

Effect of Different Aspects of Eucalypts (*Eucalyptus Tereticornis*) Based Agroforestry System on Soil Nutrient Status in Northern India

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ABSTRACT: An experiment was conducted during the winter season of 2013-2014 at CCS Haryana Agricultural University, Department of Forestry, for analysis of the soil properties under North-South direction of Eastern and Western aspects of Eucalypts based agroforestry system at two stages of crop growing season i.e. before sowing of wheat in October and after harvest of wheat in April. The soil samples were collected at different distances (2, 4, 6, 8, 10 m) in two different aspects of North-South direction. Availability of macro-nutrients (N, P and K) and organic carbon were determined under North-South direction of Eastern and Western aspects of Eucalypts based agroforestry system of surface soil (0-15 cm depths). The soil samples were also analyzed under control field or sole crop. Under this study, the organic carbon (0.54 %) and N (208.9 kg ha⁻¹), P (18.7 kg ha⁻¹) and K (203.6 kg ha⁻¹) contents were recorded maximum under western aspect at 2m distance in North-South direction of Eucalypts based agroforestry system after the harvesting of wheat crop as compared to Eastern aspect and sole crop.

Keywords: Agroforestry, aspect, direction, eucalypts, macro-nutrients and organic carbon

INTRODUCTION

Haryana with geographical area of 4.42 million hectare is predominantly an agrarian state having 80% of its area under intensive and mechanical agriculture but the state is not be bestowed with a bountiful of natural forests. In view of the prevailing socioeconomic and agro-climatic conditions favourable for agriculture in the state, it is not possible to divert the fertile agriculture land to forests. The only option to increase the area under tree cover is to integrate the tree species with agricultural crops on farm lands. Agro-forestry has caught the attention of farmers across the world, especially in India where both forest and agricultural land are under severe stress due to population pressure and industrialization. The system is proposed as a strategy to combat soil degradation and to improve soil fertility and enhance crop yield. Agro-forestry system besides it maintaining ecological balance. The soil quality and its production capacity can be restored and improved by adopting agro-forestry system like agri-silvi-horticulture system, which provides a way to sustain agricultural productions (Thakur and Kumar, 2006). trees provide natural fertilizer to restore soil health and increase crop yield (Singh and Rathod, 2006). Agroforestry is proposed as strategy to combat

soil degradation, improve soil fertility and increase crop yields (Rai *et al.*, 1999). Among the agroforestry tree species, Eucalypts is of paramount importance due to small canopy as compared to most of the agroforestry tree species and straight growing habit. Trees tend to improve the site by changing the chemical properties, physical structure, microclimate, infiltration capacity and moisture regime of the soil (Prinsely and Swift, 1986). With time, process such as litter fall, nitrogen fixation, root extension, crown expansion and nutrient cycling contribute to nutrient and organic matter build-up in the top soil leading to physical, chemical and biological improvement in the critical rooting zone (Gill *et al.*, 1987; Evans, 1992; Garg and Jain, 1992). Farmers do realize the importance of trees in a combined production system not only to meet their basic needs but also for cash benefits (Puri and Monga, 1990). Moreover, tree- crop combinations have been found to give better economic returns than tree or annual crops alone (Dogra *et al.*, 2007; Burgreess *et al.*, 2000). Apart from being an important source of organic matter and nutrient return to the soil, litterfall results in the formation and renewal of forest floor also. It protects the soil from erosion and reduces weed growth (Bell, 1973).

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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 rates and greater water-holding capacity and as a result, less runoff is generated and erosion is controlled (Verma *et al.*, 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). 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) report 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

Study Sites and Climate

The study on Eucalypts-based agroforestry was carried out during winter season of 2013-14 in the research farm of Department of Forestry, CCS Haryana Agricultural University, Hisar at 29° 10' N latitude and 75° 40' E longitude. The climate of site is semi-arid and mainly characterized by a very hot summer, a short rainy season and a cold winter.

Soil Sampling under Eucalypts based Agroforestry System

To study the effect of Eucalypts based agroforestry system under Eastern and Western aspect on soil organic carbon and available nutrients, an experiment was conducted where Eucalypts were planted at North-South direction during 2007. The wheat crop was raised with the recommended cultural practices under Eucalypts plantation during 2013-2014. In the adjoining field the same crop wheat was taken as control. Soil samples were collected from surface soil (0-15 cm depth) at two stages *i.e.* before sowing of the wheat crop in October and after harvest of wheat in April from different spacings of Eucalypts and also from control field for the study of nutrient status and physico-chemical properties *viz.* available nitrogen, phosphorus and potassium, organic carbon, pH and EC. In this study, the available N in the soil was determined by Kjeldhal's method (Jackson, 1973), organic carbon by Walkley and Black method and available K by neutral normal ammonium acetate method (Jackson, 1973).

RESULT AND DISCUSSION

Soil organic carbon and available macronutrients:

The soil organic carbon and available N, P and K content were significantly higher in the Western aspect in 2m distance of *Eucalyptus tereticornis* based agroforestry system before the sowing of wheat crop and the trend of decrease in average contents of soil organic carbon, N, P and K and organic carbon in agroforestry system with the Eastern aspect of Eucalypts plantation (Fig.1). Among all the different aspects in various distances decrease organic carbon from 2 to 10 m distance, higher organic carbon content in 2m distance *i.e.* 0.51, 0.49, 0.41, 0.37 and 0.32% in eastern aspect and 0.54, 0.47, 0.41, 0.37 and 0.32% in western aspect. The status of organic carbon, N, P, and K were significantly higher in Western aspect of 2m distance where as it was lowest under control. The higher organic carbon and available nutrient content in Eucalypts based agroforestry system over the agriculture system may be attributed to litter-fall addition from Eucalypts trees as well as addition of root residues of crops and trees.

Among all the different aspects the status of organic carbon (0.54%), N (208.9 kg ha⁻¹), P (18.7 kg ha⁻¹), and K (203.6 kg ha⁻¹) were also significantly higher in western aspect in 2m distance where as it was lowest under control (Fig. 2). The higher organic carbon and nutrient status under western aspect might be due the addition of large quantity of leaf

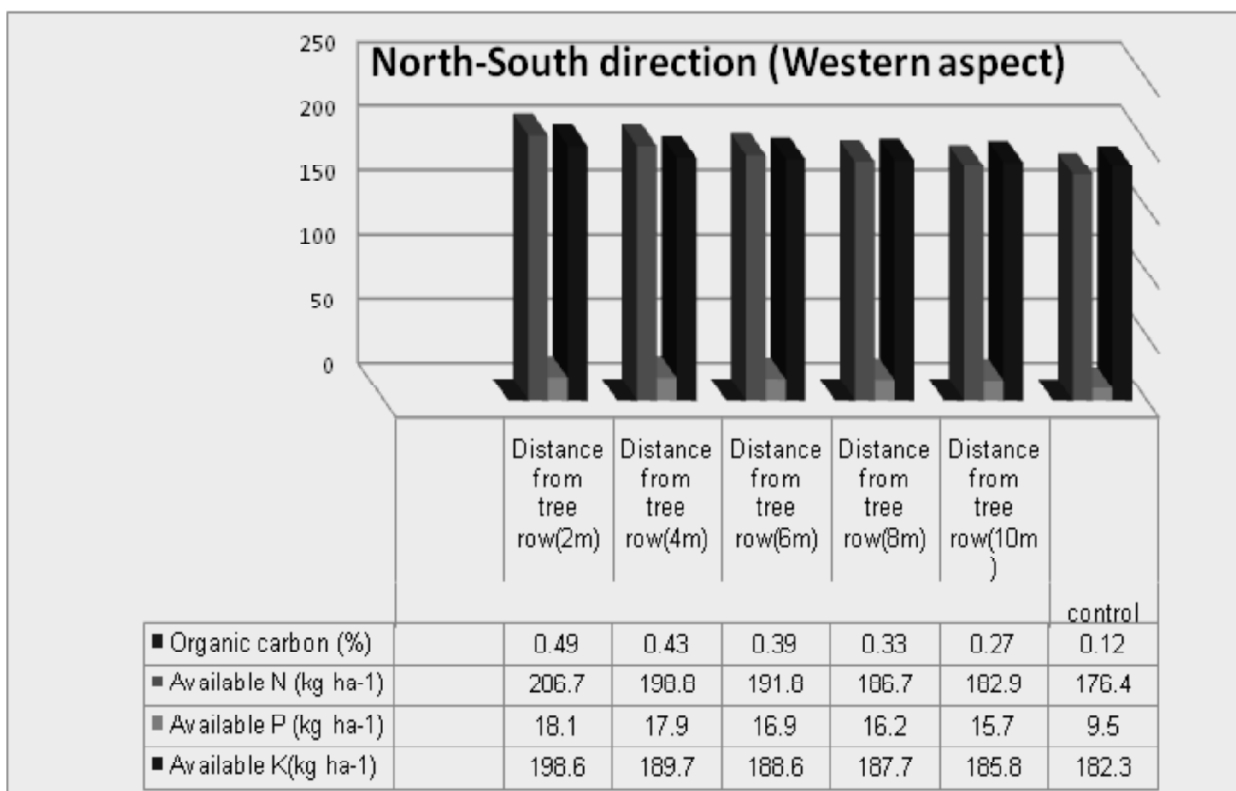
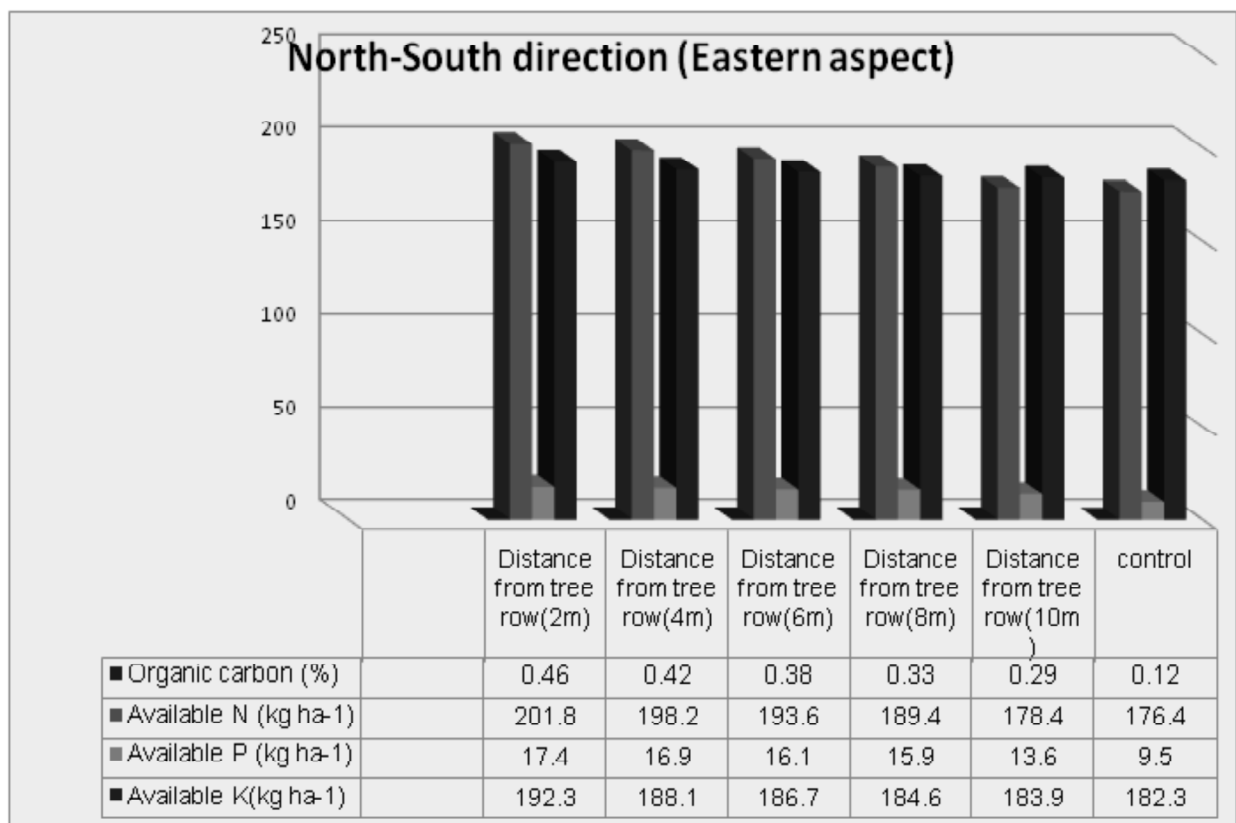


Figure 1: Effect of row direction of North-South bund planted Eucalyptus on soil chemical properties before sowing of wheat crop in October 2013

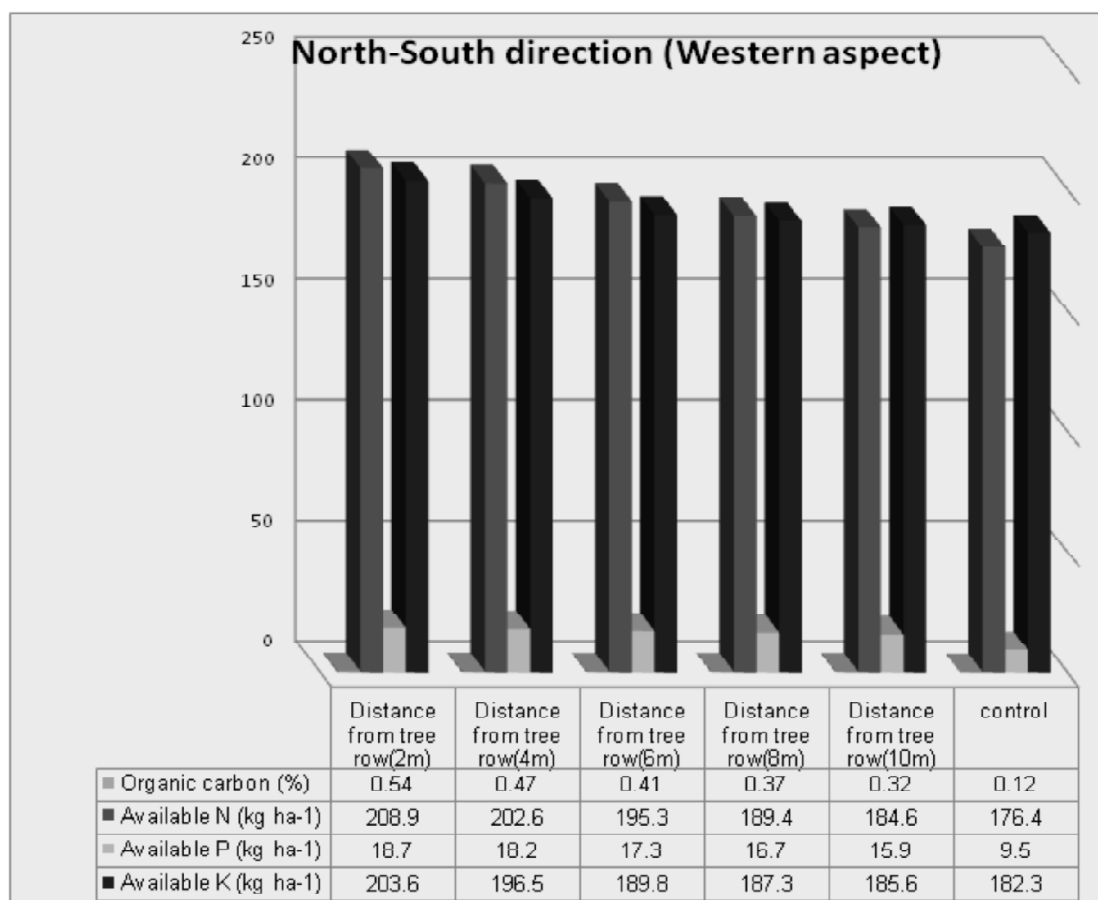
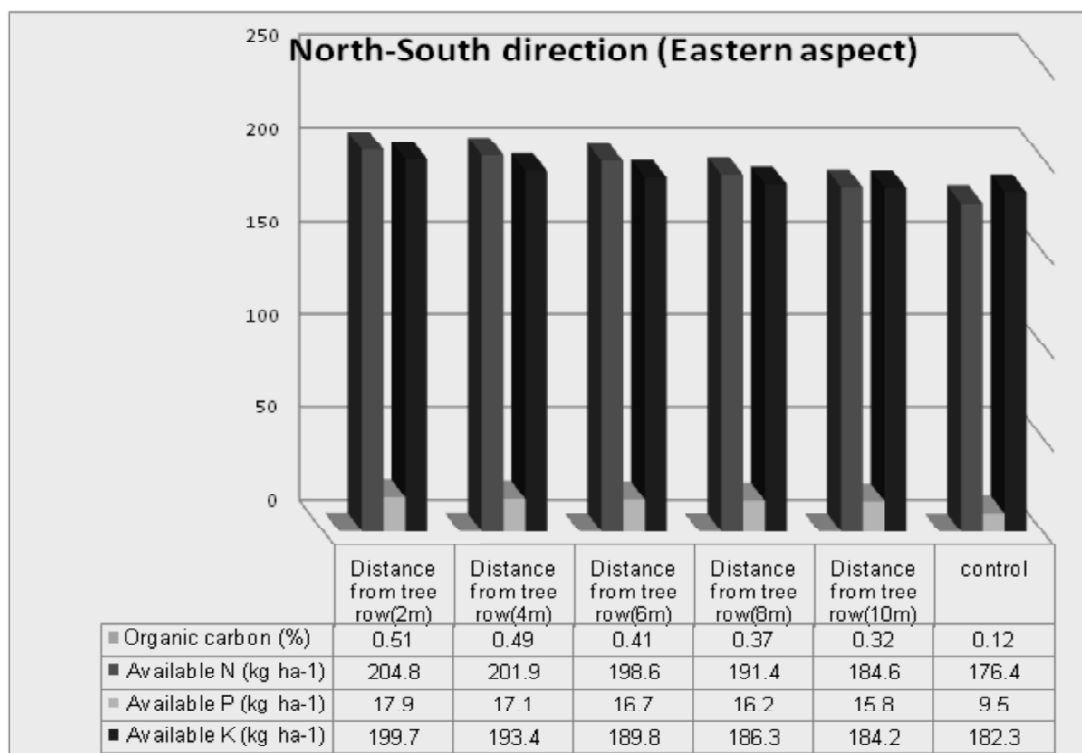


Figure 2: Effect of row direction of North-South bund planted Eucalyptus on soil chemical properties after harvest of wheat crop in April 2014

litter. The higher decomposition of leaf litter favors the higher nutrient status of the soil.

The average contents of organic carbon and N, P and K in Eucalypts based agroforestry system were higher western aspect after the harvesting of wheat as compared to before sowing of wheat (Fig. 1 & Fig. 2). High organic matter and available N, P and K contents in the intercropping treatments could be ascribed to the fact that leaf fall before and during crop sowing period on the soil which incorporates in to the soil through tillage practices and their partial decomposition adds to the soil organic matter. The reduction of soil pH and EC under the tree cover can be attributed to accumulation and subsequent decomposition of organic matter which releases organic acids.

CONCLUSION

Therefore, it may be concluded that the organic carbon and available N, P and K contents of soil improved in Eucalypts based agroforestry system. Under different aspects of Eucalypts, western aspect in 2m distance was found more suitable for improving the soil fertility by the addition of leaf litter in a large quantity with the advancement of tree age. Thus, Eucalypts based agroforestry system can sustain the soil health by improving various soil parameters.

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