Plant Archives Vol. 18, Special Issue (ICAAAS-2018), 2018 pp. 76-78 *ISSN 0972-5210*

EFFECT OF *CASUARINA* SPECIES TO IMPROVE THE PHYSICO-CHEMICAL PROPERTIES OF SOIL

R. L. Chavan, B. G. Nayak and K. N. Pawar

Department of Agroforestry, College of Agriculture, Dharwad (Karnataka), India.

Abstract

The results of the study reveals that *Casuarina equisetifolia* had found the best growth performer followed by *C. glauca* among five species and appears to be promising for rehabitation of degraded lands. The effect of *Casuarina* species on physico-chemical parameters of soil *viz*., bulk density, soil pH and electrical conductivity resulted in the highest soil enrichment in *C. obesa* followed by *C. equisetifolia* and *C. cunninghamiana*. Soil nitrogen, phosphorous and potash content were observed significantly higher underneath of *C. equisetifolia* followed by *C. glauca* and *C. obesa*.

Key words : *Casuarina* species, physico-chemical parameters, electrical conductivity.

Introduction

Casuarina species are belongs to the family Casuarinaceae and is a native of Australia. *Casuarina* species are cultivated in China, India, South East Asia, Malaysia, Pacific islands and subtropical regions, where introduced populations are grown and the species are more common outside its area of origin (Diouf *et al*., 2008). India has more than 8.0 lakhs hectares of *Casuarina* plantations mostly along the coastal tracts. Casuarinas are grown in places where most other trees fail to grow and used for reclaiming mines, salinity affected and wind-prone areas (Doran and Hall, 1983). However, currently there is increasing tendency to grow multipurpose species of *Casuarina* either as agro-forestry tree on farm land or fuel wood blocks on waste land. Casuarinas are widely accepted for landscaping, timber, medicine, dye, tannin, poles, raw material for pulp and paper, soil stabilization, nitrogen fixation and amenity planting. Species are tolerant to adverse soil and climatic conditions and more remunerative than most of arable crops in the long run. In the present investigation, in order to identify suitable species of *Casuarina* to enhance the soil fertility.

Materials and Methods

The present study was carried out to know the Physico-chemical properties of the soil by growing *Casuarina* species in the black cotton soil areas was analyzed by assessing the soil for bulk density, soil pH, EC (do/ml), N (kg ha^{-1}), P (kg ha^{-1}) and K (kg ha^{-1}). Samples were drawn randomly in four replications from soil profiles dug at 0.3 × 0.3 × 0.3 m dimensions in the 12 years old plantations during 2016. Representative samples from four pits were pooled and analyzed in duplicate. The samples were drawn from 0 - 23 cm profile range from underneath of ten trees of each species from four replicatations and estimated by following standard procedures.

Results and Discussion

Various species of *Casuarina*, investigated during present study, revealed marked differences in respect to impact on physico-chemical parameters of soil. Soil bulk density was significantly higher in control plot (1.38 g cc^{-1}), which has black cotton soil, while, underneath *Casuarina* species it ranged from 1.24 to 1.38 g cc^{-1} with an average 1.28 g cc^{-1}. However, least soil bulk density was recorded underneath *C. obesa* followed by *C. equisetifolia* (1.24 g cc^{-1} and 1.25 g cc^{-1}), respectively when compared to control plot. Bulk density underneath *C. cristata* (1.29 g cc^{-1}) followed by *C. glauca* (1.28 g $cc^{-1)}$ and *C. cunninghamiana* (1.27 g cc^{-1}) showed meager difference between them, but when compared to control plot showed significant improvement. Control plot has (8.31) pH when compared to planted site.

Casuarina obesa showed significantly superior effect for soil pH amelioration followed by *C. equisetifolia* with pH 7.73 and 7.75, respectively. Similar soil pH amelioration was also noticed underneath of *C. cristata* (7.95) when compared to control plot. *C. glauca* (7.8) and *C. cunninghamiana* (7.85) were on par with each other for this trait. Among the species, a significantly higher effect for amelioration of soil electrical conductivity (EC) was recorded underneath *C. obesa* (0.48 ds/ml) followed by *C. equisetifolia* (0.88 ds/ml) and *C. cunninghamiana* (0.77 ds/ml). Soil EC underneath *C. glauca* (0.97 ds/ml) and *C. cristata* (0.98 ds/ml) were on par with each other. However, significantly high soil EC was recorded in control plot (1.17 ds/ml). The reason for soil quality improvement is attributed to the addition of organic matter to the soil by species in the form of leaf litter. Five species of *Casuarina* were evaluated for species into site interaction especially on black cotton soil in order to select promising species for plantation programme on degraded site. It was observed that bulk density, soil pH and soil electric conductivity significantly declined underneath of all species than the control plot.

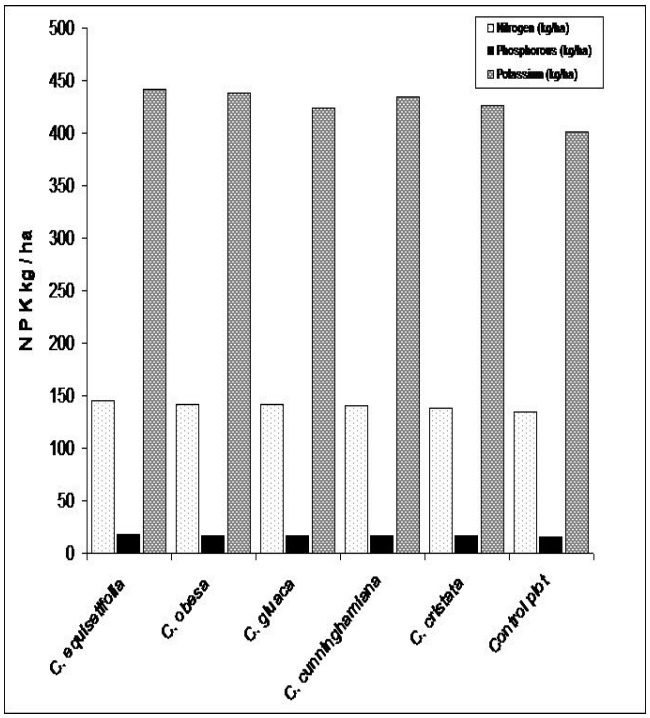

Fig. 1 : Effect of five *Casuarina* species on nitrogen, phosphorous and potassium of site.

Table 1 : Influence of five *Casuarina* species on physic-chemical parameters of soil.

***Casuarina* species**	**Bulk density**	**Soil pH**	**Soil EC (dS/ml)**	**Nitrogen (kg ha^{-1})**	**Phosphorous (kg ha^{-1})**	**Potassium (kg ha^{-1})**
C. equisetifolia	1.25	7.75	0.88	145.71	17.49	442.00
C. obesa	1.24	7.73	0.48	141.33	16.12	438.25
C. gluaca	1.28	7.80	0.97	141.69	17.15	424.00
C. cunninghamiana	1.27	7.85	0.77	140.91	16.89	434.00
C. cristata	1.29	7.95	0.98	138.66	16.34	425.75
Un-cropped plot	1.38	8.31	1.17	134.14	15.33	401.75
Mean	1.28	7.82	0.82	141.66	16.80	432.80
SEm.±	0.01	0.05	0.02	0.62	0.20	3.53
CD (0.05)	0.03	0.16	0.05	1.86	0.61	10.65
CV (%)	1.69	1.34	3.87	0.87	2.41	1.63

However, significantly highest reduction in bulk density was registered in *C. equisetifolia* followed by *C. obesa* among the species. Significantly maximum reduction of soil pH and electric conductivity was observed in *C. obesa*. Results from the table 1, described that all species reduced soil bulk density, soil pH and electric conductivity while increasing the soil fertility through adding nutrients, nitrogen, phosphorous and potash. This is probably due to the higher organic matter accumulated through litter fall underneath of *C. equisetifolia* when compared to the other species. This was in conformity with the findings of Tomar and Gupta (2002). Similarly, Madhanraj *et al.* (2011) confined that physico-chemical properties of the soil was significantly superior underneath of *Casuarina* than the open site.

The available nitrogen in black cotton soil of control plot was 134.14 kg ha^{-1}. The available nitrogen of soil ranged between 134.14 kg ha^{-1} to 145.71 kg ha^{-1} with an average value of 141.66 kg ha^{-1} in *Casuarina* plantations. Enrichment of soil nitrogen was significantly higher underneath of *C. equisetifolia* (145.71 kg ha^{-1}) and the least effect found underneath of *C. cunninghamiana* (140.91 kg ha^{-1}). But *C. obesa* (141.33 kg ha^{-1}) and *C. glauca* (141.69 kg ha^{-1}) were shown on par with each other for this trait. Significantly lower soil phosphorus was recorded in control plot or open plot (15.33 kg ha^{-1})

and increase in soil phosphorus was exhibited underneath of both species of *C. equisetifolia* (17.49 kg ha^{-1}) and *C. glauca* (17.15 kg ha^{-1}). *Casuarina cunninghamiana* (16.89 kg ha^{-1}) followed by *C. cristata* (16.34 kg ha^{-1}) and *C. obesa* (16.12 kg ha^{-1}) were resulted on par with each other for enhancement of phosphorus (fig. 1). The available potassium was shown lower in open / control plot 401.75 kg ha^{-1}. Significant higher soil potassium was recorded underneath of *C. equisetifolia* (442.00 kg ha^{-1}) among the species. Among *C. obesa* and *C. cunninghamiana* were next to *C. equisetifolia*. Significantly highest increase in available soil nitrogen, phosphorous and potash were registered in site condition of *C. equisetifolia* among species over control plot (fig. 1). However, among the five species of *Casuarina* tested, *Casuarina equisetifolia* has showed maximum root nodulation and nitrogen fixation ability and this was mainly due to genetic effects. The observations were in similar line with the results reported by Thiyageshwari *et al*. (2003) and Singh *et al*. (2011) reported significant higher improvement for soil pH, electrical conductivity, available N, P, and K underneath of *Casuarina equisetifolia* and various trees over degraded fallow land.

References

Diouf, A., T. A. Diop, I. Ndoye and M. Gueye (2008). Response of *Gliricidia sepium* tree to phosphorus application and inoculations with *Glomus aggregatum* and rhizobial strains in a sub-Saharian sandy soil. *African Journal of Biotechnology*, **7(6)** : 766-771.

Doran, J. C. and N. Hall (1983). Notes on Fifteen Australian *Casuarina* species, 19-52: *Casuarina Ecology, Management and Utilization*, Midgley, S. J., J. W. Turnbull, and R. D. Johnston (eds.) Proceedings of the 1st International *Casuarina* Workshop, Canberra, 17-21 August 1981, CSIRO, Melbourne, Australia.

Madhanraj, P., N. Nadimuthtu and A. Panneer Selvam (2011). Mycoecology in the Soil of a *Casuarina* Bioshield Plantation along South East Coast of India. *Asian Journal Pharmaceutical Research*, **1(2)** : 37-41.

Singh, Y. P., G. Singh and D. K. Sharma (2011). Ameliorative Effect of Multipurpose Tree Species Grown on Sodic Soils of Indo-Gangetic Alluvial Plains of India. *Arid Land Research and Management*, **25(1)** : 55-74.

Thiyageshwari, S., M. C. Agrwal and N. Kumar (2003). Provenance variation in seed parameters and germination of *Grewia optiva* Drummond. *Indian Forester*, **125(5)** : 517-521.

Tomar, O. S. and R. K. Gupta (2002). Relative performance of some accessions of *Casuarina* species and silvicultural practices on saline waterlogged soils in Semiarid Conditions. *Arid Land Research and Management*, **16(2)** : 177 -184.