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THE EFFECT OF EUCALYPTS CAMALDULENSIS ON SOIL PROPERTIES AND FERTILITY

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ABSTRACT

Laboratory investigations on the physico-chemical characteristic of a soil under agro forestry at two depths (0 to15cm and 15 to 45cm), were carried out in the Soil and Environmental Sciences Laboratory, N-W.F.P. Agricultural University, Peshawar during April 2003. Samples were collected at a distance of 5, 10, 15, and 20m from the Eucalyptus trees. Soil samples were analyzed for pH, electrical conductivity (EC), organic matter (O.M.), P, K and micronutrients (Zn, Cu, Fe, and Mn). All samples were analyzed separately for each property according to standard methods. Laboratory investigations showed that soil pH of both depths were alkaline. EC of the samples ranged form 0.08 to 0.35dSm^{-1}. The organic matter content was low in both the depths. In micronutrients, Zn was deficient at both depths, Cu was marginal at 0-15cm and adequate at 15-45cm, Fe was deficient at both depths; Mn was deficient at 0-15cm and marginal at 15-45cm. The effect of distance on various soil properties, pH, EC, O. M., P and K decreased with distance from the trees in the surface soil, while in the subsoil, O.M. and P decreased with distance pH, EC and K increased. In case of micronutrients, Zn, Cu and Fe decreased with distance in the surface soil while Mn increased. In the sub-soil, all the four micronutrients had positive correlation with distance. It is concluded that defecting response for nutrients, alkaline and high pH and low O.M. were found in all soil samples. Soil organic and inorganic fertility may be recorded to avoid yield reduction and soil amended for reduction of pH and soil nutrients availability.

Keywords: Eucalyptus, tree, soil, properties, fertility, micronutrients.

INTRODUCTION

Pakistan is a land of many contrasts with high hills in the north, arid plains in the middle and big deserts in the south, with exception of Northern Himalayan Tract, a major part of the country falls in arid and semi arid zone. The soil is not suitable for crop production is under forest Trees help to preserve the fertility of the soil through the return of organic matter and the fixation of nitrogen. They improve soil structure and help to maintain high infiltration rats and greater water- holding capacity and as a result, less runoff is generated and erosion is controlled (verma *et at.*, 1999).

Eucalyptus a genus and with more than 500 species of wide adaptability is a Eucalyptus constitute several of the most important timber trees of the Australian continent, covering large tracts. Soil nutrient (N, P, K, and organic matter) changes were observed where Eucalyptus was grown as compared to natural soil (Shorea robusta) forest in Uttar Pradesh (Jan. *et al*., 1996). The increase in clay and silt content and decrease in sand content were marginal, bulk density and particle density was slightly low and an appreciable increase in the cation exchange capacity, organic carbon content, total and available nutrients were observed under eucalyptus tree plantation (Balamurugan *et al*., 2000). 83% in the surface soil and 94 % in the sub-soil of the samples were found low (< 1%) in organic matter under eucalyptus tree planted area (Sharmsher *et al*., 2002). Soil fertility is determined by the presence or absence of plant nutrient i.e. macro and micronutrients. For high yield and quality nitrogen, phosphorous and potash are supplied through commercial fertilizers. N plays an important role in carbohydrates utilization, P in energy transformation and K in enzymes activation, Osmotic regulation and protein synthesis (Samuel, 1985). Nutrients taken up by plants are used for their growth and development, and the concentration at root surface plays a key role in meeting these requirements (Wild and Jones, 1988). Imbalance use of NPK fertilizers can also have soil degradation and poor yield perspectives. The ideal ratio of NPK is 2: 1: 0.5 while according to National Fertilizer Corporation (NFC) repot 43% farmers are using less N, 74% use less P, and 99% use no K which is a clear indication of reduction of soil fertility due to imbalance use of these major nutrients (Hussain and Higa, 2001). The above fact necessitates working out the effect of eucalyptus on the soil physical and chemical properties.

MATERIALS AND METHODS

To find out the effect of eucalypts on the soil properties and fertility, a field under agro-forestry was selected in D. I. Khan district planted with Eucalyptus camaldulensis. Soil samplings were done by digging four to five pits at a distance of 5, 10, 15 and 20m from eucalyptus tree at two depths of 0-15 and 15-45cm. A total of 8 composite samples were taken through mixing of 4-5 sub-samples. The samples were air-dried in the laboratory, ground with wooden mortar and passed through 2mm nylon sieve, finally packed in the poly-thane bags and labeled for conducting analysis.

20ml of AB-DTPA extracting solution was added to 10g of air-dried and sieved soil put in a conical flask, were shaken for 15 minutes, and then the soil suspensions were filtered through Whatman No. 42. (Havlin and Soltanpour, 1981). A blank extraction was also taken. Extractions were stored in bottles for further observations.

The soil samples were analyzed for pH (Meclean, 1982), Electrical Conductivity (EC) in 1:5 soil water suspension, organic matter (Nelson & Sommer, 1982) and nutrients (P, K, Zn, Cu, Fe and Mn). According to the standard procedure of (Schwab, 1997) P concentration was determined by spectrophotometer, K on flame photometer and micronutrients on atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Soil physico – chemical properties:

The soil pH ranged in the surface soil from 8.32 to 8.39 (Table-1). All the soil samples were basic in nature. In the sub-soil (15-45cm) pH ranges from 8.32 to 8.47, and pH increased as the distance increased from the trees.

The results (Table-1) revealed that the electrical conductivity (EC) of the surface soil ranged from 0.11 to 0.35dSm^{-1} and were non-saline in nature. The EC values decrease as the distance from the tree increased. In the sub-soil, the EC ranged from 0.1 to 0.18dSm^{-1}. Contrary to the surface soil the EC values increased with increased of distance tree.

Organic matter of the soil:

The organic matter content in surface soil ranged from 0.38 to 1.10 % (Table-1). Organic matter decreased as distance increased from the trees. By comparing the results with the established criteria, the samples were low in organic matter except near the trees. In subsoil organic matter ranged from 0.55 to 0.83 % and similar reduction response was observed as was in soil surface.

AB-DTPA extractable phosphorus and potassium:

In the surface soil (0-15cm) phosphorus and potassium concentration ranged from 0.18 to 1.07mg kg^{-1} respectively, the concentration of phosphorus and potassium decreased with increase in distance 36 and 129 from tree (Table-1). All the samples were low in available P and K. In sub-soil, phosphorus ranged from 0.12 to 0.36 and 39 to 115mg kg^{-1}, respectively, the concentration of phosphorus decreased as the distance increased form the trees as well. Sub-soil has lower available P than the surface soil. But K concentration increased with increased in distance from tree.

Table-1. Spatial distribution of chemical properties in agro forestry under E. Calmaldulensis.

S. No.	Distance (m)	pH (1:5)	E.C dSm^{-1}	Organic matter (%)	AB-DTPA extractable (mg/kg)	
					P	K
(0-15cm)						
1	5	8.39	0.35	1.10	1.07	129
2	10	8.32	0.08	0.38	0.48	36
3	15	8.35	0.12	0.76	0.18	46
4	20	8.33	0.11	0.90	0.54	46
(15-45cm)						
1	5	8.32	0.1	0.83	0.12	34
2	10	8.22	0.12	0.55	0.36	34
3	15	8.43	0.13	0.59	0.12	42
4	20	8.47	0.18	0.55	0.12	115

Micro nutrients of the soil:

In surface soil Zn content ranged from 0.02 to 0.11mg kg^{-1} (Table-2). The concentration of Zn in surface soil decreased as the distance increased form the trees, by comparing these results with critical values of Sultanpour (1985), Zn was deficient in all the samples. In the sub-soil Zn content ranged from 0.03 to 0.09mg kg^{-1}.

In surface soil Cu content ranged from 1.2 to 3.12mg kg^{-1} (Table-2). The concentration of Cu in surface soil decreased as the distance increased from the trees. By comparing the results with critical values of Sultanpour (1985), Cu in the surface soil was marginal. In the sub-soil, Cu content ranged from 1.33 to 2.51mg kg^{-1}. The concentration of Cu in subsoil increased as distance increased from the trees. By comparing the results with critical value of Sultanpour (1985), Cu was adequate in the sub-soil.

In surface soil (0-15cm) Fe ranged from 0.14 to 0.56mg kg^{-1} (Table-2). The concentration of Fe increased as the distance increased from the trees in the surface soil. By comparing the result with critical values of Sultanpour (1985), the concentration of Fe in surface soil was deficient. In the sub-soil (15-45cm), Fe ranged from 0.46 to 0.76mg kg^{-1}. The concentration of Fe increased as the distance increased from the trees. By comparing the results with critical values of Sultanpour (1985), the concentration of Fe in the subsoil was also deficient.

In the surface soil (0-15cm) Mn content ranged from 0.28 to 1.87mg kg^{-1} (Table-2). The concentration of Mn in surface soil decreased with the increased in distance from the trees. By comparing the results with critical value of Sultanpour (1985), Mn was deficient in surface soil. In the sub-soil (15-45cm) Mn content ranged from 0.37 to 6.87mg kg^{-1}. The concentration of Mn increased with

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increased in distance in case of sub-soil. By comparing the results with critical values of Sultanpour (1985), Mn was marginal in the sub-soil.

Table-2. Spatial distribution of micro nutrients under agro forestry with E. Calmaldulensis.

S. No	Distance (m)	Zn	Cu	Fe	Mn
		mg/kg			
(0-15cm)					
1	5	0.11	3.12	0.14	1.87
2	10	0.02	1.2	0.40	1.18
3	15	0.05	1.49	0.56	1.41
4	20	0.07	2.90	0.46	0.28
(15-45cm)					
1	5	0.03	1.56	0.50	1.04
2	10	0.08	1.33	0.46	0.37
3	15	0.09	2.03	0.66	1.02
4	20	0.09	2.51	0.76	6.87

Regression Analysis:

Regression analysis was done to establish relationship between the distance and the soil properties and the results are given in Tables 3 and 4.

pH had positive correlation with distance i.e. pH increased with distance from the trees in the surface soil. EC, O.M., K and P had negative correlation with distance. As distance from the Eucalyptus trees increased, the EC, O.M., P and K content of the soil decreased. While in sub-soil pH, EC and K had positive correlation with distance i.e. pH, K and EC increased with distance in the sub-soil. O.M. and P had a negative correlation with distance. As the distance from the Eucalyptus trees increased, the O.M. and P content of the soil decreased.

Regression analysis of micronutrients with distance showed that in surface soil, Zn, Cu and Fe had negative correlation with distance i.e. Zn, Cu and Fe, increased with distance in the surface soil (Table-4), while Mn had a positive correlation. In the sub-soil Zn, Cu, Fe, and Mn had positive correlation with distance i.e. Zn, Cu, Fe and Mn increased with distance in the sub-soil.

Table-3. Coefficient of regression analysis of soil properties with distance.

S. No.	Soil properties	a	b	r^2
(0-15 cm)				
1	pH	8.38	-0.003	0.39
2	EC	0.335	-0.014	0.50
3	O.M	0.843	-0.004	0.009
4	P	1.04	-0.004	0.43
5	K	124	-4.78	0.50
(15-45 cm)				
1	pH	8.195	0.0131	0.57
2	EC	0.07	0.005	0.90
3	O.M	0.83	-0.016	0.59
4	P	0.24	-0.005	0.07
5	K	6.5	5.02	0.67

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Table-4. Coefficient of regression analysis of micro nutrients with distance.

S. No.	Micro nutrients	a	b	r^2
(0-15cm)				
1	Zn	0.085	-0.002	0.09
2	Cu	2.27	-0.007	0.002
3	Fe	2.32	-0.09	0.77
4	Mn	0.11	0.022	0.65
(15-45cm)				
1	Zn	0.025	0.004	0.72
2	Cu	0.965	0.071	0.77
3	Fe	0.35	0.019	0.82
4	Mn	-2.206	0.36	0.59

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