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Evaluation of planting methods and tree species for non-arable lands of northern dry zone of Karnataka

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ABSTRACT

A field experiment was conducted at non-arable site at Regional Agricultural Research Station, Bijapur, Karnataka from 2004-05 to 2009-10. The treatments consisted of four planting methods and four tree species laid out in split plot design with three replications. The silvicultural parameters of tree species, *viz.,* plant height, clear bole height, collar diameter and crown spread were positively influenced by the *in-situ* moisture conserved by crescent method of planting closely followed by pit method and staggered trench method. In case of tree species, among the fast growing species *Dalbergia sissoo* produced better silvicultural parameters. Whereas in case of slow growing species *Azadirachta indica* produced better silvicultural parameters as compared to other tree species. It may be because of their adoptability to hard dryland conditions. The interaction between method of planting and tree species were found to be non significant.

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Key words : *In-situ,* Non-arable land, Planting method, Silvicultural parameter

INTRODUCTION

The northern dry tract of Karnataka state comprising five districts (Bijapur, Bagalkot, Gulbarga, Koppal and Raichur) occupy on an average of 4.3 per cent under forest cover whereas average net sown area is 74.60 per cent. The area of the tract under forest cover is not only below the national average but also becoming degraded at faster rate due to unscientific cultivation practices. In the dryland ecosystems due to their poor soil fertility status and harsh atmospheric conditions, the planting of seedlings is a challenge. Such conditions cannot support better survival and growth of tree crops. Soil moisture is often the major factor limiting the survival and growth of seedlings planted out in semi-arid tropics. Therefore, in non-arable soils of drylands, adoption of proper planting methods which can help for *in-situ* moisture conservation and thereby support the growth of seedlings is essential. Such planting methods should not be only effective but also cheap. In dryland ecosystems always moisture plays an important role which decides survival, growth and productivity of tree crops. In the early stages of plantations moisture is the most important limiting factor which affects the performance of tree crops. In this context appropriate planting methods are to be identified which are cheap and effective. Further, the tree species may respond differently to the conserved moisture. The species which responds well to the conserved soil moisture would be a better choice. With this fact, efforts were made to evaluate the planting methods suitable for some of the important tree species grown in this region.

MATERIALS AND METHODS

The experiment was conducted at non arable site at Regional Agricultural Research Station, Bijapur (northern dry zone of Karnataka) from 2004-05 to 2009-10. The soil of the experimental site was analyzed for various physico-chemical properties. It contained 25% of Sand, 23% of Silt, 52% Clay, bulk density - 1.43 g/cc, pH - 8.5, EC- 0.34 dSm^{-1}, $CaCO_3$ 18.5% and soil depth 30-35 cm. The average rainfall of the region is 586 mm with 39 rainy days.

The experiment was laid out in a Split Plot Design with three replications. The treatments consisted of four planting methods *viz.,* M_1 – Continuous contour trench method, M_2 – Staggered trench method, M_3 – Crescent method and M_4 – Pit method in main plots and four species *viz.,* S_1 – *Dalbergia sissoo*, S_2 – *Azadirachta indica,* T_3 – *Albizzia lebbeck* and S_4 – *Cassia siamea* in sub-plots. The seedlings of uniform age were planted as per treatment on September, 2004 in the different types of planting methods. The seedlings were given a small watering immediately after planting. The different tree species were planted at a spacing of 2 x 2 m in the different structures as per treatment, which were prepared 10 to 15 days in advanced. The observations on various silvicultural parameters were recorded every year and the data of last two years (2008-09 and 2009-10) were used for interpretation of results. The data recorded on various characters during the course of investigation were

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subjected to Fisher's method of analysis of variance and interpretation of data's was made as per the procedure given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

In the semi-arid regions water harvesting for better moisture conservation is the key for success of seedlings of tree species planted out. The low and erratic rainfall may harm the seedlings growth and survival in early stages if they are subjected to moisture stress. In the present study performance of four planting methods in association with four tree species are made and the results are furnished as under.

The observations on different silvicultural parameters *viz.,* plant height (m), clear bole height (m), collar diameter (cm) and crown spread (m) of different tree species (Table 1) were recorded every year from 2004-05 to 2009-10 and the data of last two years (2008-09 and 2009-10) were used for interpretation of results.

Plant height (m):

The plant height is the important silvicultural parameter which ultimately decides the growth and yield of tree crops. The plant height of different tree species varied due to the planting methods. The crescent method of planting recorded significantly maximum height during both the years i.e., 2008-09 and 2009-10 (3.35 and 4.03 m, respectively) followed by pit method of planting (2.96 and 3.71 m, respectively) and the least value was noticed in continuous contour trench method (2.63 and 3.34 m, respectively). The superior plant height recorded by crescent method has been possible due to *in situ* moisture conserved was available to the compact root in juvenile stages of plant growth. In case of staggered trench method soil moisture conserved could not have reached the root zone fully, but in case of continuous contour trench method the runoff water conserved has been unable to wet the root zone since it has moved in small gullies. Thus different planting methods have conserved *in situ* moisture and promoted the plant height accordingly. These results are in line with the findings of Jat and Yadav (2004).

Among the four tree species significantly maximum plant height was recorded by *Delbergia sissoo* (4.57 and 5.35 m, respectively) followed by *Azadirachta indica* (2.53 and 3.30 m, respectively). The minimum plant height was noticed in *Albizzia lebbeck* (2.18 and 2.91 m, respectively). The difference in plant height of tree species might be due to their capacity to conserve *in-situ* moisture and utilization of the same for better growth. The findings of Negi (1986) are in conformity with results of present study.

Clear bole height (m):

The clear bole height is an important silvicultural parameter because it decides non branchy portion of a tree. It should be around 0.6 of the total height for optimum growth of trees and also for better timber quality.

The clear bole height of different tree species was influenced by the planting methods during both the years

Table 1 : Influenced by various planting methods on silvicultural parameters of different tree species

Treatments	Tree height (m)		Clear bole height (m)		Collar diameter (cm)		Crown spread (m)	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Planting methods (M)								
M_1 - Continuous contour trench method	2.63	3.34	1.03	1.12	3.77	5.57	1.47	1.80
M_2 - Staggered trench method	2.67	3.47	1.10	1.19	3.81	5.67	1.65	2.18
M_3 - Crescent method	3.35	4.03	1.33	1.43	5.77	7.54	2.32	2.67
M_4 - Pit method	2.96	3.71	1.28	1.36	4.92	7.18	1.96	2.48
S.E.±	0.140	0.115	0.039	0.031	0.244	0.244	0.13	0.08
C.D. (P=0.05)	0.483	0.399	0.134	0.106	0.844	0.846	0.44	0.26
Tree species (S)								
S_1 - *Dalbergia sissoo*	4.57	5.35	1.28	1.38	6.63	8.38	2.57	3.22
S_2 - *Azadirachta indica*	2.53	3.30	1.23	1.32	4.83	6.59	2.04	2.30
S_3 - *Albizzia lebbeck*	2.18	2.91	1.12	1.21	2.65	5.04	1.04	1.48
S_4 - *Cassia siamea*	2.32	3.00	1.11	1.19	4.16	8.38	1.76	2.13
S.E.±	0.096	0.082	0.032	0.049	0.202	0.156	0.10	0.07
C.D. (P=0.05)	0.281	0.238	0.092	0.143	0.589	0.455	0.29	0.21
Interaction effect (MXS)								
S.E.±	0.193	0.163	0.063	0.098	0.404	0.312	0.20	0.14
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

NS-not-significant

(2008-09 and 2009-10). The crescent method (1.33 and 1.43 m, respectively) produced significantly maximum clear bole height followed by pit method (1.28 and 1.36 m, respectively) and the lowest value was recorded in case of continuous contour trench method (1.03 and 1.12 m, respectively). The superior values of clear bole height in case of crescent method and pit method might be attributed to better moisture conservation in these methods compared to others. Similarly, Tilander and Ong (1999) reported that collection of runoff water in micro-catchment area during high intensity rainfall helped in contributing more moisture and nutrients to tree seedlings in semi-arid situation. The increased moisture availability helped for improvement of the productivity of *Azadirachta indica* grown in wider alleys in an agri-silviculture system.

Among the tree spices, the clear bole height was significantly superior in *Dalbergia sissoo* (1.28 and 1.38 m, respectively) followed by *Azadirachta indica* (1.23 and 1.32 m, respectively). The was minimum value was noticed in case of *Cassia siamea* (1.11 and 1.19 m, respectively). The differences in the clear bole height of tree species may be due to their ability to utilize available soil moisture. Gupta *et al.* (1995) have reported similar findings in their study conducted in arid zone at Jodhapur.

Collar diameter (cm):

Collar diameter is the silvicultural character which will ultimately decide the planting age and finally the wood volume.

The collar diameter of tree species varied under the influence planting methods during the year of 2008-09 and 2009-10. It was significantly highest in crescent method (5.77 and 7.54 cm, respectively) followed by the pit method of planting (4.92 and 7.18 cm, respectively) and it was lowest in case of continuous contour trench method (3.77 and 5.57 cm, respectively). The *in-situ* moisture conserved at higher level by crescent method compared to other methods has produced better collar diameter. Similar trends were reported by Singh (2006).

Among the different tree species it was significantly highest in *Dalbergia sissoo* (6.63 and 8.38 cm, respectively) followed by *Azadirachta indica* (4.83 and 6.59 cm, respectively) and the lowest value was seen in *Albizzia lebbeck* (2.65 and 5.40 cm, respectively). The superior collar diameter of *Dalbergia sissoo* is due to its growth potential and better ability to utilize the soil moisture compared to other tree species. The findings of Omaro and Nair (1993) are in line with present investigations.

Crown spread (m):

The spread of crown is important because it holds the photosynthetic surface of a plant. Therefore, it directly affects the growth of tree crops.

The crown spread of tree species varied under the influence of planting methods during both the years (2008-09 and 2009-10). The crescent method (2.32 and 2.67 m, respectively) produced significantly widest crown spread followed by pit method (1.96 and 2.48 m, respectively) and the lowest was noticed with continuous contour trench method (1.47 and 1.80 m, respectively). The wider crown produced by crescent method might be due to higher *in-situ* moisture conserved.

Of the four tree species, significantly highest crown spread was noticed with *Dalbergia sissoo* (2.57 and 3.22 m, respectively) followed by *Azadirachta indica* (2.04 and 2.30 m, respectively). It was lowest in case of *Albizzia lebbeck* (1.04 and 1.48 m, respectively). The wider crown spread produced by *Dalbergia sissoo* may be due to its potential growth habit and better utilization of moisture conserved. Similar findings were recorded by Gupta (1994). The interaction effect of planting methods on silvicultural parameters of different tree species was found to be non-significant.

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