

Assessment of Chemical Properties of Soil under different Silvi-pastoral Practices in Central India

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ABSTRACT

The present study is an attempt to investigate the effect of inter-cropping system of tree species *Populus deltoides* and *Leucaena leucocephala* with fodder crops Oat, Berseem and Lucerne to facilitate crops yield and improving certain soil properties. Soil samples were collected from selected intercropping and control plots were analyzed for soil pH, organic matter, nitrogen, phosphorus and cations exchange capacity. Experiment was conducted in over one season comprising nine treatments in three replications using Complete Randomized Block Design. The results were differ significantly in inter cropping systems with significant effect on crops yield and soil characteristics. The value of pH is ranged between 7.30-7.87 and found slightly alkaline; EC value ranged between 0.23-0.92, OC is 0.25-0.67, available nitrogen varies between 185.63-229 kg/ha, available phosphorus varies between 22.87-45.53 kg/ha while available potash varies between 157.20-194.67 kg/ha.

Keywords: Inter-cropping, Agroforestry, Soil chemical properties, fodder crops, intercropping, poplar and subabul.

INTRODUCTION

Agroforestry system, as well as many natural tree based ecosystems, are perceives to improve or maintain soil fertility and productivity, to promote soil conservation, reduce soil degradation and achieve sustainable production. Growing of perennial crops is one of the strategies to improve soil conditions which would result in enhancing soil attributes and contributing to the good health of the soil. These positive effects are often attributed to the component of the system. Before discussing evidence to support or discredit these concepts it is pertinent to define what is meant by the terms agroforestry and how this relates to the impact of trees on soils. Agroforestry could be views as an amalgamation in space or time, of forestry and agriculture into a collection of land use practices. The tree component in agroforestry system helps to reduce the pH, EC and increased organic matter content, available nitrogen, phosphorus and potash content of soil over the years (Kumar *et al.*, 2015). The choice of intercrop

is important as the economic returns depend on particular tree component, though the choice is also determined by the technical factors like agro-climatic and edaphic conditions. Agroforestry system with judicious mixing of crop and trees meet all basic requirements of mankind and ecosystem (Ranjan *et al.*, 2016). In evolution the influence of trees on soils we have use not restricted ourselves to the aforementioned definition, but has drawn on examples from pure tree sees on soil systems such as plantation forestry to emphasis the positive and negative effects of trees on soil properties.

MATERIALS AND METHODS

In order to know the association between intercropping under different agroforestry and soil chemical parameters, an investigation was carried out in Research Farm of College of Forestry SHUAT, Prayagraj, Uttar Pradesh during 2015-16. Open and two inter-cropping system of tree

species *Populus deltoides* and *Leucaena leucocephala* with fodder crops Oat, Berseem and Lucerne were selected. Soil samples were collected from selected intercropping and control plots were analyzed for soil pH, organic matter, nitrogen, phosphorus and cations exchange capacity. Experiment was conducted in over one season comprising nine treatments in three replications using Complete Randomized Block Design and analyzed statistically for level of significance. The experimental site is located at elevation of 98 m above sea level at 28.87° N latitude and 81.15° E longitude. The characteristics of the soil are sandy loam in order to Inceptisol soil. The research area has a sub-tropical climate with extremes of summer and winter. During the summer season, the temperature reaches to 46-48°C, while during winter season, especially in the month of Nov. and Jan. temperature drops down to as low as 1-2°C. During winter, frost and during summer, hot

scorching wind are common features. The average rainfall in this area is around 882 mm, during the monsoon i.e. June to Sept, with a few occasional light showers and drizzles are seen in the winter also. Soil samples were collected from surface level (0-15 cm depth) covering the whole experimental area before starting the experiment as well as after harvesting of crop for comparing effects.

RESULTS AND DISCUSSION

Soil pH

The data presented in table 1 shows that soil pH varies significantly in different intercropping system and recorded minimum (7.30) in T₀C₁(Open + Oat) whereas the maximum (7.87) was found with T₂C₂(Poplar + Lucerne). T₁C₁ (Oat + Subabul trees) and T₁C₃ (Berseem + Subabul trees) were statistically at par with each other. Minimum soil pH was recorded in the open plots field while the maximum was in under Poplar based agroforestry.

Table 1: pH of soil after harvesting of fodder crops under different agroforestry models

Agroforestry model (T)	Crops (C)		
	C ₁ (Oat)	C ₂ (Lucerne)	C ₃ (Berseem)
T ₀ (Open field)	7.30	7.47	7.40
T ₁ (Subabul)	7.50	7.60	7.53
T ₂ (Poplar)	7.60	7.87	7.70
	F-Test	S. Ed. (±)	C. D. (P=0.05)
Agroforestry model (T)	S	0.02	0.04
Crops (C)	S	0.02	0.04
Interaction (T x C)	S	0.03	0.07

Table 2: Electrical conductivity of soil (dSm⁻¹)

Agroforestry model (T)	Crops (C)		
	C ₁ (Oat)	C ₂ (Lucerne)	C ₃ (Berseem)
T ₀ (Open field)	0.92	0.72	0.84
T ₁ (Subabul)	0.56	0.46	0.50
T ₂ (Poplar)	0.41	0.23	0.35
	F-Test	S. Ed. (±)	C. D. (P=0.05)
Agroforestry model (T)	S	0.01	0.03
Crops (C)	S	0.01	0.03
Interaction (T x C)	S	0.02	0.05

Electrical conductivity of soil (dSm^{-1})

The data presented in table 2 shows significant differences in soil electrical conductivity due to agroforestry models, crops and their interaction. Maximum electrical conductivity of soil was recorded in open field followed by under Subabul agroforestry model while minimum electrical conductivity of soil was recorded under Poplar agroforestry model. T_0C_1 (Oat +open) recorded maximum electrical conductivity followed by T_0C_3 (Berseem + open) and T_0C_2 (Lucerne + open) whereas minimum value (0.23 dSm^{-1}) was recorded in T_2C_2 (Berseem + Poplar trees). T_1C_2 (Lucerne + Subabul) and T_1C_3 (Berseem +Subabul) were statistically at par with each other. Open field, fodder crop Oat and their combination recorded maximum electrical conductivity of soil, whereas, Poplar agroforestry model, fodder crop

Lucerne and their combination recorded the minimum.

Organic carbon in soil (%)

The data presented in table 3 shows that soil organic carbon varies significantly in different intercropping system. Maximum soil organic carbon was recorded in open field followed by Subabul agroforestry model whereas minimum under Poplar agroforestry model. Treatment combination T_0C_1 (Oat +open) recorded maximum (0.67) organic carbon followed by T_0C_3 (Berseem + open) and T_0C_2 (Lucerne + open) whereas minimum (0.30) was recorded in T_2C_2 (Berseem + Poplar trees). Organic carbon in soil was found maximum in open field followed by Subabul agroforestry model while poplar based agroforestry model recorded the minimum.

Table 3: Organic carbon in soil (%)

Agroforestry model (T)	Crops (C)		
	C_1 (Oat)	C_2 (Lucerne)	C_3 (Berseem)
T_0 (Open field)	0.67	0.56	0.61
T_1 (Subabul)	0.50	0.40	0.46
T_2 (Poplar)	0.35	0.25	0.30
	F-Test	S. Ed. ($\pm$)	C. D. (P=0.05)
Agroforestry model (T)	S	0.00	0.00
Crops (C)	S	0.00	0.00
Interaction (T x C)	S	0.00	0.01

Table 4: Available nitrogen in soil (kg ha^{-1})

Agroforestry model (T)	Crops (C)		
	C_1 (Oat)	C_2 (Lucerne)	C_3 (Berseem)
T_0 (Open field)	229.00	219.20	221.40
T_1 (Subabul)	216.07	209.87	213.20
T_2 (Poplar)	204.87	185.63	192.47
	F-Test	S. Ed. ($\pm$)	C. D. (P=0.05)
Agroforestry model (T)	S	0.76	1.62
Crops (C)	S	0.76	1.62
Interaction (T x C)	S	1.32	2.81

Available nitrogen in soil (kg ha⁻¹)

The data presented in table 4 shows that soil available nitrogen varies significantly in different intercropping system. Available nitrogen was observed maximum in T₀C₁(Oat +open) recorded followed by with T₀C₃ (Berseem + open) and T₀C₂ (Lucerne + open) whereas minimum was recorded with T₂C₂ (Lucerne + Poplar). T₀C₂ (Lucerne in open) and T₀C₃ (Berseem in open) were statistically at par with each other. Study revealed that maximum available nitrogen in soil was found in open field followed by Subabul, whereas Poplar based agroforestry model recorded the minimum.

Table 5: Available phosphorus in soil (kg ha⁻¹)

Agroforestry model (T)	Crops (C)		
	C ₁ (Oat)	C ₂ (Lucerne)	C ₃ (Berseem)
T ₀ (Open)	45.93	34.47	41.00
T ₁ (Subabul)	33.40	26.13	27.13
T ₂ (Poplar)	25.13	22.87	24.00
	F-Test	S. Ed. (±)	C. D. (P=0.05)
Agroforestry model (T)	S	0.20	0.43
Crops (C)	S	0.20	0.43
Interaction (T x C)	S	0.35	0.75

Table 6: Available potassium in soil (kg ha⁻¹)

Agroforestry model (T)	Crops (C)		
	C ₁ (Oat)	C ₂ (Lucerne)	C ₃ (Berseem)
T ₀ (Open field)	194.67	185.80	187.53
T ₁ (Subabul)	183.33	177.87	180.60
T ₂ (Poplar)	173.60	157.20	163.07
	F-Test	S. Ed. (±)	C. D. (P=0.05)
Agroforestry model (T)	S	0.66	1.40
Crops (C)	S	0.66	1.40
Interaction (T x C)	S	1.14	2.43

Available potassium in soil (kg ha⁻¹)

The data presented in table 6 shows that soil available potassium varies significantly in different intercropping system. T₀C₁ (Oat+ open) recorded maximum available potassium in soil followed by T₀C₃ (Berseem + open) and T₀C₂ (Lucerne+ open) whereas minimum was recorded

Available phosphorus in soil (kg ha⁻¹)

The data appended in table 5 shows that soil available phosphorus varies significantly in different intercropping system. Open field recorded maximum available phosphorus in soil followed by with Subabul based agroforestry while minimum in Poplar agroforestry model. T₀C₁ (Oat+ open) recorded maximum available phosphorus in soil followed by T₀C₃ (Berseem + open) and T₀C₂ (Lucerne+ open) whereas minimum was recorded in T₂C₂ (Lucerne +Poplar).

in T₂C₂ (Lucerne +Poplar). Available potassium in soil was found maximum in open field followed by Subabul based agroforestry whereas poplar based agroforestry model and their interaction recorded the minimum.

CONCLUSION

In view of the findings and results presented above, it is concluded that nitrogen, phosphorous

and potassium were found maximum T_0 (open field) than the agroforestry models. Fodder crop Oat has minimum effect on soil health and helps in

improving soil chemical properties. Hence fodder oat can be recommended to grow under different agroforestry system for sustainable farming.

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