NITROGEN CONTRIBUTION OF *ACACIA MODESTA* IN TWO SOIL SERIES OF LOHI BEHR RANGE

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Abstract

Phulai *(Acacia modesta)* is a widely distributed species in northern Pakistan. It has high forage and fuelwood value. Its nitrogen contributing potential to soil was studied at Lohi Behr Range. Soil samples were taken under and outside of the canopy of phulai trees at various depths. Significantly higher nitrogen content was observed under the canopy. A general trend of decreasing nitrogen with depth was found. Two soil series did not show much difference in nitrogen content.

Key Words: Phulai, Soil, Nitrogen Fixation, Legumes.

Introduction

Soil nitrogen is often depleted due to accelerated deforestation, intensive agriculture, overgrazing by cattle and an excessive use of fire in agriculture and range management (Hogberg, 1982). Fertilizer can be used to increase soil nitrogen content but is often too expensive to justify it economically (IFDC, 1980). However, a cheap way of increasing the soil nitrogen is to propagate forage legumes (Haque and Jutzi, 1984). Generally, woody legumes form the dominant vegetation in warm desert ecosystems throughout the world (Virginia and Jarrell, 1983). Studies on nitrogen fixation by these plants have been few (Farnsworth et al, 1978). Garcia-Moya and McKell (1970) found little difference in soil nitrogen content beneath the leguminous shrubs *Acacia greggi* and *Cassia aimata* and non-leguminous shrubs in the Mohave Desert. But nitrogen fixing trees have the potential for land reclamation and soil and enrichment. They may also be useful for revitalization of impoverished soils by incorporation of organic matter with low carbon to nitrogen ratio and for transfer of minerals from deep layers to the soil surface (Felker and Bandurski, 1979).

Acacia modesta (locally called phulai), a leguminous tree, is widely distributed throughout Pakistan as pure stand or in association with other species (Troup, 1921). It is highly palatable livestock and many species of wildlife (Troup, 1921; Roberts, 1977; and Khan, 1979). The purpose of present study was to evaluate nitrogen contributing potential of phulai at various depths in two soil series in Lohi Behr range.

Methods

The study was conducted in an *Acacia modesta* scrub forest at Lohi Behr Range Research Project in Pothowar tract located 25 km south of Islamabad. The area lies in a

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sub-tropical sub-humid scrub region. The average annual rainfall is 800 mm occuring mostly in the summer monsoon season; little rainfall occurs in the winter months. The summers are hot, mean maximum temperature rising to 38° C in June. Winter is cold with frost during the month of January.

Two soil series, Kala and Talagang were selected for this study. The Kala series is present in 6.5% of the project area. It is subrecent river alluvium that is deep, weakly structured and lime nodules. About 8.2% of the project area is comprised of the Talagang soil series which is old, fine loamy alluvium. Brown to dark brown soil is deep and moderately structured. The soil is loam to clay loam in texture and is strongly calcareous with a kankar zone in the sub-soil.

Soil sample were collected in the spring of 1983 from both soil series under the canopy of Phulai tree and from the interspaces between the trees. Triplicate soil samples were taken from the depths of 0-8 cm, 8-15 cm, 15-30 cm, 30-60 cm and 60-90 cm in both soil types and under both conditions of the study. Total nitrogen content of the soil sample was determined using Kjeldhal's method at the Animal Nutrition Laboratory of the University of Agriculture, Faisalabad. The data were statistically analysed using split-split-block design. Soil series were main blocks, canopy coverage comprised the sub-block and soil depths were the sub-sub blocks. Treatment means were compared using LSD.

Results and Discussion

The results indicate that soil nitrogen did not significantly differ ($P > 0.5$) between two soil series but remarkable differences were observed in nitrogen contents at various depths (table 1). The general trend of decreasing nitrogen with depth was observed in both soil series under the canopy cover as well as in the interspaces between the trees (table 2). Similar results were obtained by Virginia and Jarrell (1983), Adams and Attiwill (1986) and Kadeba (1985).

Significantly higher ($P < 0.0001$) amounts of soil nitrogen were observed under the canopy of phulai tree than the interspaces in both the Kala and Talagang series. The difference in total soil nitrogn content of samples from under the canopy and the interspaces indicated that phulai trees develop nutrient islands similar to that reported by Charley and West (1975, 77) for semi-arid shrubs, by Barth and Klemmendson (1978) for arid land trees and by Zinke (1962) for isolated conifers. The difference in total soil nitrogen between under the canopy and interspaces was most pronounced at surface layer. Below this the difference was not significant (table 2). Similar results were obtained by Charley and West (1977) and Parker et al. (1982). The results can be explained by the fact that litterfall is the major pathway for the return of nitrogen, phosphorus, calcium, and magnesium to soil among rainfall, throughfall and litterfall (Adams and Attiwill, 1986). Litter from the above ground plant parts dominated by leaves is decomposed and nitrogen is added to the surface soil (Huss-Danell, 1986). Moreover, upper soil layers have more fine fibrous roots than the deeper layers (Virginia and Jarrell, 1983) and the decomposition of fine roots enhance the quantity of soil nitrogen in the upper layers (Huss-Danell, 1986).

TABLE 1

ANALYSIS OF VARIANCE

S. No.	DF	SS	F. Value	PR > F
Soil	1	0.00007619	0.37	0.5449
Cover condition	1	0.00457619	22.33	0.0001
Soil × open	1	0.00057619	2.81	0.1001
Soil × P × Rep.	8	0.00189524	1.16	0.3450
Depth	6	0.13448095	109.36	0.0001
Soil * Depth	6	0.00789048	6.42	0.0001
OL * Depth	6	0.00512381	4.17	0.0019
Soil * OC × Depth	6	0.00632381	5.14	0.0004

TABLE 2

PERCENT SOIL NITROGEN IN THE OPEN SPACE AND UNDER THE CANOPY AT KALA AND TALAGANG SOIL SERIES IN LOHI BEHR

	Open Space		Under The Canopy	
Soil depth (cm)	Kala Soil	Talagang	Kala	Talagang
0-8	0.133	0.12	0.210	0.147
8-15	0.093	0.060	0.070	0.113
15-30	0.070	0.053	0.073	0.077
30-60	0.050	0.057	0.057	0.067
60-90	0.033	0.050	0.027	0.063
90-120	0.020	0.037	0.027	0.047
120-150	0.020	0.023	0.027	0.027
LSD 0.05		0.066		

Conclusion

The presence of woody legumes such as phulai alters the spatial distribution of nutrients and increase soil nitrogen, resulting in overall increase in the fertility of soil influenced by these plants.

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