Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 280-283
Received: 18-03-2020
Accepted: 20-04-2020

Barsha Samal
Department of Forestry, College of Agriculture, Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India

Dr. Lalji Singh
Department of Forestry, College of Agriculture, Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India

Corresponding Author:
Barsha Samal
Department of Forestry, College of Agriculture, Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India

Growth and biomass pattern in two age group of forest tree species grown on Entisols of tropical environment

Barsha Samal and Lalji Singh

Abstract
The present study was conducted to know the growth and biomass pattern in two age group of forest tree species {*Adina cordifolia* (Roxb.) and *Mitragyna parvifolia* (Roxb.)} grown on Entisols of tropical environment of Chhattisgarh during 2018-2019. For calculating the tree biomass, allometric equations relating collar girth to biomass was formulated. The stand biomass for site 1(6 years old plantation) and site 2(4 years old plantation) were 55.25 t ha^{-1} & 45.22 t ha^{-1} for *Adina cordifolia* & 58.71 t ha^{-1} & 48.23 t ha^{-1} for *Mitragyna parvifolia*, respectively. The net primary productivity values were 10.32 t ha^{-1} yr^{-1} (site 1) & 8.92 t ha^{-1} yr^{-1} (site 2) for *Adina cordifolia* plantation and 11.08 t ha^{-1} yr^{-1}(site 1) & 9.63 t ha^{-1} yr^{-1} (site 2) for *Mitragyna parvifolia* plantation. Study shows that 6 years old plantation site and *Mitragyna parvifolia* (Roxb.) perform better, hence the same can be suggested for propagation.

Keywords: allometric, biomass, increment, net primary production

Introduction
Tropical dry forests comprise about 46% of tropical forests (Olson *et al*., 2001) [1] and are considered among the least protected and most disturbed ecosystems on the earth (Hoekstra *et al*., 2005) [2]. Tropical forests covers 50% of the world's forested area & 30% of the world's land area which is around 4 billion ha (FAO and JRC, 2012) [3] and one of the richest and complex terrestrial ecosystems supporting a variety of life forms and have a tremendous intrinsic ability for self-maintenance. At present there is a dearth of information on the qualitative & quantitative patterns of forests of tropical environment and the impact of forest conversions on the biomass and status of vegetation. A large no of indigenous species have been known to give better yield. Every area is therefore involved in various plantation programmes in these recent years.
In the state of Chhattisgarh many tree species have been brought under plantation programme in order to replace the poor regeneration of tree species and to fill the gap created due to deforestation and to revegetate the degraded wasteland. The important species among them are *Tectona grandis*, *Gmelina arborea*, *Bamboo* species., *Emblica officinalis*, *Eucalyptus* species etc. However the species like *Adina cordifolia* and *Mitragyna parvifolia* are rarely seen in plantation programmes. *Adina cordifolia* (Roxb.) is a deciduous tree having a large crown, growing generally between 18 - 30 metres tall, some trees can grow up to 45 metres also. The trees are harvested from the forests for their useful timber, which is generally traded locally because it is only available in very less quantities. They are also harvested for local medicinal use. *Mitragyna parvifolia* (Roxb.) is a plant of the tropics, and it is found at elevations up to 1,300 metres. The roots and barks are used in the treatment of colic and fevers. The wood gives a light pinkish-brown colour which is moderately hard, durable and even-grained.
The plantation of aforesaid species have been done by Mahasamund forest division at compartment no.22 & 69. Hence, the study was aimed to understand the ecology of *Adina cordifolia* and *Mitragyna parvifolia* tree species

Material and Methods
The study was conducted at two sites viz. 6 years old plantation (compartment 22) and 4 years old plantation (compartment 69) in the irrigated plantations of Mahasamund forest division in Mahasamund, Chhattisgarh. These areas viz 6 years old plantation and 4 years old plantation are located in the forest block Kaujhar and forest block Mahasamund, respectively. The plantations of *Adina cordifolia* & *Mitragyna parvifolia* were conducted in 2012-13 and 2014-15 at 6 years old plantation and 4 years old plantation respectively. The Mahasamund forest division is situated at latitude and longitude of 21.1091° N & 82.0979° E respectively and an

altitude of 301 m above sea level in the state of Chhattisgarh. The type of soil of the study site are Entisols which is locally called as Bhatta lands.

Collar girth

The collar girth of standing trees were measured with the help of measuring tap at 10 cm from the base of the tree.

Tree biomass

Collar girth was measured at 10 cm from the base of the tree using measuring tape. Girth of all the individuals of the two species were divided into 7 girth classes, 10 cm to 45 cm.

For the measurement of tree biomass allometric equations relating collar girth to biomass was developed. For developing allometric equation 10 individuals each of *Adina cordifolia & Mitragyna parvifolia* were felled representing all available collar girth classes. The harvest data were subjected to regression analysis to relate the dry weight of bole, branch & foliage with collar girth values. Computational protocol as described by Singh & Singh (1991) [4] was used.

Tree individuals in each quadrat were categorized into all possible collar girth classes. The mean collar girth value for each species for a collar girth class was used in the regression equation to get an estimate of biomass (by component) for that collar girth class. Then this value was multiplied by the density of trees in that collar girth class. The collar girth class value was summed to obtain the biomass estimate for each of the 10 quadrats on each site. The estimates were averaged across the number of quadrats to obtain the mean estimates for each site.

The relationship between girth of a tree and dry weight of a component followed the logarithmic relationship between weight and collar girth which is given by the equation:

$$\text{Log } Y = a + b \log X$$

Where,

Y = dry weight (kg) of component (bole, branch & leaf)

X = collar girth (cm) at 10cm height from base

a and b = allometric constants.

Herb biomass

Herbaceous biomass was harvested from 8 (50×50 cm) harvest quadrats on each site at it's peak biomass stage in an annual cycle and it's biomass was measured.

Litter mass

Littermass was collected from 8 (50×50 cm) harvest quadrats on each site and it's biomass was measured.

Statistical analysis

The data on above ground biomass, herb biomass & litter biomass was analysed through two factor analysis i.e., RBD (randomized block design). The differences between treatment means of all parameters were tested for their significance at 5% or 1% levels following Snedecor and Cochran (1967) [5].

Estimation of Net Primary Productivity

The net primary production of the two species viz. *Adina cordifolia* (Roxb.) & *Mitragyna parvifolia* (Roxb.) were measured using girth increments and biomass data following Singh and Singh (1991) [4]. In May 2018, 12 trees of each species on each site were marked and their collar girth were measured and the girth of the same individuals were re-measured after one year in May 2019. Mean annual girth increment for each girth class was calculated. Using the allometric equations developed for the two species in the present study, the biomass for bole, branch, foliage and coarse roots were calculated from girth measurements of May 2018 (B1) and 2019 (B2). The net biomass accumulation for 2018-19 (B2-B1) were calculated. The foliage biomass B2 was taken as net foliage production for the year 2019.The estimation of total net primary productivity for each species was calculated by summing the NPP of trees (by components obtained from allometric equations).

Results and Discussion

A. Biomass estimation

A.1. Aboveground biomass

The stand biomass for *Adina cordifolia* was 55.25ton ha^{-1}&45.22 ton $ha^{-1}$for 6 years old plantation and 4 years old plantation respectively &for *Mitragyna parvifolia* were 58.71 ton ha^{-1} & 48.23 ton $ha^{-1}$for 6 years old plantation and 4 years old plantation. For both the species the biomass at 6 years old plantation was more than 4 years old plantation. In *Adina cordifolia* the biomasses of different components are in the order of stem › branch › leaf but in case of *Mitragyna parvifolia*the component wise biomass followed the order branch › stem › leaf.Simmilar pattern have been reported by Singh & Singh (1991) [4] for dry tropical forest where branch had more biomass than the bole.

A.2. Litter biomass (Yield)

Litter mass on present sites ranged from 1.1t ha^{-1} to 2.92t ha^{-1} for *Adina cordifolia* plantation & 1.32 t ha^{-1} to 3.05 t ha^{-1} for *Mitragyna parvifolia* plantation. Zhou and Yan (2006) [6] observed that the litter mass in broadleaved evergreen tree plantations in China ranged in between 3.56t ha^{-1} to 10.56t ha^{-1}. The results in the present study was generally lower because the trees are deciduous in nature but in case of evergreen trees litterfall (generally leaf fall) occurs throughout the year.

A.3. Herbaceous Biomass

In case of *Adina cordifolia* (Roxb.) plantation the herbaceous biomass ranged from 1.31t ha^{-1} to 3.44t ha^{-1} and in case of *Mitragyna parvifolia* (Roxb.) plantation it ranged from 1.32 t ha^{-1} to 2.52t ha^{-1}. Pande (2005) [7] reported the herb biomass to be 1.0 t ha^{-1} -1.54t ha^{-1} in tropical dry deciduous teak plantations. The herb biomass in present study is more, this may be due to the favourable weather conditions of the area.

Two way analysis (RBD) was done for above ground biomass, litter biomass & herbaceous biomass. There are two factors viz. 6 years plantation & 4 years plantation & species (*Adina cordifolia* (Roxb.) and *Mitragyna parvifolia* (Roxb.) with 5 replications and a total of 3 characters. Character 1-above ground biomass, Character 2-herbaceous biomass & Character 3-litter biomass.

For character 1 (above ground biomass),the two way analysis shows that 6 years old plantation with mean 51.02 t ha^{-1} performed better than 4 years old plantation with mean 44.10 t ha^{-1} and *Mitragyna parvifolia* (Roxb.) with mean 49.27t ha^{-1} performed better than *Adina cordifolia* (Roxb.) with mean 45.85t ha^{-1} (Table 1).

Table 1: Average above ground biomass (t ha^{-1}) over plantation years and species

	***Adina cordifolia* (spp.1)**	***Mitragyna parvifolia* (spp.2)**	**Average AGB Over plantation years**
6 Years old plantation	48.89	53.15	51.02
4 Years old plantation	42.81	45.39	44.10
Average AGB over species	45.85	49.27	

AGB = Above ground biomass (t ha^{-1}), spp.1= species 1, spp.2=species 2

For character 2 (herbaceous biomass),the two way analysis shows that 6 years old plantation with mean 298.64 g cm^{-2} performed better than 4 years old plantation with mean 132.04g cm^{-2} and *Adina cordifolia* (Roxb.) with mean 237.88 g cm^{-2} performed better than *Mitragyna parvifolia* (Roxb.) with mean 192.80 g cm^{-2} (Table 2). The critical difference between the sites is 101.59.

Table 2: Average herbaceous biomass (g cm^{-2}) over plantation years and species

	***Adina cordifolia* (spp.1)**	***Mitragyna parvifolia* (spp.2)**	**Average HB Over plantation years**
6 Years old plantation	344.32	252.96	298.64
4 Years old plantation	131.44	132.64	132.04
Average HB over species	237.88	192.80	

HB= Herbaceous biomass (g cm^{-2}), spp.1= species 1, spp.2 = species 2

For character 3 (litter biomass),the two way analysis shows that 6 years old plantation with mean 299.28g cm^{-2} performed better than 4 years old plantation with mean 132.40g cm^{-2} and *Mitragyna parvifolia* (Roxb.) with mean 229.84 g cm^{-2} performed better than *Adina cordifolia* (Roxb.) with mean 201.84 g cm^{-2} (Table 3).The critical difference between the sites is 63.19.

Table 3: Average litter biomass (g cm^{-2}) over plantation years and species

	***Adina cordifolia* (spp.1)**	***Mitragyna parvifolia* (spp.2)**	**Average LB Over plantation years**
6 Years old plantation	292.72	305.84	299.28
4 Years old plantation	110.96	153.84	132.40
Average LB over species	201.84	229.84	

LB= Litter biomass (g cm^{-2}), spp.1= species 1, spp.2 = species 2

B. Quantification of net primary production (NPP)

The average girth increment for both the species were found to be more in 6 years old plantation at 6 months as well as 1 year interval whereas in case of *Mitragyna parvifolia* plantation increase in both the sites were at par for the 1st 6 months interval. The NPP values for the two sites viz. 6 years old plantation and 4 years old plantation were found to be 10.32 t ha^{-1} yr^{-1} & 8.92 t ha^{-1} yr^{-1} respectively for *Adina cordifolia* plantation and 11.08 t ha^{-1} yr^{-1}& 9.63 t ha^{-1} yr^{-1} for *Mitragyna parvifolia* plantation (Table 4). Clark *et al* (2002) [8] reported the NPP as 9.47 t ha^{-1} yr^{-1}in dry tropical plantations. Thus the values of the present study are at par with these studies.

Table 4: NPP in two species viz *Adina cordifolia* & *Mitragyna parvifolia* at the two sites

species	**Components**	**NPP**	
		6 Years old Plantation	4 Years old plantation
Adina cordifolia	Stem	2.95	3.25
	Branch	2.32	2.57
	Leaf	1.61	1.79
	Total	**6.88**	**7.61**
	Herb	3.44	1.31
	Stand Total	**10.32**	**8.92**
Mitragyna parvifolia	Stem	2.81	2.75
	Branch	3.11	3.01
	Leaf	2.64	2.55
	Total	**8.56**	**8.31**
	Herb	2.52	1.32
	Stand Total	**11.08**	**9.63**

NPP= Net Primary Production (t ha^{-1} $year^{-1}$)

Conclusion

Global warming is a worldwide concern now a days. The increase in greenhouse gases (GHGs) in the atmosphere is caused due to emission of Carbon dioxide (CO2) in a huge amount. Increased concentration of greenhouse gases in atmosphere give rise to global warming that ultimately decreases yield of crops, reduces rainfall &changes species composition. The productivity of tree species directly influences the absorption of CO2 in the biomass. Thus for biomass productivity proper input management should be done. The current research was conducted to know the growth and biomass in two age group of forest tree species grown on Entisols of tropical environment in Mahasamund forest division, Chhattisgarh during the period 2018-2019. Allometric equations were based on the correlation between dry weight of the various components like bole, branch & leaf with the collar girth of the tree. 6 years old plantation i,e. Forest Block Kaujhar, Compartment no.22 (plantation year

2012-13) and *Mitragyna parvifolia* (Roxb.) (Mundi) performs better than 4 years old plantation (Forest block Mahasamund) and *Adina cordifolia* (Roxb.) respectively, thus for propagation purpose, the same can be recommended.

Acknowledgement
Thanks are due to Professor & Head Forestry, Dean College of Agriculture, Director Research Services, Director Instructions and Hon'ble Vice-Chancellor IGKV, Raipur for their kind support during the study.

Reference

1. Olson DM, Dinerstein E, Wikramanayake ED. Terresterial ecoregions of the world: a new map of life on earth. Bioscience. 2001; 51:933-938.
2. Hoekstra JM, Boucher TM, Ricketts TH, Roberts C. Confronting a biome crisis: global disparities of habitat loss and protection. Ecol Lett. 2005; 8:23-29.
3. FAO, JRC. Global forest land-use change 1990–2005. In: Lindquist EJ, D'Annunzio R, Gerrand A *et al* (eds) FAO forestry paper no. 169. Food and Agriculture Organization of the United Nations and European Commission Joint Research Centre, Rome, 2012. Available at: http://www.fao.org/docrep/017/i3110e/i3110e.pdf
4. Singh L, Singh JS. Species structure, dry mater dynamics and carbon flux of a dry tropical forest in India. Annals of Botany. 1991; 68:263-273.
5. Snedecor GW, Cochran WG. Statistical Methods. Oxford and IBH Publ. Co., New Delhi, 1967, 593.
6. Zhou GY, Yan JH. Old-growth forests can accumulate carbon in soils Science, 314: 1417. Tropical Ecology. 2006; 46(2):229-239.
7. Pande PK. Biomass and productivity in some disturbed tropical dry deciduous teak forests of Satpura plateau, Madhya Pradesh, 2005.
8. Clark DB, Clark DA, Brown S, Oberbauer SF, Veldkamp E. Stocks and flows of coarse woody debris across a tropical rain forest nutrient and topography gradient. Forest Ecology and Management. 2002; 164(1-3):237-248.