Journal of Agroecology and Natural Resource Management
p-ISSN: 2394-0786, e-ISSN: 2394-0794, Volume 4, Issue 4; July-September 2017, pp. 314-317

http://www.krishisanskriti.org

Evaluation of Soil Properties in *Melia composita* Willd Plantation in Punjab, India

[1*]Viswajeet Sharma, [2]Devendra Kumar, [1]Mukesh Prasad and [2]Charan Singh

[1]Silvicultre Division, Forest Research Institute, Dehradun
[2]Extension Division, Forest Research Institute, Dehradun
**E-mail: svishwa37@gmail.com*

Abstract—*Soil physic-chemical properties and some quantitative characteristics of Melia composita Wild plantations and relationships between them were evaluated in Handesra, Mohali an Bhera Village, Hoshiyarpur plain of Punjab. Two same aged Melia plantations with low and high qualities were selected. In each Melia plantation, fourteen sample of soil at both sites with systematic sampling method were selected. Soil samples were taken from 0-30cm in each samples and pH, Organic Carbon (O.C), Available Nitrogen (N), available Phosphorus (P) and exchangeable potassium (K) were determined for each soil sample in laboratory. The results showed that among soil properties, organic carbon (O.C), available nitrogen (N), available phosphorus (P) and exchangeable potassium (K) were significantly different between two plantations. The maximum organic carbon (2.89%), available nitrogen (0.037 %), available phosphorus (0.0011%) and exchangeable potassium (0.027%) were observed at Handesra, Mohali and minimum organic carbon (1.69%), available nitrogen (0.027 %), available phosphorus (0.00068%) and exchangeable potassium (0.021%) were observed at Bhera Village, Hoshiyarpur. The results also indicated that poor quality plantations has negative effect on soil nutrient and reduces its fertility. Reduction of nutrient availability had negative effects on quantity and quality of Melia trees.*

Keywords*: Melia composita , Soil, Punjab, Plantation, Evaluation*

1. INTRODUCTION

Melia composite locally known as Drek in Punjabi it is an example of such type of tree under modern agroforestry practices. The tree has capability to grow in arid and semi arid and also in semi- moist areas. due to fast growth and multiple uses it emerging as a favorite tree growing under agroforestry plantations in North Western states of the country. Its trade name as Burma or Ghana Neem and in India is Malabar Neem. In India it found in it is observed that *Melia composita* can be grown in adverse condition and has a wide altitudinal range from 600 to 1800m. As several studies was found that in several years of rotation the tree attains height up to 14 to 60 cm girth. The growing demand of wood for paper and several other industries put pressure on the natural forest to lease out pressure on natural forest, the plantation of Melia prove to be one of important species for forestry and agro-forestry plantation. Because of population growth, increasing demand for wood and declining of forest harvesting, development in plantation of fast growing species especially Melia has occurred in Punjab in recent years.

On the other hand as Singh and Shrama (2007) and Augusto *et al.* (2002) stated tree plantations influence soil physical, chemical and biological properties negatively or positively through litter fall, accretion and decomposition of organic matter that before plantation these areas, both of these places covered by not-usable native covers, and after the cutting down of them the plantations were established. So it is predictable that through these years the quality and quantity of Melia can impact on soil properties especially on surface layers of the soil. On the base of above mentioned matters, it seems that there are complex relationships between soil properties and Melia plantations. This study tries to assess the soil properties for Melia stands and also explain influence of Melia plantations on soil attributes.

2. MATERIALS AND METHODS:

The study was conducted in the district of Mohali and Hoshiyarpur in the state of Punjab with reference to Melia. For the establishment of experimental plots at selected sites of Handesra, Mohali (30º 25’ 28.94 N, 076º 53’ 36.43E) and Bhera Village, Hoshiyarpur(31º 34’ 15.8 N, 075º 56’ 15.8 E) . The topography of the area was marked by plain or moderate slope. The area fall under the subtropical climate with three distinct seasons’ viz rainy, winter and summer. The annual rainfall during the study period was aprox. 1200 mm and mean monthly temperature ranged from 7.7 ºC in January to 41 ºC maximum in June. In each plantation, fourteen sample at each sites. The soil samples were taken from 0-30cm. All of soil samples were air-dried and passed through a 2mm mesh. soil pH in water suspension of 1:2.5 (soil: liquid ratio), total nitrogen (N) by Kjeldal method (Bremner, 1996), organic carbon (O.C) by Walkely and Black method (Walkley & Black, 1934) were determined. Available P (P) was analyzed according to the standard methods (Olsen and Dean, 1954), and exchange-able K (K) was analyzed after extraction using

1M ammonium acetate at pH7.0 was de-termined by flame-photometer (Black *et al.*, 1965).

3. RESULTS AND DISCUSSION:

Results of soil pH and the nutrients at planting stage are given (Table 1). The mean pH was recorded 6.67 and 6.68 at sites at Mohali and Hoshiyarpur respectively. The organic carbon percentage were recorded higher at Mohali (2.89%) and lower at Hoshiyarpur(1.69%). The available nitrogen percentage recorded higher at Mohali (0.037%) and lower were recorded at Hoshiyarpur (0.027%). The available phosphorus and exchangeable potassium show similar trends(Table 1).

Table 1 Mean ± SD of soil parameter at study sites

Sites	pH	OC%	N%	P%	K%
MOHALI	6.67 ± 0.27	2.89 ± 0.93	0.037± 0.01	0.0011±0 .00	0.0273±0. 005
HOSHIYARPUR	6.68±0. 30	1.69±0.9 5	0.027±0. 008	0.0008±0 .00	0.0216±0. 003

OC= Organic Carbon (%), N=Available nitrogen, P(%)=Available phosphorus, K(%)= Exchangeable Potasium

The variability in soil chemical, physical and biological properties has been increase after plantation observed by the several studies. The heterogeneity of soil properties may be occurred at large scale (region) or at small scale (community), even in the same type of soil or in the same community (Du Feng e*t al.*, 2008). Weindorf & Zhu (2010) and Kavianpoor *et al*. (2012) in their studies mentioned the variations of soil texture in small scale. The soil texture can not change in a short time (Shahoei, 2006), the pH affect by the forest but it will take more time to change. The results, Mohali shows higher mean nutrient contents compare to Hoshiyarpur under Melia. It might be due to the quantitative growth of trees in two plantations; it seems that the quantitative and qualitative growth of trees in Mohali has been able to create positive conditions to improve soil chemical and nutrient properties.

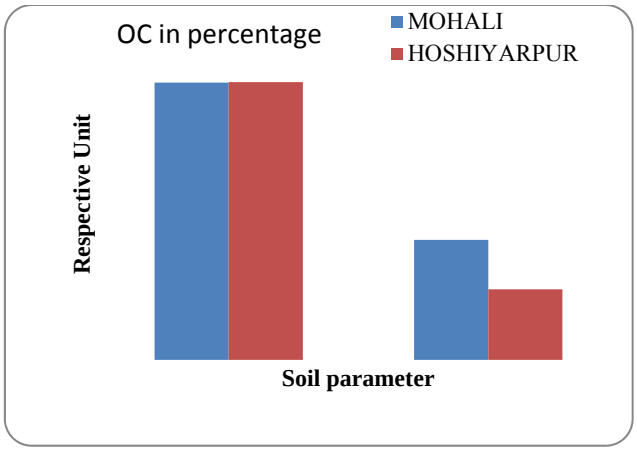

Fig. 1 pH and soil organic carbon at two sites

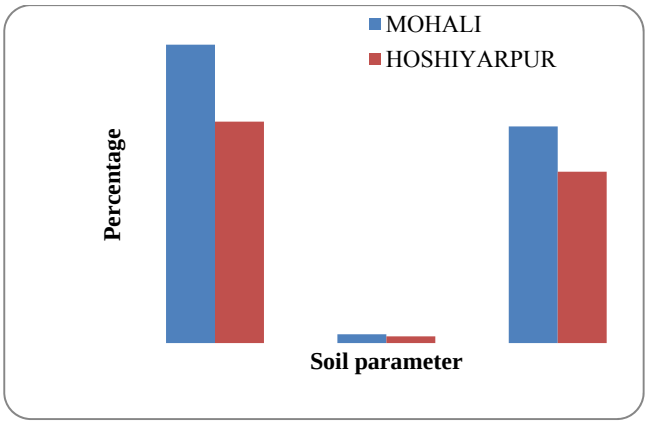

Fig. 2: Nitrogen, phosphorus and potassium at two sites

Binkley and Sollins (1990), Augusto *et al.* (2002), Singh and Sharma (2007) noted the effect of poor quality and quantity of litter on inappropriate decomposition of them and weak nutrient release to the soil may be one of the reason for lower nutrient availability. Due to appropriate quantitative growth of trees in Mohali, might results in more amounts of litter falls in the plantation than Hoshiyarpur. The rates of forest litter falls and decomposes of them contribute to the regulation of nutrient cycling, primary productivity, and the maintenance of soil fertility in forest ecosystems (Fioretto *et al.*, 2003, Onyekwelu *et al.*, 2006). As Wang *et al.* (2008) demonstrated that litter decomposition provides organic and inorganic elements for the nutrient cycling processes and controls nutrient return to the forest ecosystem.

Table 2 Mean of soil parameter at two sites

Site-1 Handesra, Mohali					
S.no.	**pH**	**OC%**	**N%**	**P%**	**K%**
1	6.43	2.44	0.02088	0.00115	0.029
2	6.18	3.88	0.03752	0.0013	0.034
3	6.87	3.46	0.04032	0.0006	0.031
4	6.94	1.86	0.02701	0.0006	0.017
5	7.2	1.92	0.03472	0.00105	0.031
6	6.68	1.22	0.03304	0.0006	0.027
7	6.47	3.62	0.03696	0.00055	0.033
8	6.7	1.34	0.02613	0.0017	0.02
9	6.7	3.3	0.03528	0.00165	0.031
10	6.48	3.28	0.03192	0.001	0.021
11	6.94	3.42	0.03248	0.00205	0.025
12	6.31	3.74	0.09576	0.00065	0.021
13	6.73	3.62	0.03976	0.00205	0.035
14	6.84	3.36	0.03584	0.0006	0.028
Mean	6.67	2.89	0.037	0.0011	0.0273

Site-2 Bhera Hoshiyarpur					
S. no	pH	OC%	N%	P%	K%
1	6.54	1.38	0.02184	0.00065	0.017
2	6.77	1.24	0.03696	0.0007	0.036
3	6.99	1.82	0.01792	0.0013	0.008
4	6.96	1.56	0.0336	0.00325	0.029
5	6.91	1.36	0.02464	0.0011	0.02

6	6.53	2.6	0.02016	0.0001	0.017
7	6.45	3.84	0.02296	0.00025	0.02
8	6.74	0.58	0.0308	0.00035	0.026
9	6.88	2.8	0.03472	0.0006	0.021
10	6.88	1.04	0.03696	0.0011	0.026
11	6.72	0.74	0.02688	0.00075	0.025
12	6.83	2.18	0.01232	0.0006	0.01
13	5.81	2.26	0.03584	0.00065	0.019
14	6.64	0.38	0.03584	0.00065	0.029
Mean	6.68	1.69	0.027	0.0008	0.0216

OC= Organic Carbon (%), N=Available nitrogen, P(%)=Available phosphorus, K(%)= Exchangeable Potassium

The relationships between trees and nutrient availability in the soil are well known it improved by plantations. The better quality and quantity of trees of *Melia composita* in Mohali improve soil nutrient availability and higher contents of these elements have caused better quantitative conditions in soil. High availability of nutrient was related to high productivity of Melia trees as evidenced by their growths parameters. Poor stand reduces soil fertility and reduction in availability of nutrient elements has had negative effects on growth and quality of stand. The results showed that after plantations, not only biomass and wood amount in the poor quality stand have been reduced, but soil nutrient availability was also diminished. These results demonstrate the essential role of soil properties and detail studies for careful selection of the sites for Melia plantations.

Table 3: Correlations of different Parameters of soil

		pH	**OC**	**N**	**P**	**K**
pH	Pearson Correlation	1	-0.299	-0.244	0.272	-0.005
	Sig. (2-tailed)		0.122	0.21	0.162	**0.982**
	N	28	28	28	28	28
OC	Pearson Correlation	-0.299	1	0.322	0.043	0.156
	Sig. (2-tailed)	0.122		0.094	**0.827**	0.427
	N	28	28	28	28	28
N	Pearson Correlation	-0.244	0.322	1	0.016	0.319
	Sig. (2-tailed)	0.21	0.094		**0.936**	0.098
	N	28	28	28	28	28
P	Pearson Correlation	0.272	0.043	0.016	1	0.251
	Sig. (2-tailed)	0.162	**0.827**	**0.936**		0.197
	N	28	28	28	28	28
K	Pearson Correlation	-0.005	0.156	0.319	0.251	1
	Sig. (2-tailed)	**0.982**	0.427	0.098	0.197	
	N	28	28	28	28	28

OC= Organic Carbon (%), N(%)=Available nitrogen, P(%)=Available phosphorus, K(%)= Exchangeable Potassium

The correlation of different parameters of soil shows the positive correlation with other parameters like nitrogen with phosphorus potassium with pH. The plants accumulate these nutrients and redeposit them on the soil surface in organic matter from which nutrients are much more readily available by microbial breakdown (Li, 2006; Conesa *et al.*, 2007, Mendez and Maier, 2008). The increase in organic carbon level is due to the accumulation of leaf litter and its decomposition to form humus (Maiti and Ghose, 2005, Sawada 1999, Spain *et al.*, 2006 and Tibbett 2008). Ghose (2005) explained that due to continual loss of the soil properties with respect to time, the soil was ultimately rendered biologically unproductive after a certain period of time. This period has been named as the shelf life period. The organic carbon and N-P-K (nitrogen-phosphorus- potassium) values came to a stagnant condition and microbiological population also at different age level of plantations. The physical and chemical properties of soil have significance to plant establishment and growth because physical chemical properties of soil determined the depth of rooting zone and air and water relation. Furthermore, they have additional and indirect significance because many chemical and biological aspects of soil fertility can be inferred from physical properties. The key point is that trees can affect the management practices required to maintain nutrient status in soil suitable for growth and development of soil.

The study reveals that an appropriate *Melia composite* plantation can enhanced the productivity of the land with improvement of soil quality. This may also improved the soil nutrients uptake by the plants. The study also show the potential suitability of sites for trees along with agro forestry system in same condition.

REFERENCES

[1] Augusto L. and Ranger, J. (2001). Impact of tree species on soil solutions in acidic conditions. - *Annals of Forest Science*, 58: 47-58.

[2] Binkley D., Solins, P. (1990). Factors determining in soil pH in adjacent conifer and alder-conifer stands. - *Soil Science Society of America Journal,* 54: 1427-1433.

[3] Black C.A., Evans, D.D., Whitw, J.L., Ensminger, L.E. and Clark, F.E. (1965). Methods of soil analysis. - *Agronomy,* 9: Part 2.

[4] Bremner, J. M. (1996). Nitrogen-total. Methods of soil analysis. (Eds. Sparks D. L. et al.), pp. 1085-1122. Published by: Soil Science Society of America, Inc. - *American Society of Agronomy,* Inc. Madison, Wisconsin, USA.

[5] Conesa, H.M., Garcia, G., Faz, A., and Arnaldos, R. (2007). Dynamics of metal tolerant plant communities development in mine tailings from the Cartagena-La Union Mining District (SE Spain) and their interest for further revegetation purposes.*Chemosphere,* 68: 1180-1185.

[6] Du Feng, L.Z., Xuxuexuan, Z.X. and Shan, L. (2008). Spatial heterogeneity of soil nutrients and aboveground biomass in abandoned old-fields of Loess Hilly region in Northern Shaanxi, China. - *ActaEcologica Sinica*, 28(1): 13−22.

[7] Fioretto A., Papa,S. and Fuggi, A. (2003). Litterfall and litter decomposition in a low Mediterranean shrubland. - *Biology and Fertility of Soils.*, 39: 37–44.

[8] Ghose, M.K. (2005). Soil conservation for rehabilitation and revegetation of mine-degraded land. TERI Information Digest on Energy and Environment, 4(2): 137- 150.

[9] Kavianpoor H., Esmali, A .O., Jeloudar, Z. J. and Kavian, A. (2012). Spatial Variability of Some Chemical and Physical Soil Properties in Nesho Mountainous Rangelands. - *American Journal of Environmental Engineering*, 2(1): 34-44.

[10] Li, M.S. (2006). Ecological restoration of mineland with particular reference to the metalliferous mine wasteland in China: a review of research and practice. *Soil Total Environment,* 357: 38-53.

[11] Maiti, S.K. and Ghose, M.K. (2005). Ecological restoration of acidic coal mine overburden dumps- an Indian case study. *Land Contamination and Reclamation,* 13(4): 361-369.

[12] Mendez, M.O. and Maier, R.M. (2008a). Phytoremediation of mine tailings in temperate and arid environments. *Reviews Environmental Science and Biotechnology,* 7: 47-59.

[13] Olsen, S.R. and Dean, L.A. (1965). Method for soil analysis, part-2(Black, C.A; ed) *American Society of agronomy Inc*; Madison, Wisconsin, USA.

[14] Onyekwelu J.C., Mosandl, R. and Stimm, B. (2006). Productivity, site evaluation and state of nutrition of *Gmelina arborea* plantations in Oluwa and Omo forest reserves, Nigeria. - *Forest Ecology and Management*, 229: 214–227.

[15] Sawada, Y. (1999). Microbial Indices for Assessing the Progress of Rehabilitation of Mined Land and Mine Residues, Ph.D. Thesis, University of Western Australia.

[16] Shahoei, S. (2006). *The nature and properties of soils (Translated)*. Kordestan University press. 880 p.

[17] Singh B. and Sharma K.N. (2007). Tree growth and nutrient status of soil in poplar (*Populus deltoides* Bartr.) - based agroforestry system in Punjab, India. - *Agroforest System*, 70: 125-134.

[18] Spain, A.V., Hinz, D.A., Ludwig, J., Tibbett, M. and Tongway, D. (2006). Mine closure and ecosystem development: Alcan Gove bauxite mine, Northern Territory, Australia. Proceedings of the First International Seminar on Mine Closure, Fourie, A.B. and Tibbett, M. (eds), pp. 299-308.

[19] Tibbett, M. (2008). Carbon Accumulation in Soils During Reforestation — The Australian Experience After Bauxite Mining Mine Closure 2008 – A.B. Fourie, M. Tibbett, I.M. Weiersbye, P.J. Dye (eds) pp 3-11.

[20] Walkley, A. I. and Black, A. (1934). An Examination of Degtjareff Method for Determining Soil Organic Matter and a Proposed Modification of the Chromic Acid Titration Method. - *Soil Science*, 37: 29-37.

[21] Wang G., Gertner, G., Howaed, H. and Anderson, A.(2008). Optimal spatial resolution for collection of ground data and multi-sensor image mapping of a soil erosion cover factor. – *Journal of Environmental Management*, 88(4): 1088–1098.

[22] Wang Q., Wang, S. and Huang, Y. (2008). Comparisons of litterfall, litter decomposition and nutrient return in a monoculture *Cunninghamia lanceolata* and a mixed stand in southern China. - *Forest Ecology and Management*, 255: 1210–1218.

[23] Weindorf D.C. and Zhu, Y. (2010). Spatial variability of soil properties at Capulin volcano, New Mexico, USA: Implications for sampling strategy. - *Pedosphere*, 20(2): 185-197.