



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SPI: 2132-2134

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Screening of multipurpose tree species and shrubs for adaptability and growth performance at Chattarpur farm of Palamau district under dryland conditions Of Jharkhand

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Abstract

Tree growth is a function of the genetic potential of the species and environmental condition. Before introducing a species to a given agro-ecology there is always a need for well conducted field trial for matching the species/provenance to a particular site. To this end, a study was conducted at Chattarpur farm of Zonal Research Station Chianki, Birsa Agricultural University Ranchi, Jharkhand. during 2015-16 and 2016-17 to evaluate adaptation and growth performance of different tree and shrub species were compared in randomized block design with three replications. Results revealed that there were highly significant ($P \leq 0.5$) variations among species in height growth, collar diameter development and survival after two years of age. This could be due to environmental factors and/or genetic potential of the species, which generally govern the growth of a given species Among the species tested Khair (*Acacia catechu* L.) showed superior performance in terms of height increment (154.30 cm) and diameter increment (20.40 mm) growth whereas, after two years of experimentation. Khair (*Acacia catechu*) and Chakundi (*Cassia samedia*) showed highest survival rate (98%). Hence, it can be inferred that the condition of Palamau region matched well with the environmental requirement of Khair and Chakundi.

Keywords: tree species, shrubs, genetic potential

Introduction

The recorded forest area in India is about 76.5 million ha (23% of total land mass). However, the actual forest/tree cover is just about 19% of the total geographical area. The per capita forest area in the country is 0.08 ha as compared to the world average of 0.64 ha. The total removal of fuelwood from forestland is estimated at 270 million tons annually. During the last two decades, India has witnessed annual depletion of forest cover at a rate of 235 km². The consumption of fuelwood and timber in the country was 23.5 and 40 million m³, respectively against the availability of 40 million m³ and 15 million m³ from the forests. India occupies 10th rank among the most forested countries of the World (GFRA 2010). Forests support livelihood of around 200 million people in the country. National Forest Policy, 1988 strives for national goal of achieving one third of geographical area under forest cover in order to ensure ecological & environmental security. Forests play an important role in the socio-economic development of a country like India. They are rich sources of energy, housing, firewood, timber and fodder and they provide employment to a large section of the rural population. Demand for forest products and services in the country are increasing with rapid economic growth, industrialization and increase in population. Multipurpose trees and shrubs (MPTs) plays considerable role in addressing such multifaceted demand crop line stock production (Betre Alem *et al.*, 2000) They have the ability to fit into the farming fire wood, farm implements and other like shade and shelter (Kahsay Berhe *et al.*, 2001). However, each tree/shrub has its own biotic and abiotic factors in which it performs to its maximum potential. It has specific edaphic and climatic requirements (Abebe Yadessa *et al.*, 2000) Before introducing any species to a given agro-ecology, there is always a need for a well conducted field trials for matching of the species to a particular site (Zobel and Jabret 1984; Abebe Yadessa *et al.*, 2000 Mebrate Mihretu *et al.*, 2004) The most reliable information is based on trial planting in the proposed plantation area (Savile *et al.*, 1996) The first trial should be a species screening trial that will test the survival and early growth of the species in one to three years (Eldridge *et al.*, 1994) Many species screening experiments have been conducted in different parts of the country. However information is scarce at Palamau region of Jharkhand to recommend promising multipurpose tree and shrub species for use in agroforestry. Hence

there is a need to investigate adaptable and promising tree and shrub species in the area. The present screening trial was, therefore, to evaluate the adaptation and growth performance of Ten (10) MPTS to dryland conditions and site for similar agro-ecology. Hence this paper reports the adaptation and growth performance of Ten (10) MPTS after two years of establishment.

Materials and Methods

The study was conducted at Chattarpur Farm of Palamau district situated 60 kilometer away from Zonal Research station, Chianki linked to NH 98. The soil of the trial site is loam to clay loam, well drained poor consistency with low water holding capacity. It is located between 24.0^o-24.37^o N latitude and 84.0^o-84.19^o E longitude and within the altitude range of 140 to 143 meter. The mean annual rainfall ranges 850 to 870 mm. The rainfall is unevenly distributed with one or two long dry spell. The area is characterized by short range of rainy season that extend from July to September. The mean maximum and minimum temperature are 45.5 °C and 4 °C, respectively.

Plant Material

Seeds of multipurpose tree species included in this experiment (Table-1) were obtained from planting stock of moderate age and phenotypically superior trees grown in blocks scattered over different parts of Palamau districts. Before sowing of seeds, specific treatment was given to each species seeds.

Sowing of seeds was done in polythene tube of size 30 x 10 cm. filled with mixture of soil, vermicompost and pesticides. After germination seedlings were cared and watered twice per day during morning and evening except on days when it rained. This was, however, reduced once every day three weeks prior to planting out. Weeds were removed on detection and root pruning was done when ever roots out grew the polythene containers.

Plantation and Design of the Experiment

The plantation was done in July 2015 at an initial spacing of 2m x 2m. The experiment was replicated thrice in a randomized block design. Polythene tube grown seedlings of all 10 (Ten) species viz. Teak (*Tectonagrandis* L.), Shisam (*Dalbergiasissoo* Roxb.), Gamhar (*Gmelinaarborea* Roxb.), Karanj (*Pongamiapinnata* L.) Neem (*Azadirachta indica* A. Juss.), Bakain (*Meliaazedirach* L.) Chakundi (*Cassia siamea* L.), Khair (*Acacia catechu* L.), Arjun (*Terminaliaarjuna* Roxb.) and August (*Sesbaniagrandiflora* L.) of apoxmately 30 cm shoot length were planted in pit size of 30 x 30 x 30 cm. with supplement of 25g DAP and 15g of MOP. The survival percent were recorded before the month July 2016. The growth parameter (Height and collar diameter Diameter) was measured in both the year *iein* 2016 and 2017. The height was measured with the help of graduated sticks and collar diameter was measured with the help of calipers.

Table 1: List of Multipurpose tree species included in the study, their niche and spacing

SL. No.	Species name	Family	Planting niche	Spacing
1	Teak (<i>Tectonagrandis</i> L.)	Verbenaceae	Chhatarpur Farm	2m x2m
2	Stisam (<i>DalbergiSissoo</i> Rorb.)	Fabaceae	"	2m x2m
3	Gamhar (<i>Gmelinaarborea</i> L.)	Verbenaceae	"	2m x2m
4	Karanj (<i>Pongamiapinnata</i> L)	Fabaceae	"	2m x2m
5	Neem (<i>Azadirachta indica</i> A. Juss)	Meliaceae	"	2m x2m
6	Bakain (<i>Meliaazedirach</i> L.)	Meliaceae	"	2m x2m
7	Chakundi (<i>Cassia siamea</i> L.)	Fabaceae	"	2m x2m
8	Khair (<i>Acacia catechu</i> L.)	Fabaceae	"	2m x2m
9	Arjun (<i>Terminaliaarjuna</i> Roxb.)	Combretaceae	"	2m x2m
10	August (<i>Sesbaniagrandiflora</i> L.)	Fabaceae	"	2m x2m

Results and Discussin

Height (cm.)

Data on height increment, root collar diameter increment and survival rate two years after establishment are presented in Table 2. Analysed data revealed that differences in height increment among tree/shrub species were highly significant ($p < 0.05$) after two years of age. Height growth rate trend (Table 2) shows that Khair (*Acacia catechu*) grown at faster rate 154.30 cm. closely followed by August (*Sesbania grandiflora*) 150 cm. and Gamhar (*Gmelinaarborea*). This is in line with the finding of Tilahan Chibssaet *al.* which indicated superior performance of *Acacia catechu* as compared to other species. Betre Alemet *al.* as reported better early growth performance of August (*Sesbaniasesban*) as compared to other species in trial in highland region of Rawanda. This could also attribute to the growth superiority of August *Sesbaniasesban*.

Root Collar Diameter (mm.)

As depicted in Table 2. There is significant difference among tree/shrub species in root collar diameter growth rate. The highest root collar diameter growth rate (20.40 mm.) was recorded for Khair (*Acacia catechu*) closely followed by

Gamhar (*Gmelinaarborea*) and August (*Sesbaniagrandiflora*), and Shisham (*Dalbergiasissoo*). Results indicated that tree species having the greatest root collar diameter increment which grown tallest.

Survival

Among species, difference were highly significant ($P < 0.05$) for survival as well (Table 2) after two years of establishment. Significantly highest survival percent (98%) were recorded in two species. Khair (*Acacia catechu*) and Chakundi (*Cassia samea*) followed by six species namely Neem (*Azadirachta indica*), Stisam (*Dalbergi Sissoo*), Gamhar (*Gmelinaarborea*), Karanj (*Pongamiapinnata*), Bakain (*Meliaazedirach*) and Teak (*Tectonagrandis*) which shown at par performance in terms of survival with values (89-98%). Hence, it can be inferred that condition of Palamau region matched well with environmental requirement of these species.

Arjun (*Terminaliaarjuna*) and August (*Sesbaniagrandiflora*) on the other hand moderate to low survival percent (48-75%) hence, it may be inferred that these two species fund not compatible with the prevailing climatic situation in the region.

Conclusion

It can be concluded that Khair (*Acacia catechu*) and Chakundi (*Cassia siamea*) can most likely to grow and adapt to the environmental condition of Palamau region of Jharkhand area. On the other hand, the climatic conditions of Palamau region of Jharkhand may not good enough for adaptation of August (*Sesbaniagrandiflora*) and Arjun (*Terminaliaarjuna*) due to inability of the species to adapt to the environmental condition of the region. Thus, in order to use the advantage of

early vigorous growth of the species, introducing species with ecological background better suited to the conditions of this region. Generally for Khair(*Acacia catechu*) Gamhar (*Gmelinaarborea*), Shisham (*Dalbergiasissoo*), Karanj (*Pongamiapinnata*), Neem (*Azadirachtaindica*) and Bakain (*Meliaazedirach*), on farm evaluation of their contribution to soil improvement and crop yield either by intercropping or biomass transfer has to be further investigated to make use of their potential in Agroforestry at the prescribed site.

Table 2: Growth parameter of two years old multipurpose Tree & shrub species at Chattarpur farm

Treatments/Ten Tree Species	1 st year mean height (cm)	2 nd year mean height (cm)	Height increment (cm)	1 st year mean diameter (mm)	2 nd year mean diameter (mm)	Diameter increment (mm)	Survival Percent
Teak (<i>Tectonagrandis</i> L.)	33.7	66.00	32.30	6.00	15.40	9.40	89
Stisam (<i>DalbergiSissooRorb.</i>)	50.00	155.00	105.00	7.00	23.00	16.00	97
Gamhar (<i>Gmelinaarborea</i> L.)	50.50	156.00	105.50	8.80	27.90	19.10	92
Karanj (<i>Pongamiapinnata</i> L.)	51.50	109.00	57.50	8.10	15.00	6.90	90
Neem (<i>Azadirachtaindica</i> A. Juss)	48.50	95.00	46.50	5.70	17.50	11.80	96
Bakain (<i>Meliaazedirach</i> L.)	68.50	104.00	35.50	7.40	16.30	8.90	89
Chakundi (<i>Cassia siamea</i> L.)	50.00	95.00	45.00	7.10	17.70	10.60	98
Arjun (<i>TerminaliaarjunaRoxb.</i>)	35.90	45.00	9.10	6.20	7.90	1.70	75
Khair (<i>Acacia catechu</i> L.)	65.70	216.00	154.30	8.60	29.00	20.40	98
August (<i>Sesbaniagrandiflora</i> L.)	50.00	204.00	150.00	6.50	22.90	16.40	48
SEm ±			43.02			7.26	3.00
CD at 5%			10.80			5.39	8.93
CV%			7.5			15.67	5.96

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