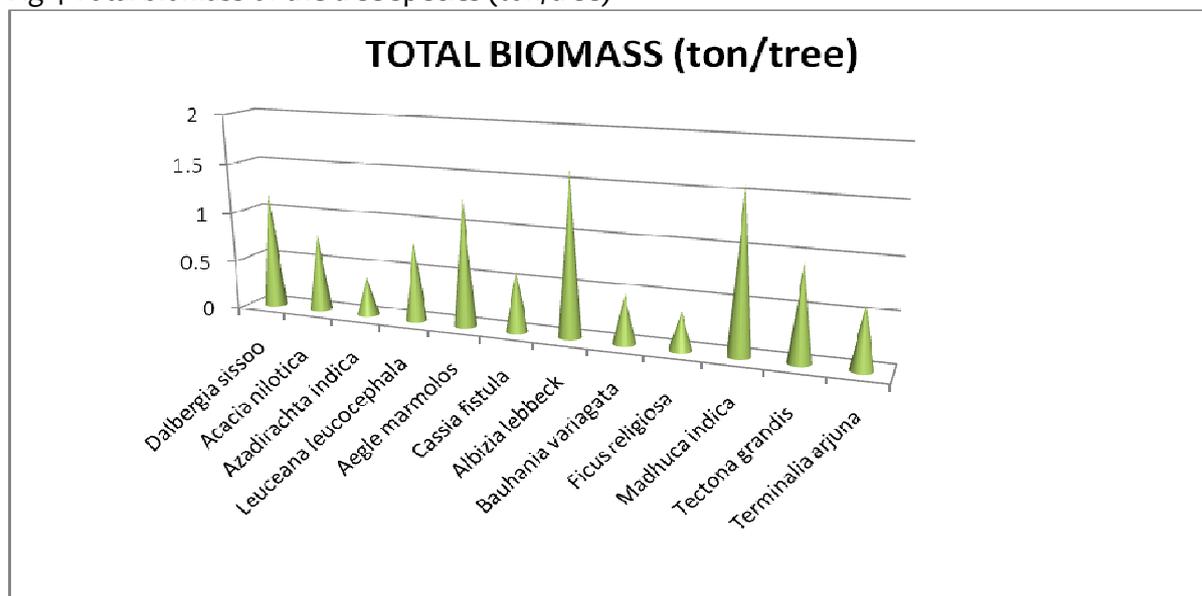


Fig : 4 revealed the maximum total ground biomass (9.021ton/tree) was found for *Albizia lebbeck* which is statistically at par with *Madhuca indica*(7.867ton/tree), *Aegle marmolos* (7.538ton/tree), *Dalbergia sissoo* (7.370ton/tree), the rest of treatments showed significant different with each other, minimum (1.953ton/tree) was found for *Azadirachta indica*.

Fig: 5 Percentage mineral content (Ash) of the tree species (%)

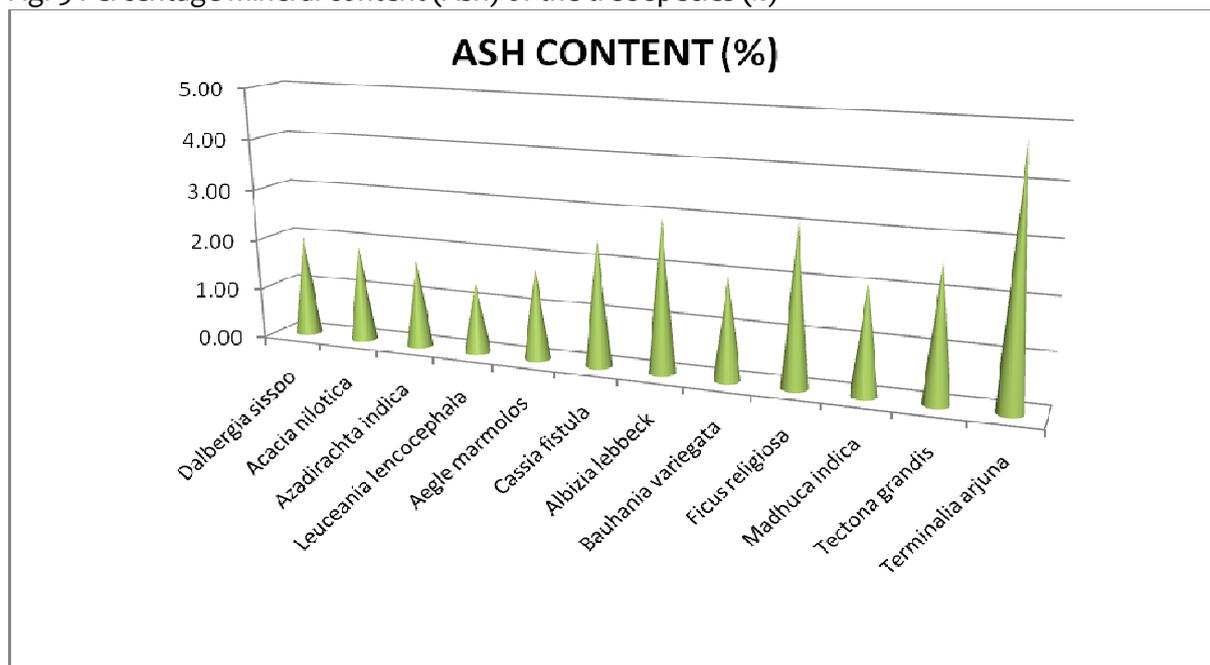


Fig .5 revealed maximum ash content (4.74%) was obtained for *Terminalia arjuna*, followed by *ficus religiosa* (3.087%), *Albizia lebbbeck* (2.967%), *Tectona grandis* (2.580%). However, the minimum ash content (1.390) was recorded for *Leuceania leucocephala*.

Conclusion

The research estimated the biomass production and variation in mineral content (Ash) for the selected tree species the data was subjected to statistical analysis using ANOVA techniques and critical different test ,the treatment effect was determined by F test. From the result obtained it revealed that, maximum biomass (9.021 ton/tree) for *Albizia lebbbeck* and minimum for (1.953 ton/tree) for *Azadirachta indica*. Maximum mineral content (%) was recorded for *Terminalia arjuna* (4.743%)

and minimum (1.790%) for *Leuceania leucocephala*. This research is significant to ensure the sustainable management of forest resources, commercial use of wood, and to the global carbon cycle.

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